

# Leica Captivate



Technical Reference Manual  
Version 7.0  
English

- when it has to be **right**




# Introduction

## Purchase

Congratulations on the purchase of the Leica Captivate.

## Symbols

The symbols used in this manual have the following meanings:

| Type  | Description  |
|---|--|
|  | Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner. |




To use the product in a permitted manner, please refer to the detailed safety directions in the available User Manuals.

The CS30/CS35 controller is a Windows based tablet customized to work together with Leica Captivate field software. Changing settings in the operating system of the CS30/CS35 controller, other than changes recommended by Leica Geosystems, is the responsibility of the user.

The proper operation of Leica Captivate cannot be guaranteed anymore after such changes.

Any support by Leica Geosystems after such changes is limited and lies rather in the responsibility of the user or the user's IT department.

| Changes allowed   | Changes that might cause issues   |
|---|---|
| <ul style="list-style-type: none"><li>Installing software</li></ul> | <ul style="list-style-type: none"><li>Loading another, non Leica image</li><li>Installing non Leica provided drivers</li><li>Loading software which is also using the CLM licence management but working on a different version</li></ul> |

 Bringing the CS30/CS35 controller into an IT infrastructure might change network settings automatically and can result in issues with the Leica network settings.

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## Validity of this manual

- This manual applies to the Leica Captivate software.
- This manual covers all instruments using Leica Captivate software.
- For the TS13, some terms must be replaced:
  - ATR instead of ATRplus
  - SpeedSearch instead of PowerSearch



Video tutorials are available on:





<http://www.leica-geosystems.com/captivate-howto>



**Leica Geosystems  
address book**

On the last page of this manual, you can find the address of Leica Geosystems headquarters. For a list of regional contacts, please visit [http://leica-geosystems.com/contact-us/sales\\_support](http://leica-geosystems.com/contact-us/sales_support).

**Available documenta-  
tion**

| Name  | Description/Format  |    |    |
|---|---|---|---|
| CS20 User Manual<br>GS10 User Manual<br>GS14/GS16 User Manual<br>GS18 User Manual<br>GS25 User Manual<br>TS10 User Manual<br>TS13 User Manual<br>TS16 User Manual<br>TS60/MS60/TM60 User Manual                     | All instructions required to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.       | -   | ✓   |
| CS20 Quick Guide<br>GS10 Quick Guide<br>GS14/GS16 Quick Guide<br>GS18 Quick Guide<br>GS25 Quick Guide<br>TS10 Quick Guide<br>TS13 Quick Guide<br>TS16 Quick Guide<br>TS60/MS60/TM60 Quick Guide<br>AP20 Quick Guide | Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.  | ✓   | ✓   |
| Name  | Description/Format  |  |  |
| Leica Captivate Technical Reference Manual  | Overall comprehensive guide to the product and apps. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists. | -   | ✓   |
| Licence Activation for CS30/CS35  | Guide to activate the preinstalled licence on the CS30/CS35.  | ✓   | ✓   |

**Refer to the following resources for all documentation/software:**

- the Leica USB documentation card
- <https://myworld.leica-geosystems.com>

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Heerbrugg, 25 March 2013

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## 2

## Operating Principles

### 2.1

### Software

#### Keyboard and touch screen



The user interface is operated either by the keyboard or by the touch screen with supplied stylus. The workflow is the same for keyboard and touch screen entry, the only difference lies in the way information is selected and entered.

#### Operation by keyboard


Information is selected and entered using the keys.

#### Operation by touch screen




Information is selected and entered on the screen using the supplied stylus.

| Operation  | Description   |
|--|---|
| To select an item  | Tap on the item.  |
| To start the edit mode in editable fields                            | Tap on the editable field.  |
| To highlight an item or parts of it for editing                      | Drag the supplied stylus from the left to the right.  |
| To accept data entered into an editable field and exit the edit mode | Tap on the screen outside of the editable field.  |
| To open a context-sensitive menu                                     | Tap on the item and hold for 2 s.   |
| To zoom in   | Available on CS30/CS35 and win32 tablets.<br>Tap in the 3D viewer area using two fingers and move them apart.<br>            |
| To zoom out  | Available on CS30/CS35 and win32 tablets.<br>Tap in the 3D viewer area using two fingers and bring them closer together.<br> |

#### Operation on CS30/CS35 and win32 tablets for quick text deletion

| Operation                             | Description   |
|---------------------------------------|---|
| To highlight a whole text for editing | Two options are available: <ul style="list-style-type: none"><li>• Double-click the text.</li><li>• Long-press (press-and-hold) on the text.</li></ul>              |
| To delete a whole text                | Highlight a whole text for editing.<br>Press the  key on the virtual keyboard. |

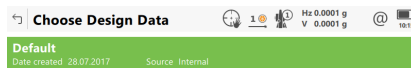


| Operation  | Description  |
|--|--|
| To delete a whole text and enter new text at the same time | Highlight a whole text for editing. Type the characters for the new text on the virtual board.   |
| To set the cursor at the beginning of a text               | Highlight a whole text for editing. Press the  key on the virtual keyboard.                           |
| To set the cursor at the end of a text                     | Highlight a whole text for editing. Press the  key on the virtual keyboard.                           |
| To delete the text in the code editable field              | Highlight a whole text for editing. Press <b>Ctrl</b> plus  on the virtual keyboard at the same time. |

## Searching

Searching is possible in panels with and without pages.

1. Open a panel or page with listed items.



2. Type in any letter or number key to start the search.

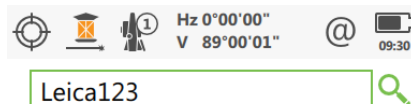


On the TS, the setting for **Data input method** in **Screen, Audio & Text Input** defines how characters can be typed. Refer to [29.2 Screen, audio & text input](#).

A search field appears below the icons in the top right area of the panel. The field shows the characters typed in.















The job search is not case sensitive.




3. The item with the name closest to the letters typed in is highlighted.

### Functions of key when job search is active in the Leica Captivate - Home menu


| Key                           | Function  |
|-------------------------------|---|
| Function keys<br><b>F1-F6</b> | Press Esc first to leave the job search.<br><br>Correspond to six softkeys that appear on the bottom of the screen when the screen is activated. |

| Key                            |   | Function   |
|--------------------------------|---|--|
| Function keys<br><b>F7-F12</b> |  | Press Esc first to leave the job search.                                 |
|                                |  | User definable keys to execute chosen commands or access chosen screens. |
| Alphanumeric keys              |  | To type letters and numbers.   |
| Esc                            |  | Leaves the job search.   |
| <b>Fn</b>                      |  | Press Esc first to leave the job search.                                 |
|                                |  | Switches between the first and second level of function keys.            |
| Enter                          |  | Leaves the job search.   |
| ON/OFF                         |  | Turns to Power Options menu when held for 2 s.                           |
| Favourites                     |  | Without function. The search field remains in edit mode.                 |
| Home                           |  | Leaves the job search.   |
| <b>OK</b>                      |  | Leaves the job search.   |

### Functions of icons when job search is active in the Leica Captivate - Home menu

| Icon             |   | Function               |
|------------------|---|------------------------|
| Magnifying glass |  | Leaves the job search. |

### Functions in job and apps carousel when job search is active in the Leica Captivate - Home menu

| Action   |   | Function  |
|--|---|---|
| Tapping on any job that is not in the centre of the job carousel |   | Leaves the job search.<br>Moves the tapped job to the centre of the carousel. |
| Tapping on any job that is in the centre of the job carousel     |   | Leaves the job search.<br>Opens the job menu for that job.                    |
| Tapping on any app in apps carousel                              |  | Leaves the job search.<br>Tap again on the app icon to start the app.         |

## 2.2

### Configurable Keys

### 2.2.1

#### Hot Keys

#### Description

Two levels of hot keys exist:

- The first level is the keys **F7** to **F12** and **F13**, the key on the side of the instrument.
- The second level is the combination of **Fn** and **F7** to **F12**.

## Functionality

Hot keys provide a shortcut for quickly and directly carrying out functions assigned to the keys. The assignment of functions to hot keys is user configurable.

## Use

- The first level is accessed by pressing **F7 ... F12** or **F13** directly.
- The second level is accessed by pressing **Fn** first followed by **F7 ... F12**.
- Hot keys can be pressed at any time. It is possible that a function assigned to a hot key cannot be used in certain situations.

## Define hot key step-by-step

This step-by-step description shows how to assign the **Regional** panel to the **F7** key.

1. Select **Leica Captivate - Home: Settings\Customisation\Hot keys & favourites**.
2. **Hot Keys & Favourites**  
Select **F7: User - Regional settings** on the **TS hot keys** page.
3. **OK**
4. **OK**
5. Press **F7** to access **Regional**.

## Key on the side of the instrument

The key on the side of the instrument is located next to the right-hand fine drives. It enables fast and comfortable recording of measurements. Being equipped with a soft touch key located on the instrument's turning axis allows highest precision measurements. All functions that can be assigned to the hot keys can be assigned to this key including **<None>**.

### 2.2.2

#### Favourites Key

## Description

For GS:

- The  key opens the **My GS Favourites** menu.

For TS:

- The  key opens the **My TS Favourites** menu.

## Functionality of the favourites menu

The **My GS Favourites** and **My TS Favourites** menus can be configured to contain the most used functions. The favourites menu cannot be accessed while in a settings panel.

Selecting an option in the menu carries out the function assigned to the option.

## My favourites menu

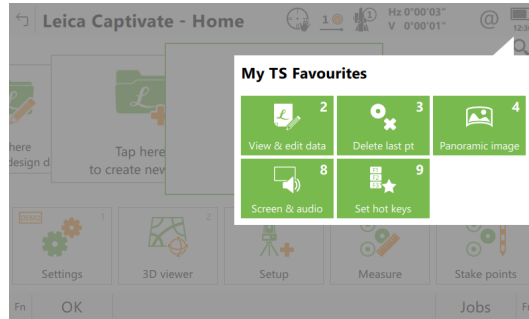
The following panel is an example of what a **My GS Favourites** or **My TS Favourites** menu can look like. The functions which are assigned to the individual places in the menu can differ depending on the settings.

Tap on a pop-up bubble menu item to use a function.

OR



On the keyboard, press the number which is displayed in pop-up bubble menu item.



---

### Define favourites menu step-by-step

Defining the favourites menu is the same process as for defining the hot keys. Refer to [2.2.1 Hot Keys](#).

---

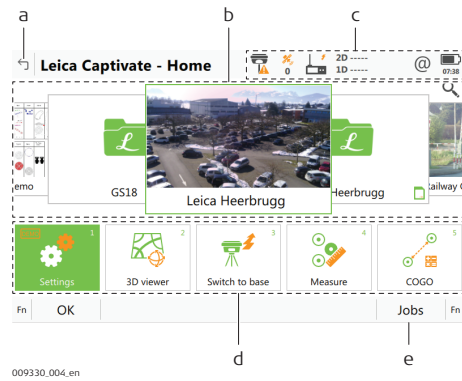
# 3

# Home

## 3.1




## Functions


### Leica Captivate - Home





- a Quit
- b Job carousel
- c Icon bar
- d Apps carousel
- e Keys

| Key                                      | Description   |
|--|---|
| <b>OK</b>                                | To open and close the job menu.   |
| <b>Jobs</b>                              | To access the <b>Job Management</b> panel. Refer to <a href="#">3.3 Job Management</a> .  |
| <b>Fn Instru-<br/>ment</b>               | To switch between GS and TS mode.   |
| <b>Fn New job</b>                        | To create a new job.  |
| <b>Fn Lock</b><br>or<br><b>Fn Unlock</b> | To lock or unlock the selected job.<br>When a job is locked, no other job can be selected from the Job carousel. The job stays highlighted. The left and the right button on the keyboard is also locked. The job search is disabled.<br>If a new job is created, the new job is highlighted and the old job is unlocked. |
| <b>Fn Exit</b>                           | To close software.  |

| Icon  | Description   |
|---|---|
|  | Displayed in the top right corner of the job tile.<br>When the icon is displayed, then the job is locked.<br>When no icon is displayed, then the job is unlocked.   |
|  | Displayed in the bottom right corner of the job tile.<br>When the icon is displayed, then the job is stored to the SD card.<br>When no icon is displayed, then the job is stored to the internal memory.  |
|  | Software maintenance is close to due date or has expired. The reminder message has previously been confirmed with <b>OK</b> . The icon disappears when licence keys are entered manually or uploaded from a file. Refer to <a href="#">30.3 Entitlements &amp; licences</a> . |

| Icon  | Description  |
|---|--|
|  | <p>Displayed in the bottom right corner of the <b>Settings</b> tile.</p> <p>When the icon is displayed, a new Leica Captivate version is available in myWorld. For an automatic check, the instrument must be connected to the Internet.</p> <p>When no icon is displayed, there is no new version or the instrument is not connected to the Internet.</p> |

### Description of the functions

| Function      | Description  |
|---------------|--|
| Icon bar      | <ul style="list-style-type: none"> <li>For status information and frequently used functionality.</li> </ul>  |
| Job menu      | <ul style="list-style-type: none"> <li>The selected job is displayed in the front.</li> <li>Tap to select an existing job.</li> <li>Typing one or several letters of a job name moves the job with the most similar name to the centre of the carousel. If no job name starts with the typed letters, the active job stays active.</li> <li>Select the left or right most tile in the carousel: Press <b>Fn</b>. Then press <b>Home</b> or <b>End</b>.</li> <li>Tap to create a job.</li> </ul>  |
| Job carousel  | <ul style="list-style-type: none"> <li>To manage jobs and data, import and export data, send data and delete jobs.</li> <li>Job menu items are shown on the second level of each job. Click a job to see the menu items.</li> <li>To delete a job, move the job to the centre of the job carousel. Press the  key on the keyboard.</li> </ul>  |
| Apps carousel | <ul style="list-style-type: none"> <li>Tap to select an app.</li> <li>OR</li> <li>On the keyboard, press the  key and then the number which is displayed for the app. The number corresponds to the order in the <b>App Visibility</b> panel.</li> </ul> <p><b>Settings</b></p> <ul style="list-style-type: none"> <li>To access settings regarding the instrument, instrument connections, the software and the display as well as other useful tools.</li> </ul> <p><b>Apps</b></p> <ul style="list-style-type: none"> <li>Contains all loaded apps. To select and start an app.</li> <li>Selecting an option in the menu starts the app. Settings and measurements that can be performed depend on the app.</li> </ul> |

## 3.2

### Job Menu

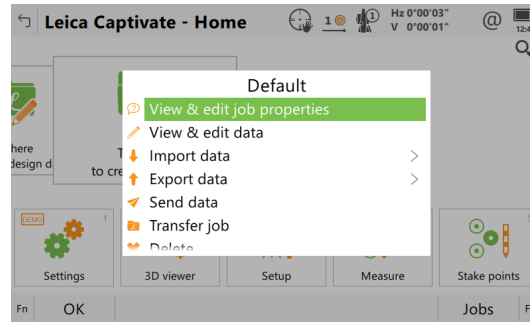
#### Description

The job menu is available when operating an RTK rover or a TS. It is used to:

- View and edit job properties.
- Create, view and edit data.
- Import data.
- Start Leica Exchange.
- Transfer jobs between the data storage device and the internal memory.
- Delete a job.

- Export and copy data.

## Job menu



### Next step

**View & edit job properties**

Refer to chapter [6 Job Menu - Jobs](#).

**View & edit data**

Refer to chapter [7 Job Menu - View & edit data](#).

**Import data**

Refer to chapter [10 Job Menu - Import data](#).

**Export data**

Refer to chapter [11 Job Menu - Export data](#).

**Send data**

To start an online service that allows the data exchange between two users of the service.


**Transfer job**

Refer to [Transfer user objects](#).

**Delete**

To delete the current job.



To delete a job, move the job in the centre of the job carousel. Press the  key on the keyboard.

## 3.3

### Job Management

#### Job Management

Listed are the existing jobs on the data storage devices.

| Job Management                      |  |                  |                |
|-------------------------------------|--|------------------|----------------|
| <input checked="" type="checkbox"/> | <b>Default</b><br>Date created: 07.11.2018     | Source: Internal | State: Visible |
| <input type="checkbox"/>            | <b>Kemerovo</b><br>Date created: 01.11.2017    | Source: Internal | State: Visible |
| <input type="checkbox"/>            | <b>kubikk.1</b><br>Date created: 02.09.2021    | Source: Internal | State: Visible |
| <input type="checkbox"/>            | <b>MUCKAWAY</b><br>Date created: 01.06.2020    | Source: Internal | State: Visible |
| <input type="checkbox"/>            | <b>ShotDiagram</b><br>Date created: 07.11.2012 | Source: Internal | State: Visible |
| <input type="checkbox"/>            | <b>VOL2 15.01</b><br>Date created: 15.01.2020  | Source: Internal | State: Visible |
| Fn                                  | OK   | New              | Edit           |
|                                     |  | Delete           | Data           |
|                                     |  | State            | Fn             |

#### Key

#### Description

**OK**

To accept the settings and to return to the previous panel.

**New**

To create a new job.

**Edit**


To edit the highlighted job.

| Key                             | Description   |
|---------------------------------|---|
| <b>Delete</b>                   | To delete the selected job or the selected jobs.  |
| <b>Data</b>                     | To view, edit and delete points, lines, images and scans stored with the job. Points, lines, images and scans are shown on separate pages. Selected sort and filter settings apply. |
| <b>State</b>                    | To change between the options in the metadata for <b>State</b> . To show or hide the job in the job carousel.   |
| <b>Fn Settings</b>              | To configure job backup options. Refer to <b>Job Settings</b> .   |
| <b>Fn Internal</b>              | To make only jobs from the internal memory visible in the job carousel.   |
| <b>Fn SD card</b>               | To make only jobs from the SD card visible in the job carousel.   |
| <b>Fn All</b> or <b>Fn None</b> | To select all jobs. The selected jobs can be deleted or set to visible or invisible in the job carousel at once.  |

## Job Settings

| Key       | Description            |
|-----------|------------------------|
| <b>OK</b> | To store the settings. |

### Description of fields

| Field                                     | Option          | Description   |
|---|-----------------|---|
| <b>Back up working job</b>                | Check box       | <p>When this box is checked, a backup for the selected working job is created based on the defined settings.</p> <p>The selected working job must be stored in the internal memory.</p> <p>The backup is created on the SD card in the folder \DBX\Backup.</p> <p>The backed up jobs can be used to recover important files, should the working job or any contained data be deleted accidentally.</p> <p>When this box is not checked, no backup is created on the SD card.</p>  |
| <b>Back up when</b>                       | Selectable list | Define when the backup is saved to the SD card: When entering an app, when leaving an app or on both occasions.   |
| <b>Show a reminder to back up the job</b> | Selectable list | <p>A message appears automatically after the defined time interval. From the message window, a backup can be initiated.</p> <p> When the reminder appears while working in an app and the backup process is accepted by pressing <b>Yes</b> in the message window, then the app is closed and the <b>Leica Captivate - Home</b> menu appears. This is to close the database before starting the backup, to make sure not data gets lost.</p> |

| Field                                  | Option    | Description   |
|--|-----------|---|
| <b>Include scans</b>                   | Check box | When this box is checked, the job is backed up with the folder, where scan data is stored.  |
| <b>Include images and image groups</b> | Check box | When this box is checked, the job is backed up with the folder, where all onboard, TS and panoramic images are stored. Images belonging to image groups are included in the backup. |
| <b>Include reference files</b>         | Check box | When this box is checked, all reference files attached to the working job such as CAD files, DGN files or IFC files are included in the backup.                                     |

### 3.4

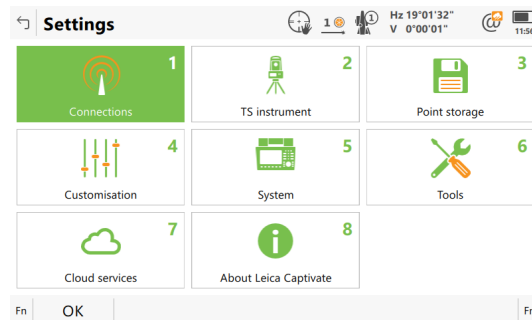
## Settings

### Description

**Settings** is used to:

- Configure parameters related to the interfaces.
- Configure parameters related to the instrument.
- Configure user favourite settings for the survey and the instrument.
- Configure parameters which are not directly related to surveying data, such as loading firmware or licence keys and format data storage devices.
- Download files, upload files and access cloud services.

### Settings



| Key                  | Description   |
|----------------------|---|
| <b>OK</b>            | To select the highlighted option and to continue with the subsequent panel. |
| <b>Fn Instrument</b> | To switch between GS and TS mode.   |

### Next step

#### Connections

Refer to chapter [19 Connections - All other connections](#).

#### TS instrument

Refer to chapter [23 Settings - TS instrument](#).

#### GS sensor

Refer to chapter [24 Settings - GS sensor](#).

#### Point storage

Refer to chapter [26 Settings - Point storage](#).

**Customisation**

Refer to chapter [27 Settings - Customisation](#).

**System**

Refer to [29 Settings - System](#).

**Tools**

Refer to chapter [30 Settings - Tools](#).

**Cloud services**

Refer to chapter [31 Settings - Cloud services](#).

**About Leica Captivate**

Refer to [32 Settings - About Leica Captivate](#).

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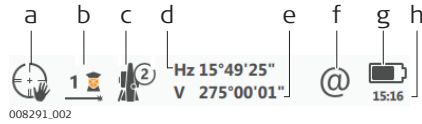
**Description**

The panel icons display the status information of the instrument.



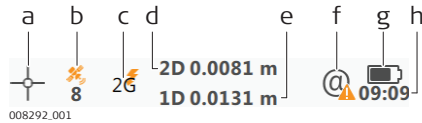
The icons provide information related to basic instrument functions. The icons that appear depend upon which instrument is used and the current instrument configuration.

**Icon bar - TS Mode**



- a Aim & Search
- b Measure & Target
- c Instrument
- d Current horizontal angle of instrument, tap to see the target height
- e Current vertical angle of instrument, tap to see the slope distance
- f Connections
- g Battery
- h Time

**Icon bar - GNSS Mode**









- a GS Position
- b Satellite Tracking
- c RTK Data Link
- d 2D position quality, tap to see the antenna height
- e 1D position quality, tap to see the 3D position quality
- f Connections
- g Battery
- h Time

**Aim & Search**

Displays the current automatic aiming or PowerSearch settings.

| Icon | Description  |
|------|--|
|      | The instrument is in auto aiming mode using automatic aiming.  |
|      | The instrument is in manual aiming mode  |
|      | The instrument is in target lock mode, however not currently following a prism. Lock Status: Unlocked. |



| Icon   | Description   |
|--|---|
|   | The instrument is in target lock mode, currently following a prism. Lock Status: Locked.  |
|   | The instrument is in prediction or locking on the fly is activated. The instrument locks toward a prism coming into the field of view and follows this prism. |
|   | Compensation for AP20 tilt is active.<br>When the tilt pole initialisation is lost, move the pole naturally for a new initialisation.                         |
|   | Searching for the prism using <b>Auto aiming</b> .  |
|   | Searching for the prism using <b>PowerSearch</b> .  |
|  | Caution. Connection between CS and TS is not established.   |









## Measure & Target







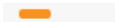



Displays the selected measurement mode.

Displays the selected prism.

The laser icon is displayed when the red laser is active.





| Icon  | Description                              |
|---|--|
|  | <b>Measure distance: Once</b>            |
|  | <b>Measure distance: Once &amp; fast</b> |

| Icon  | Description                                      |
|---|--|
|    | Measure distance: Continuously                   |
|    | Measure distance: Repeatedly & average           |
|    | Measure distance: Greater than 4km               |
|    | Measure distance: >4km & average                 |
|  | Measure distance: Highest precision on TS60/TM60 |
|  | Leica round prism                                |
|  | Leica 360° prism                                 |
|  | Leica mini prism                                 |

| Icon  | Description  |
|---|--|
|    | Leica mini 0   |
|    | Leica mini 360°  |
|    | Leica Machine Automation power prism MPR122                    |
|    | Leica reflective tape or HDS target.                           |
|  | Any surface  |
|  | User-defined prism   |
|  | Distance measurement active                                    |
|  | Red laser is turned on<br>The icons are displayed dynamically. |
|  | Red laser is turned off  |
|  |  |







## Level status




Displays the compensator is off or out of range icons, or the instrument face I or II icon.

| Icon  | Description  |
|---|--|
|  | Compensator is turned off.   |
|  | Compensator is turned on, but is out of range.   |
|  | The current face of the instrument is shown, if the compensator and the horizontal correction are turned on. |
|  |  |

## GS Position


Displays the status of the current position. As soon as this icon becomes visible the instrument is in a stage where practical operation can commence.

| Icon  | Description  |
|---|--|
|  | Navigation position available  |
|  | Navigation position available<br><b>Tilt compensation</b> active<br>When the tilt pole initialisation is lost, move the pole naturally for a new initialisation. |
|  | Code solution available  |
|  | Code solution available<br><b>Tilt compensation</b> active<br>When the tilt pole initialisation is lost, move the pole naturally for a new initialisation.       |
|  | Fixed position available   |
|  | Fixed position available<br><b>Tilt compensation</b> active<br>When the tilt pole initialisation is lost, move the pole naturally for a new initialisation.      |

| Icon  | Description  |
|---|--|
|  | xRTK fixed position available  |
|  | xRTK fixed position available<br><b>Tilt compensation</b> active<br>When the tilt pole initialisation is lost, move the pole naturally for a new initialisation. |
|  | The checks indicate that an ambiguity check is being made.   |









## Satellite Tracking


Displays the number of theoretically visible satellites above the configured cut-off angle according to the current almanac.

| Icon  | Description                       |
|---|-----------------------------------|
|  | The number of visible satellites. |












## RTK Data Link

Displays the status of the real-time device configured to be used.

| Icon  | Description  |
|---|--|
|   | An arrow pointing down indicates a real-time rover. The arrow flashes when real-time messages are received.  |
|  | An arrow pointing up indicates a real-time base. The arrow flashes when real-time messages are sent.   |
|  | Sending/receiving data   |
|  | Signal strength<br>Displayed if the device being used for the RTK rover interface is the internal CS20 modem.  |
|  | RTK or PPP/RTK bridging using the setting <b>Use PPP service: Via IP stream</b> or <b>Via IP stream and satellite</b> in <b>Satellite Tracking, Augmentation</b> page.<br>If RTK is configured, the icon displayed is based on RTK only. |
|  | Phone  |
|  | Radio  |
|  | RS232  |

| Icon  | Description   |
|---|---|
|  | SBAS<br>OR<br>PPP/RTK bridging but NOT RTK is configured using the setting <b>Use PPP service: Via satellite</b> in <b>Satellite Tracking, Augmentation</b> page. |






## Connections

| Icon  | Description  |
|---|--|
|    | Instrument is online in the Internet.  |
|    | Internet not connected.  |
|    |  |
|    | Logged in to Leica Exchange.   |
|   | Connection to the Leica ConX server is established and the device is paired.               |
|  | Logged in to BIM 360 Docs.   |
|  | Data upload in progress.   |
|  | Data download in progress.   |
|  | Exchanging new data.   |
|  | Data transfer problem.   |
|  | Active Assist is active. Leica technical support can gain remote access to the instrument. |



## Battery

Displays the battery level.

| Icon  | Description                                      |
|---|--|
|  | Sufficient power available.                      |
|  | Power level is getting low.                      |
|  | Power level is getting very low.                 |
|  | Battery empty. Instrument turns off immediately. |
|  |  |

# 5 Icon Pop-up Bubbles

## 5.1 Access

### Description

Status information helps using the instrument by showing the state of many instrument functions. All fields are display only fields. Unavailable information is indicated by -----.

Frequently used functionality can be accessed and changed quickly. The change is applied immediately. The workflow is not interrupted.

Changes are stored in the active working style.

### Access

Tap an icon in the icon area. An icon pop-up bubble opens.

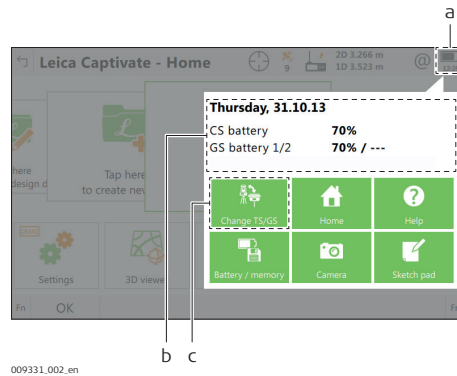
An icon pop-up bubble shows:

- Status information
- Functionality related to the icon which was tapped

Tap a bubble icon to use the functionality.

To close an icon pop-up bubble:

- Press any key on the keypad.
- Touch the panel anywhere outside of the icon pop-up bubble.



- a Icon in icon area
- b Status information
- c Bubble icon

### Description of the icon pop-up bubbles

Refer to the individual chapters for more information.

### Aim & Search

| Status Information   | Functionality   |
|--|---|
| <ul style="list-style-type: none"><li>• Current target aiming</li><li>• PowerSearch filter</li><li>• TargetID status</li></ul> | <ul style="list-style-type: none"><li>• Switch between manual/automatic aiming</li><li>• Turn target lock on/off</li><li>• Locks onto a prism by searching or by waiting for a prism to come into the field of view</li><li>• Switch between PowerSearch left/right</li><li>• Turn TargetID on or off</li></ul> |

## Measure & Target

| Status Information   | Functionality   |
|--|---|
| <ul style="list-style-type: none"><li>• Current target with defined constants</li><li>• Type of distance measurement</li></ul> | <ul style="list-style-type: none"><li>• Switch between measurements to any surface or to prisms</li><li>• Set continuous or non-continuous measurement mode</li><li>• Select targets</li><li>• Turn AP20 tilt compensation on or off</li><li>• Turn the red laser of the reflectorless EDM on/off</li></ul> |

## Instrument

| Status Information   | Functionality  |
|--|--|
| <ul style="list-style-type: none"><li>• Current setup ID, instrument height and level status</li></ul> | <ul style="list-style-type: none"><li>• Change the face of the telescope</li><li>• Turn the telescope to a certain direction</li><li>• Electronic level bubble and compensator settings</li><li>• Turn the instrument using keyboard arrow keys</li><li>• Information related to the current setup on the instrument</li></ul> |

## Hz and V

| Status Information  | Functionality |
|---|---------------|
| <ul style="list-style-type: none"><li>• Current horizontal and vertical angle</li><li>• Tap to see pole height and slope distance</li></ul> | -             |

## GS Position

| Status Information  | Functionality   |
|---|---|
| <ul style="list-style-type: none"><li>• Current GNSS position</li></ul> | <ul style="list-style-type: none"><li>• Information related to the current antenna position and the speed of the antenna.</li></ul> |

## Satellite Tracking

| Status Information  | Functionality   |
|---|---|
| <ul style="list-style-type: none"><li>• Number of satellites available and satellites used per satellite system G (GPS), R (GLONASS), E (Galileo) or B (BeiDou)</li></ul> | <ul style="list-style-type: none"><li>• Satellites ordered by the elevation angle, satellite information in a graphical way, used almanac</li><li>• Information related to logging of raw observations.</li></ul> |

## RTK Data Link

| Status Information   | Functionality  |
|--|--|
| <ul style="list-style-type: none"><li>• Seconds since last RTK message was sent/received</li><li>• Percentage of real-time data received from the base compared with data received from the antenna within the last minute</li></ul> | <ul style="list-style-type: none"><li>• Load an existing RTK profile using the <b>RTK rover wizard</b>.</li><li>• Information related to real-time data, for example the data link and the device used to transfer real-time data</li><li>• Status Internet connection</li><li>• Force a new initialisation</li><li>• Change the radio channel</li><li>• Information related to the SmartNet status, for example the device used and the connectivity steps completed.</li></ul> |

## 2D and 1D

| Status Information  | Functionality |
|---|---------------|
| <ul style="list-style-type: none"><li>• Current 2D coordinate quality of computed position</li><li>• Current height coordinate quality of computed position</li><li>• Tap to see pole height</li><li>• Tap to see 3D position quality</li></ul> | -             |

## Connections

| Status Information   | Functionality   |
|--|---|
| <ul style="list-style-type: none"><li>• Internet online or not</li><li>• WLAN configured and connected</li></ul> | <ul style="list-style-type: none"><li>• Status Bluetooth connection</li><li>• Start <b>Start Active Assist</b></li><li>• Start <b>Internet status</b> with options for<ul style="list-style-type: none"><li>• <b>Connected to Leica Exchange</b></li><li>• <b>Connected to Leica ConX</b></li></ul></li><li>• Start <b>Cloud services</b> with options for<ul style="list-style-type: none"><li>• <b>Cloud services</b></li><li>• <b>BIM 360 Docs</b></li><li>• <b>Leica ConX</b></li><li>• <b>Bricsys 24/7</b></li></ul></li></ul> |

## Battery and time

| Status Information  | Functionality  |
|---|--|
| <ul style="list-style-type: none"> <li>• Date and time</li> <li>• Remaining power capacity for the battery</li> </ul> | <ul style="list-style-type: none"> <li>• Select instruments to use</li> <li>• Return to <b>Leica Captivate - Home</b> menu</li> <li>• Start online help</li> <li>• Usage and status of battery and memory</li> <li>• Begin the camera function</li> <li>• Create a sketch on a virtual piece of paper</li> </ul> |


## 5.2


## Icon Pop-Up Bubble: Aim & Search

### 5.2.1

### Bubble Icons

#### Bubble icons

| Icon   | Description   |
|--|---|
| <b>Auto aiming</b>   | Sets <b>Aim at target: Automatic.</b>   |
| <b>Manual aiming</b>   | Sets <b>Aim at target: Manually.</b>  |
| <b>Search &amp; lock</b>   | Available for <b>Aim at target: With lock.</b> For robotic instruments and the remote operation with CS20. Searches for a prism to lock on.   |
| <b>Wait &amp; lock</b>   | Locks to a prism as soon as it enters the field of view of automatic aiming. When previously locked to a prism and target lock was lost. Works on all prisms and tape targets.  |
|  <b>Target lock off</b> | A PowerSearch helps to lock to shaking prisms. Stops the lock.  |
| <b>Target lock on</b>  | Sets <b>Aim at target: With lock.</b>   |
| <b>Target lock off</b>   | Sets <b>Aim at target</b> to the previous non-lock setting.   |
| <b>Filter learn</b>  | Starts a PowerSearch scan by doing three times a 360° scan with different vertical positions of the telescope. The PowerSearch scan finds prisms and other reflective spots in the surrounding of the instrument. Around each found prism or reflective spot, an exclusion area is defined. The exclusion area has the dimension of $H_z = \pm 1 \text{ gon}$ , $V = \pm 50 \text{ gon}$ and $d = \pm 12 \text{ m}$ is defined. |
| <b>Filter on</b>   | Available when <b>Filter learn</b> was used before. Turns on the PowerSearch filter and excludes the learned prisms from a PowerSearch.   |
| <b>Filter off</b>  | Available when <b>Filter learn</b> was used before. Turns off the PowerSearch filter and includes all prisms in a PowerSearch.  |
| <b>PowerSearch</b>   | Prisms are searched for with PowerSearch in the PowerSearch window when this icon is used.  |

| Icon  | Description   |
|---|---|
|  | If this icon is selected and <b>Meas any surface</b> is still set, then this setting is changed to <b>Measure prism</b> . |
| <b>TargetID on</b>  | Available when an AP20 with TargetID functionality is configured. Turns the TargetID functionality on.                    |
| <b>TargetID off</b>   | Available when an AP20 with TargetID functionality is configured. Turns the TargetID functionality off.                   |

## 5.3

### Icon Pop-Up Bubble: Measure & Target

#### Bubble icons

| Icon                    | Description  |
|-------------------------|--|
| <b>Meas any surface</b> | To measure to any surface (reflectorless). Automatically sets <b>Aim at target: Manually</b> .                               |
| <b>Measure prism</b>    | To measure to prisms.  |
| <b>Meas continuous</b>  | To set the distance measurements to continuous.  |
| <b>Meas single shot</b> | To set the distance measurements to the previous non-continuous mode.  |
| <b>Targets</b>          | To select a prism.   |
| <b>Red laser on</b>     | To turn the red laser of the reflectorless EDM on.   |
| <b>Red laser off</b>    | To turn the red laser of the reflectorless EDM off.  |
| <b>Tilt on</b>          | Available when an AP20 with tilt compensation functionality is configured. Turns <b>Tilt compensation</b> functionality on.  |
| <b>Tilt off</b>         | Available when an AP20 with tilt compensation functionality is configured. Turns <b>Tilt compensation</b> functionality off. |

## 5.4

### Icon Pop-Up Bubble: Instrument

#### 5.4.1

#### Bubble Icons

#### Bubble icons

| Icon                 | Description  |
|----------------------|--|
| <b>Current setup</b> | Information related to the current setup on the instrument. Refer to <a href="#">5.4.2 Current setup</a> . |
| <b>Turn to Hz/V</b>  | To turn the instrument to a specific entered position. Refer to <a href="#">5.4.3 Turn to Hz/V</a> .       |
| <b>Arrow keys</b>    | To turn the instrument using the arrow keys. Refer to <a href="#">5.4.4 Arrow keys</a> .                   |

## 5.4.2

## Current setup

### TS Current Setup Info

|                   |                 |
|-------------------|-----------------|
| Current setup ID  | Stn001          |
| Instrument height | 1.500 m         |
| Setup method      | Set orientation |
| Easting           | 0.000 m         |
| Northing          | 0.000 m         |
| Height            | 0.000 m         |
| Temperature       | 12.0 °C         |
| Pressure          | 1013.3 mbar     |

Fn OK ppm Fn

| Key            | Description  |
|----------------|--|
| OK             | To exit the panel.   |
| ppm/Scale fctr | To switch between displaying the setup scale factor and the setup ppm. |

### Description of fields

| Field                            | Description  |
|----------------------------------|--|
| Current setup ID                 | The current setup.   |
| Instrument height                | Instrument height of the current setup.  |
| Setup method                     | The setup method used for the current setup.   |
| Easting                          | Easting value of the instrument position.  |
| Northing                         | Northing value of the instrument position.   |
| Local ellipsoid height or Height | For a selected coordinate system, ellipsoidal height and elevation can be displayed. |
| Temperature                      | Temperature set on the instrument.   |
| Pressure                         | Pressure set on the instrument.  |
| Atmospheric ppm                  | Atmospheric ppm set on the instrument.   |
| Setup ppm                        | Ppm of the current setup.  |
| Setup scale                      | Scale factor of the current setup.   |

## 5.4.3

## Turn to Hz/V

### Description

This panel is used when the instrument is controlled remotely and when the telescope must be turned to a certain direction.

### Turn Instrument to Hz/V, Absolute page

Turn Instrument to Hz/V

Absolute Relative

Enter the absolute azimuth & vertical angles you wish to turn the instrument to

|         |          |
|---------|----------|
| Azimuth | 0.0001 g |
| V angle | 0.0001 g |

OK Page



| Key  | Description   |
|------|---|
| OK   | To return to <b>Leica Captivate - Home</b> menu. The instrument turns to the prism. |
| Page | To change to another page on this panel.  |

#### Description of fields

| Field              | Option         | Description   |
|--------------------|----------------|---|
| <b>Azimuth</b>     | Editable field | Oriented horizontal direction for the instrument to turn to.  |
| <b>Angle right</b> | Editable field | Horizontal angle from the backsight point for the instrument to turn to. Available when <b>Hz angle display: North azimuth</b> is set in <b>Regional, Angle</b> page. |
| <b>V angle</b>     | Editable field | Vertical direction for the instrument to turn to.   |

#### Next step

**Page** changes to the **Relative** page.

#### Turn Instrument to Hz/V, Relative page

The values are added to the current telescope position to calculate the new direction for the telescope to turn to.

#### Description of fields


| Field                         | Option         | Description   |
|-------------------------------|----------------|---|
| <b>Difference in Hz angle</b> | Editable field | Angular difference for the horizontal angle to turn to. |
| <b>Difference in V angle</b>  | Editable field | Angular difference for the vertical angle to turn to.   |

#### Next step

Press **OK**. The instrument turns to the prism.

For **Aim at target: Automatic** an automatic aiming measurement is performed. If no prism was found, the instrument turns to the position typed in.

For **Aim at target: With lock** the instrument locks on the prism.

The  icon is displayed.

If no prism was found, the instrument turns to the position typed in.

#### 5.4.4

#### Arrow keys

#### Description

The instrument can be turned using the keyboard arrow keys on the instrument or field controller, or the arrow keys displayed on the touch screen.

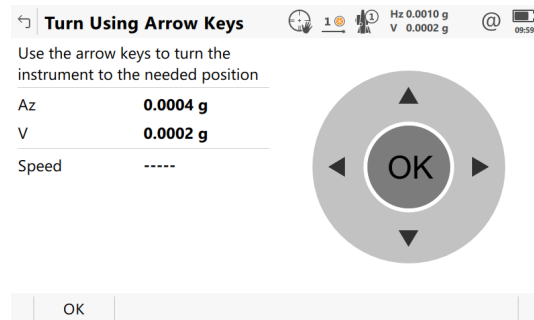
When this panel is accessed, the EGL is turned on automatically. When you exit the panel, the EGL is turned off.

## Turn Using Arrow Keys

Use the arrow keys to start the telescope movement.

Press an arrow key again to speed up the movement. Press any of the other arrow keys while the instrument turns to stop the movement.

Press **OK** to stop the instrument movement.



| Key | Description                                      |
|-----|--|
| OK  | To return to <b>Leica Captivate - Home</b> menu. |

### Description of fields

| Field | Option  | Description  |
|-------|---|--|
| Speed | -----, <b>Very slow</b> , <b>Slow</b> , <b>Medium</b> and <b>Fast</b> | Displays the rotational speed of the instrument. Press the same arrow key to change the speed. |

## 5.5

## Icon Pop-Up Bubble: GS Position

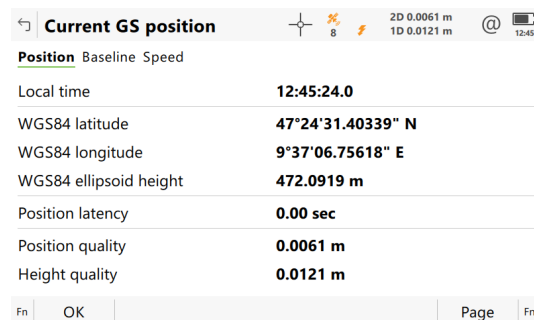
### 5.5.1

### Current position

#### Description

This panel shows information related to the current antenna position and the speed of the antenna. For real-time rover settings, the baseline vector is also shown. 3D viewer shows the current position in a graphical format.

#### Current GS position, Position page



| Key       | Description  |
|-----------|--|
| OK        | To return to the <b>Leica Captivate - Home</b> .   |
| Page      | To change to another page on this panel.   |
| Fn Coord  | To see other coordinate types. Local coordinates are available when a local coordinate system is active. |
| Fn Height | To see height as elevation. Available when local grid coordinates are displayed.                         |

| Key              | Description   |
|------------------|---|
| <b>Fn Ell Ht</b> | To see height as ellipsoidal height. Available when local grid coordinates are displayed. |

#### Description of fields

| Field   | Description  |
|---|--|
| <b>Position latency</b>                           | The latency of the computed position. Latency is mostly due to time required for data transfer and computation of position. Depends on the use of the prediction mode. |
| <b>Position quality</b> and <b>Height quality</b> | Available for phase fixed and code only solutions. The 2D coordinate and height quality of the computed position.  |
| <b>HDOP</b> and <b>VDOP</b>                       | Available for navigated solutions.   |

#### Next step

| IF   | THEN   |
|--|--|
| the instrument is a real-time rover            | <b>Page</b> changes to the <b>Baseline</b> page. |
| the instrument is not configured for real-time | <b>Page</b> changes to the <b>Speed</b> page.    |
| the instrument is a real-time base             | <b>OK</b> exits <b>Current GS position</b> .     |

**Current GS position, Baseline page**

Information on the baseline vector is displayed.

#### Next step

**Page** changes to the **Speed** page.

**Current GS position, Speed page**

#### Description of fields

| Field                   | Description  |
|-------------------------|--|
| <b>Horizontal speed</b> | The speed over ground in the horizontal direction.   |
| <b>On bearing</b>       | Available for local coordinate systems. The bearing for the horizontal direction related to the North direction of the active coordinate system. |
| <b>Vertical speed</b>   | The vertical component of the current velocity.  |

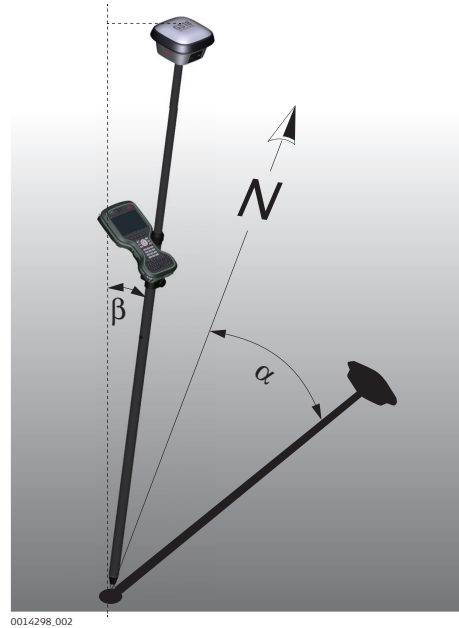
#### Next step

| IF  | THEN   |
|---|--|
| the instrument is a GS18 and the tilt compensation is active                | <b>Page</b> changes to the <b>Tilt</b> page. |
| the instrument is not a GS18 or the tilt compensation on a GS18 is inactive | <b>OK</b> exits <b>Current GS position</b> . |

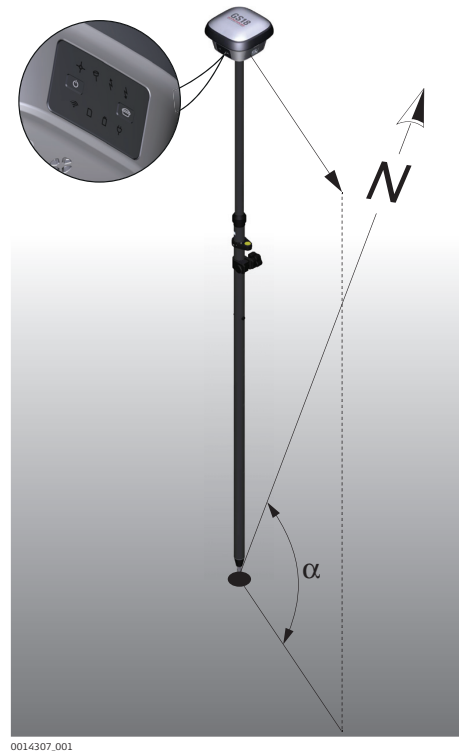
**Current GS position, Tilt page**

Available for GS18 with **Use tilt compensation** checked in **Tilt Compensation**.

The fields are updated according to the setting for **GS position update rate** in **Screen, Audio & Text Input**.



$\alpha$  Direction of tilt  
 $\beta$  Tilt



$\alpha$  GS heading

#### Description of fields

| Field                | Description   |
|----------------------|---|
| Local time           | The current local time.                                     |
| Overall tilt quality | The current 3D coordinate quality of the computed position. |

| Field                            | Description   |
|----------------------------------|---|
| <b>Tilt</b>                      | The angle between the vertical and the tilted pole of the antenna.<br>This angle is calculated by the GS18. |
| <b>Tilt quality</b>              | The accuracy of the tilt angle of the antenna.  |
| <b>Direction of tilt</b>         | The azimuth of the tilted antenna pole.   |
| <b>Direction of tilt quality</b> | The accuracy of the azimuth angle of the tilted antenna pole.   |
| <b>GS heading</b>                | The direction in which the keyboard of the GS18 faces.  |
| <b>GS heading quality</b>        | The accuracy of the direction in which the keyboard of the GS18 faces.                                      |

### Next step

OK exits **Current GS position**.

## 5.6 Icon Pop-Up Bubble: Satellite Tracking

### 5.6.1 Bubble Icons

#### Bubble icons

| Icon                      | Description   |
|---------------------------|---|
| <b>Satellite tracking</b> | Information related to the tracked satellites. Refer to <a href="#">5.6.2 Satellite tracking</a> .    |
| <b>Data logging</b>       | Information related to the logging of raw observations. Refer to <a href="#">5.6.3 Data logging</a> . |

### 5.6.2 Satellite tracking

#### Description

This panel shows information related to the tracked satellites ordered by the elevation angle.

#### Rover Satellite Tracking, GPS/Glonass/Galileo/BeiDou/Augmentation/QZSS/NavIC page

The screenshot shows the 'Rover Satellite Tracking' interface. At the top, it displays 'GPS Skyplot Almanac' and a search icon. Below this is a table with columns for satellite ID, Elevation (Elev), Azimuth, and Signal-to-Noise Ratio (S/N) for L1 and L2 frequencies. The table lists several satellites: G27 (Elev 1.88, Azimuth 329, S/N L1 50, S/N L2 49), G06 (Elev 1.80, Azimuth 134, S/N L1 49, S/N L2 44), G03 (Elev 1.77, Azimuth 286, S/N L1 50, S/N L2 45), G22 (Elev 1.63, Azimuth 120, S/N L1 50, S/N L2 45), G19 (Elev 1.51, Azimuth 302, S/N L1 49, S/N L2 44), and C/A1.1 (Elev 1.47, Azimuth 302, S/N L1 47, S/N L2 44). At the bottom of the table, there are navigation buttons: 'OK', 'Base', 'Health', 'More', 'Page', and 'Fn'.

| GPS           | Elev | Azimuth | S/N L1 | S/N L2 |
|---------------|------|---------|--------|--------|
| <b>G27</b>    | 1.88 | 329     | 50     | 49     |
| <b>G06</b>    | 1.80 | 134     | 49     | 44     |
| <b>G03</b>    | 1.77 | 286     | 50     | 45     |
| <b>G22</b>    | 1.63 | 120     | 50     | 45     |
| <b>G19</b>    | 1.51 | 302     | 49     | 44     |
| <b>C/A1.1</b> | 1.47 | 302     | 47     | 44     |

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To return to the <b>Leica Captivate - Home</b> menu.                                  |
| <b>Base / Rover</b> | To change between the SNR values of rover and base.                                   |
| <b>Health</b>       | To view the health status of the satellites categorised in good, bad and unavailable. |

| Key         | Description  |
|-------------|--|
| <b>More</b> | To display the SNR values for all the available frequencies of the satellites. |
| <b>Page</b> | To change to another page on this panel.                                       |

#### Description of metadata

| Metadata  | Description  |
|---|--|
| -   | The Pseudo Random Noise number (GPS), the Slot number (GLONASS), the <b>Space Vehicle</b> number (Galileo, BeiDou, QZSS) or the name (Terrastar, NavIC) of the satellites. |
| <b>Elev</b>   | The elevation angle in degrees. The arrows indicate if the satellite is rising or falling.   |
| <b>Azimuth</b>  | The azimuth of the satellite in degrees.   |
| <b>S/N L1, S/N L2, S/N L3, S/N L5, S/N E1, S/N E5a, S/N E5b, S/N E6, S/N AltBOC, S/N B1, S/N B2, S/N B3</b> | The SNR on L1, L2 and L5 for GPS/QZSS, on L1, L2 and L3 for GLONASS, on L5 for NavIC, on E1, E5a, E5b, E6 and AltBOC for Galileo and on B1, B2 and B3 for BeiDou.          |

#### Next step

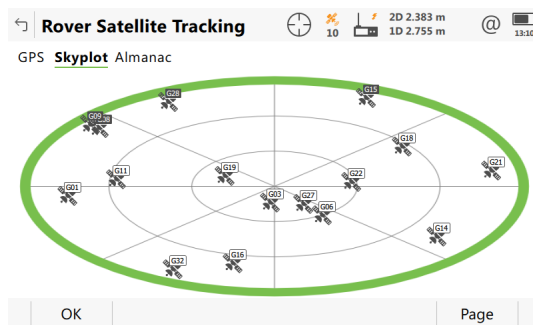
**Page** changes to another page on this panel.

### Rover Satellite Tracking, Skyplot page

Shows all currently tracked satellites.

Satellites below the **Cut-off angle** configured in **Satellite Tracking** are marked grey.



The part of the skyplot between the 0° elevation and the cut-off angle is marked grey.



| Key                     | Description   |
|-------------------------|---|
| <b>OK</b>               | To return to the <b>Leica Captivate - Home</b> menu.  |
| <b>GPS off / GPS on</b> | To hide or show the GPS satellites (shown by the prefix G).   |
| <b>GLO off / GLO on</b> | To hide or show the GLONASS satellites (shown by the prefix R). Available when <b>Glonass</b> is activated in <b>Satellite Tracking, Global</b> page. |

| Key                         | Description  |
|-----------------------------|--|
| <b>GAL off / GAL on</b>     | To hide or show the Galileo satellites (shown by the prefix E).<br>Available when <b>Galileo</b> is activated in <b>Satellite Tracking, Global</b> page. |
| <b>BDS off / BDS on</b>     | To hide or show the BeiDou satellites (shown by the prefix C).<br>Available when <b>BeiDou</b> is activated in <b>Satellite Tracking, Global</b> page.   |
| <b>QZSS off / QZSS on</b>   | To hide or show the QZSS satellites (shown by the prefix J).<br>Available when <b>QZSS</b> is activated in <b>Satellite Tracking, Regional</b> page.     |
| <b>NavIC off / NavIC on</b> | To hide or show the NavIC satellites (shown by the prefix I).<br>Available when <b>NavIC</b> is activated in <b>Satellite Tracking, Regional</b> page.   |
| <b>More</b>                 | Available when more than four satellite systems are used.<br>To display additional keys to turn satellite systems on or off.                             |
| <b>Page</b>                 | To change to another page on this panel.   |

#### Description of symbols

| Symbol  | Description   |
|---|---|
|  | Satellites above the <b>Cut-off angle</b> configured in <b>Satellite Tracking</b> . |
|  | Satellites below the <b>Cut-off angle</b> configured in <b>Satellite Tracking</b> . |

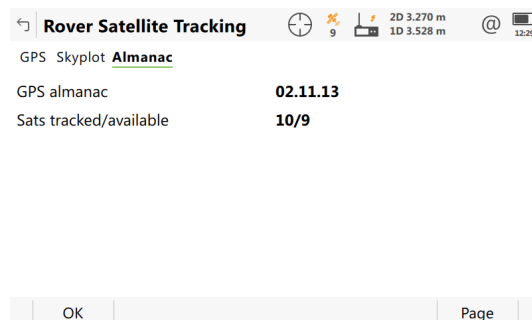
#### Next step

**Page** changes to the **Almanac** page.

### Rover Satellite Tracking, Almanac page

The **Almanac** page shows

- the date of the used almanacs, for each GNSS constellation configured
- as shown on the skyplot, the number of satellites tracked and the number of satellites available above the cut-off elevation mask.



← **Rover Satellite Tracking** + 9 2D 3.270 m 1D 3.528 m @ 12:29

GPS Skyplot **Almanac**

GPS almanac **02.11.13**

Sats tracked/available **10/9**

OK Page



| Key  | Description  |
|------|--|
| OK   | To return to the <b>Leica Captivate - Home</b> menu. |
| Page | To change to another page on this panel.             |

### Next step

OK exits the panel.

## Base Satellite Tracking

The satellite tracking information shown for the base is identical with the information shown for the rover.

### 5.6.3

## Data logging

### Description

This panel shows information related to logging of raw observations.

## GNSS Data Logging Status, Logging information page

| Key  | Description  |
|------|--|
| OK   | To return to the <b>Leica Captivate - Home</b> menu. |
| Page | To change to another page on this panel.             |

| Key  | Description  |
|------|--|
| OK   | To return to the <b>Leica Captivate - Home</b> menu. |
| Page | To change to another page on this panel.             |

### Description of fields

| Field                                 | Description  |
|---------------------------------------|--|
| <b>Data format</b>                    | Shows if raw data is saved and if so in which format.      |
| <b>Data stored on</b>                 | Shows where the data is saved.                             |
| <b>Current dynamics</b>               | Indicates if the instrument is static or moving.           |
| <b>Obs logged in current interval</b> | The number of observations logged in the current interval. |
| <b>Static observations logged</b>     | The number of static epochs recorded in the current job.   |
| <b>Kinematic observations logged</b>  | The number of moving epochs recorded in the current job.   |
| <b>DBX points logged</b>              | The number of points stored to the database.               |

### Next step

Page changes to the **Point occupation** page.

**GNSS Data Logging  
Status,  
Point occupation page**

**Description of fields**

| Field   | Description   |
|---|---|
| <b>Current dynamics</b>                         | Shows if the instrument is moving or not.   |
| <b>GDOP</b>                                     | Current GDOP.   |
| <b>Logging rate</b>                             | Rate at which raw observations are being recorded.  |
| <b>Number of moving observations</b>            | The number of logged moving raw observations. Reset as soon a new moving interval starts.   |
| <b>Logging data from more than 5 sats since</b> | The time for how long five or more satellites are tracked on L1 and L2 without interruption. If fewer than five satellites were tracked, the counter is reset. The counter is not reset after <b>Measure, Stop</b> or <b>Store</b> .  |
| <b>Measurement completed</b>                    | The percentage of collected data required for successful processing. It is a conservative estimate based on a 10 - 15 km baseline. The criteria used to display this value depend on the settings for <b>Automatically stop point measurement</b> in <b>Leica Captivate - Home: Settings\Point storage\GS quality control</b> . |
| <b>Time to go</b>                               | The estimated time in hours, minutes and seconds until the configured stop criteria is reached. The criteria used to display this value depend on the settings for <b>Automatically stop point measurement</b> in <b>Leica Captivate - Home: Settings\Point storage\GS quality control</b> .                                    |

**Next step**

**Page** changes to the **RTK base** page.

**GNSS Data Logging  
Status,  
RTK base page**

As shown below, the name of the page changes depending on the type of base used.

| Name of page               | Description  |
|----------------------------|--|
| <b>RTK base</b> page       | Base is a real base station.   |
| <b>Base (Nearest)</b> page | Base is the closest to the rover determined by for example SmartNet.   |
| <b>Base (i-MAX)</b> page   | Base information is individualised Master-Auxiliary corrections determined and sent by for example SmartNet. |
| <b>Base (MAX)</b> page     | Base information is Master-Auxiliary corrections determined and sent by for example SmartNet.                |
| <b>Base (VRS)</b> page     | Base is a virtual base station.  |
| <b>Base (FKP)</b> page     | Base information is area correction parameters.  |

## Description of fields

| Field               | Option        | Description  |
|---------------------|---------------|--|
| <b>Logging rate</b> | A time in sec | The logging rate at the base. This information is shown if the real-time message format supports this information and raw observations are being logged at the base. |
|                     | -----         | Raw observations are not being logged, or status information is not supported by RTK format.   |

## Next step

OK exits **GNSS Data Logging Status**.

## 5.7

## Icon Pop-Up Bubble: RTK Data Link

### 5.7.1

### Bubble Icons

#### Bubble icons

| Icon                      | Description  |
|---------------------------|--|
| <b>RTK data link stat</b> | Available when RTK is configured. Opens the status panel <b>RTK Data Link Status</b> or <b>RTK1 Data Link Status/RTK2 Data Link Status</b> . Refer to <a href="#">17 RTK rover wizard</a> . Shows also information related to the incoming data from active devices. |
| <b>Initialize RTK</b>     | Refer to <a href="#">5.7.3 Initialize RTK</a> .  |
| <b>Auto coord on</b>      | Available for <b>RTK data format: RTCM v3</b> or <b>Leica 4G</b> . To set an RTCM coordinate system received by a reference network as active coordinate system.   |
| <b>Change channel</b>     | To open the settings panel <b>Radio Settings</b> . Refer to <a href="#">20.3 Radios for GPS Real-Time</a> .  |
| <b>Start RTK stream</b>   | To start streaming RTK data.   |
| <b>Stop RTK stream</b>    | To stop streaming RTK data.  |

| Icon          | Description  |
|---------------|--|
| SmartNet stat | <p>Available when <b>PPP service/Use RTK bridging service</b> via IP stream is configured. Opens the status panel <b>SmartNet Status</b>. For <b>PPP service/Use RTK bridging service</b> using satellites, the bubble icon is unavailable.</p> <p>The information displayed on the available pages is very similar to the information on the status panel <b>RTK Data Link Status</b>. Refer to <a href="#">5.7.2 RTK data link stat</a>.</p> <p>Two configurations are required so that the bubble icon is displayed:</p> <ol style="list-style-type: none"> <li>1. <b>Leica Captivate - Home: Settings/Connections/All other connections</b>. On <b>Connection Settings, GS connections</b> page, select <b>RTK rover</b>. Press <b>Edit</b>. Select <b>Connect using: CS Internet 1</b>, for example.</li> <li>2. <b>Leica Captivate - Home: Settings/GS sensor/Satellite tracking</b>. In <b>Satellite Tracking, Augmentation</b> page, select <b>Use PPP service: Via IP stream</b> and <b>Connect using: CS Internet 2</b>, for example.</li> </ol> |

## 5.7.2

### RTK data link stat

#### Description

This panel shows information related to real-time data, for example the data link and the device used to transfer real-time data.

#### RTK Data Link Status, General page


| RTK Data Link Status                 |          |
|--------------------------------------|----------|
| General Device RTK base Connectivity |          |
| RTK data format                      | Leica 4G |
| GPS used L1/L2/L5                    | -----    |
| Last received                        | -----    |
| In last minute                       | -----    |
| RTK network                          | None     |

|    |      |      |
|----|------|------|
| OK | Data | Page |
|----|------|------|

| Key  | Description   |
|------|---|
| OK   | To exit the panel.  |
| Data | To view the data being received. Depending on the <b>RTK data format</b> , the shown data differ. |
| Page | To change to another page on this panel.  |

#### Description of fields

| Field             | Description  |
|-------------------|--|
| RTK data format   | The received real-time data format message type.                                       |
| GPS used L1/L2/L5 | The number of satellites on L1, L2 and L5 being used in the current position solution. |

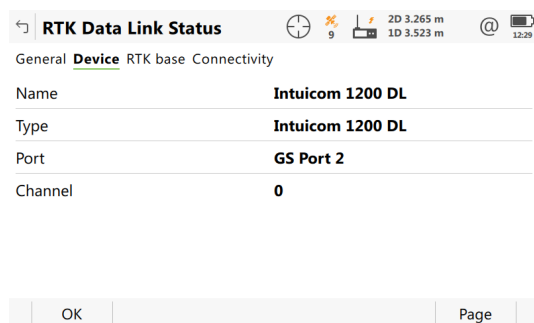
| Field                     | Description   |
|---------------------------|---|
| <b>GLO used L1/L2</b>     | Available if <b>Glonass</b> is activated in <b>Satellite Tracking, Global</b> page. The number of satellites on L1 and L2 being used in the current position solution.  |
| <b>GAL used E1/E5a</b>    | Available if <b>Galileo</b> is activated in <b>Satellite Tracking, Global</b> page. The number of satellites on E1 and E5a being used in the current position solution.   |
| <b>GAL used E5b/ABOC</b>  | Available if <b>Galileo</b> is activated in <b>Satellite Tracking, Global</b> page. The number of satellites on E5b and AltBOC being used in the current position solution.   |
| <b>BDS used B1/B2/B3</b>  | Available if <b>BeiDou</b> is activated in <b>Satellite Tracking, Global</b> page. The number of satellites on B1I, B2I, B2a and B3I being used in the current position solution.   |
| <b>QZSS used L1/L2</b>    | Available if <b>QZSS</b> is activated in <b>Satellite Tracking, Regional</b> page. The number of satellites on L1 and L2 being used in the current position solution.<br> To send QZSS correction data, select <b>RTK data format: RTCM v3 (MSM)</b> in <b>RTK Base Settings (RTK 1), RTK data</b> page. |
| <b>Last data sent</b>     | Available for RTK base. Seconds since the last message from the base was sent.  |
| <b>Last data received</b> | Available for Rover Satellite Tracking. Seconds since the last message from the base was received.  |
| <b>In last minute</b>     | Available for Rover Satellite Tracking. The percentage of real-time data received from the base compared with the data received from the antenna within the last minute. This percentage indicates how well the data link is working.   |
| <b>RTK network</b>        | Available for an Rover Satellite Tracking. The type of base network in use.   |

### Next step

Page changes to the **Device** page.

### RTK Data Link Status, Device page

The content of this page differs for each type of device in use.



RTK Data Link Status

General **Device** RTK base Connectivity

|         |                  |
|---------|------------------|
| Name    | Intuicom 1200 DL |
| Type    | Intuicom 1200 DL |
| Port    | GS Port 2        |
| Channel | 0                |

OK Page

| Key | Description        |
|-----|--------------------|
| OK  | To exit the panel. |

| Key  | Description                              |
|------|--|
| Page | To change to another page on this panel. |

### Description of fields

#### For all devices available

| Field | Description             |
|-------|-------------------------|
| Name  | The name of the device. |

#### For RS232

| Field     | Description  |
|-----------|--|
| Type      | The type of device.  |
| Port      | The port to which the device is connected.   |
| Bluetooth | Available if device is connected using Bluetooth. Indicates the state of the connection. |

#### For digital cellular phones and modems

| Field        | Description  |
|--------------|--|
| Type         | The type of device.  |
| Port         | The port to which the device is connected.   |
| Firmware     | The software version of the attached digital cellular phone.   |
| Operator     | The name of the network operator in which the digital cellular phone is operating.   |
| Network type | The type of reference network selected in <b>RTK Rover Settings</b> . Refer to <a href="#">RTK Rover Settings</a> , <a href="#">RTK network page</a> . |
| Status       | The current mode of the digital cellular phone. The options are Unknown, Detection and Registered.   |
| Bluetooth    | Available if device is connected using Bluetooth. Indicates the state of the connection. Unavailable for CS modem.                                     |
| Signal       | Indication of received signal strength of the digital cellular phone network.  |

#### For radios

The available fields depend on the radio type.

| Field           | Description   |
|-----------------|---|
| Type            | The type of device.   |
| Port            | The port to which the device is connected.  |
| Channel         | The radio channel.  |
| Frequency       | The current set frequency of the radio.   |
| Channel spacing | Channel spacing assigned to the channel in kHz. The frequency spacing between channels depends on the radio used. |

| Field           | Description                                 |
|-----------------|---|
| <b>Firmware</b> | The software version of the attached radio. |

#### For Internet on the rover

| Field                  | Description   |
|------------------------|---|
| <b>TCP/IP port</b>     | TCP/IP port number in use.  |
| <b>IP address</b>      | IP address of the connected client.                                     |
| <b>Duration</b>        | The time length since when the instrument is connected to the Internet. |
| <b>KBytes received</b> | The amount of data received from the Internet in kilobyte.              |
| <b>KBytes sent</b>     | The amount of data sent to the Internet in kilobyte.                    |

#### For Internet on the base

| Field                    | Description   |
|--------------------------|---|
| <b>TCP/IP port</b>       | TCP/IP port number in use.  |
| <b>Clients connected</b> | The number of connected clients and the number of allowed client connections as configured in <b>Internet Port Connection</b> . |

#### Next step

Page changes to the **RTK base** page.

#### RTK Data Link Status, RTK basepage

As shown below, the name of the page changes depending on the type of base being used.

| Name of page               | Description  |
|----------------------------|--|
| <b>RTK base</b> page       | Base is a real base station.   |
| <b>Base (Nearest)</b> page | Base is the closest to the rover determined by for example SmartNet.   |
| <b>Base (i-MAX)</b> page   | Base information is individualised Master-Auxiliary corrections determined and sent by for example SmartNet. |
| <b>Base (MAX)</b> page     | Base information is Master-Auxiliary corrections determined and sent by for example SmartNet.                |
| <b>Base (VRS)</b> page     | Base is a virtual base station.  |
| <b>Base (FKP)</b> page     | Base information is area correction parameters.  |

#### Description of fields

| Field              | Description  |
|--------------------|--|
| <b>Point ID</b>    | The name of the reference.   |
| <b>RTK base ID</b> | An identification for a base station. The ID can be converted into a compact format to be sent out with real-time data in all real-time data formats. It is different from the point ID of the base station. |

| Field   | Description  |
|---|--|
| <b>Ground marker to antenna reference point</b> | <ul style="list-style-type: none"> <li>For <b>RTK data format: Leica, RTK data format: Leica 4G, RTK data format: RTCM v3 or RTK data format: RTCM 9,2 v2/RTCM 1,2 v2</b> with <b>RTCM version: 2.3</b>:<br/>The antenna height at the base from the marker to the MRP.</li> <li>For <b>RTK data format: CMR/CMR+ and RTK data format: RTCM 18,19 v2 or RTK data format: RTCM 18,19 v2</b> with <b>RTCM version: 2.2</b>:<br/>The antenna height at the base from the marker to the phase centre.</li> <li>For all other <b>RTK data format-----</b>: is displayed because the data format does not include information about the antenna height.</li> </ul> |
| <b>Coordinates of</b>                           | <p>The coordinates for the base station which are transferred depend on the active real-time data format.</p> <ul style="list-style-type: none"> <li>For real-time messages which include antenna height and antenna type: <b>Marker</b>.</li> <li>For real-time messages which do not include antenna information: <b>Phase Centre</b> of L1.</li> </ul>  |
| <b>Number of aux ref</b>                        | The number of active auxiliary base stations from which data is received. Availability depends on selected network.  |
| <b>Antenna at base</b>                          | The antenna used at the base.  |
| <b>Sensor type at base</b>                      | The instrument type used at the base.  |

#### Next step

| IF                                    | THEN   |
|---------------------------------------|--|
| other coordinate types must be viewed | <b>Fn Coord.</b> Local coordinates are available when a local coordinate system is active. |
| another page must be accessed         | <b>Page.</b>   |
| this panel must be quit               | <b>OK</b> exits the panel.   |

#### RTK Data Link Status, Connectivity page

This panel shows the status real-time connectivity as dynamic troubleshooting panel. It shows the success of each of the steps in the connectivity to receive real-time corrections. If one step fails or is skipped, the check box is unchecked.

As each step is successfully completed, the check box is activated.

#### RTK Data Link Status, DynDNS page

The page shows the status of the DynDNS connection.

This page is available, if DynDNS is activated. Refer to [19.2 CS internet / GS internet / TS Internet](#).



Unavailable for CS30/CS35. Use the status panel in Windows.



## On base

| Field                        | Option        | Description   |
|------------------------------|---------------|---|
| <b>DynDNS status</b>         |               | Available on base.  |
|                              | <b>Error</b>  | DynDNS is active but the IP address could not be updated at the DynDNS service.                                   |
|                              | <b>Active</b> | DynDNS is active and has updated the IP address.  |
|                              | <b>Off</b>    | DynDNS is inactive.   |
| <b>Last update</b>           | Display only  | Available on base. The time and the date of when the IP address was last updated at the DynDNS service by the GS. |
| <b>Current registered IP</b> | Display only  | Available on base. The last IP address that has been updated for the GS.  |

## Real-Time Input Data

The following provides additional information on the satellite data received using real-time message. Information of those satellites is displayed, which are used on both base and rover.

### Access

**Data** on **RTK Data Link Status, General** page.

| Real-Time Input Data |                          |
|----------------------|--------------------------|
| Sat PRN              | <b>G16</b>               |
| Sat Time             | <b>10:43:37</b>          |
| Phase L1             | <b>110576765.757 cyc</b> |
| Phase L2             | <b>86163706.486 cyc</b>  |
| Phase L5             | -----                    |
| Code L1              | <b>21042059.620 m</b>    |
| Code L2              | <b>21042058.620 m</b>    |
| Code L5              | -----                    |

OK      Next sat

| Key             | Description  |
|-----------------|--|
| <b>OK</b>       | To return to <b>RTK Data Link Status</b> .   |
| <b>Next sat</b> | To display information on the satellite with the next higher number.   |
| <b>Prev sat</b> | To display information on the satellite with the next lower number. Available when <b>Next sat</b> was pressed before. |

### Description of fields

The data being received from the satellites and the layout of the panel depend on the active real-time data format.

| Field                                   | Description  |
|---|--|
| <b>Sat PRN</b>                          | The PRN number (GPS), the Slot number (GLONASS) or the Space Vehicle number (Galileo, BeiDou) of the satellites shown with the prefix G (GPS), R (GLONASS), E (Galileo) or C (BeiDou). |
| <b>Sat Time</b>                         | The GPS time of the satellite.   |
| <b>Phase L1, Phase L2, Phase L5</b>     | The number of phase cycles from the antenna to the GPS satellite on L1, L2 and L5.   |
| <b>Phase L1, Phase L2</b>               | The number of phase cycles from the antenna to the GLONASS satellite on L1 and L2.   |
| <b>GAL used E1/E5a, GAL used E1/E5a</b> | The number of phase cycles from the antenna to the Galileo satellite on E1, E5a, E5b and Alt-BOC.  |
| <b>Phase B1, Phase B2</b>               | The number of phase cycles from the antenna to the BeiDou satellite on B1, B2 and B3.  |
| <b>Msg 18 L1, Msg 18 L2</b>             | The uncorrected carrier phases for L1 and L2.  |
| <b>Msg 20 L1, Msg 20 L2</b>             | The carrier phase corrections for L1 and L2.   |
| <b>Code L1, Code L2, Code L5</b>        | The pseudorange from the antenna to the GPS satellite for L1, L2 and L5.   |
| <b>Code L1, Code L2</b>                 | The pseudorange from the antenna to the GLONASS satellite on L1 and L2.  |
| <b>GAL used E1/E5a, GAL used E1/E5a</b> | The pseudorange from the antenna to the Galileo satellite on E1, E5a, E5b and Alt-BOC.   |
| <b>Code B1, Code B2</b>                 | The pseudorange from the antenna to the BeiDou satellite on B1, B2 and B3.   |
| <b>Msg 19 L1, Msg 19 L2</b>             | The uncorrected pseudoranges for L1 and L2.  |
| <b>Msg 21 L1, Msg 21 L2</b>             | The pseudorange corrections for L1 and L2.   |

### 5.7.3

#### Initialize RTK

##### Requirements

The active working style is a real-time rover setting.

##### Initialize RTK

If the instrument currently has a fixed solution, the initialisation starts automatically.

The current ambiguity solution is discarded and a new initialisation is gained when the ambiguities are solved.

### 5.8

#### Icon Pop-Up Bubble: Connections

#### 5.8.1

##### Bubble Icons

##### Bubble icons

| Icon                   | Description   |
|------------------------|---|
| <b>Internet status</b> | To see details about the Internet connectivity and the device used for the Internet connection. |
| <b>Bluetooth</b>       | To define Bluetooth connections.  |

| Icon                       | Description   |
|----------------------------|---|
| <b>Leica Exchange</b>      | To start <b>Leica Exchange</b> . <b>Leica Exchange</b> is an online service that allows the data exchange between two users of the service. Refer to <a href="#">31.1 Leica Exchange</a> .  |
| <b>BIM 360 Docs</b>        | To connect to an Autodesk BIM 360 Docs project. <b>BIM 360 Docs</b> is an online service from Autodesk that allows authenticate with your Autodesk ID, project selection, uploading and downloading of files. Refer to <a href="#">31.2 BIM 360 Docs</a> . Available for CS30/CS35. |
| <b>Leica ConX</b>          | To connect to the Leica ConX cloud service. The Leica ConX cloud service allows you to upload and download files and jobs to be used in Leica Captivate. Also allows to store the measured points directly on the server.   |
| <b>Start Active Assist</b> | To connect to the Active Assist service. Refer to <a href="#">5.8.2 Active Assist</a> .   |
| <b>End Active Assist</b>   | To disconnect from the Active Assist service.   |

## 5.8.2

### Active Assist

#### Description

Active Assist is an online support tool that allows Leica technical support to gain remote access to your instrument or field controller.



Valid CCP and Active Assist licences are required to use Active Assist.

#### Using Active Assist step-by-step

1. Establish a connection to the Internet.
2. Call your local technical support.
3. Select **Start Active Assist** to connect to the Active Assist service.
4. Quote the equipment number shown on the panel to your supporter.



Leica technical support has now remote access to your TS instrument or field controller.

5. Select **End Active Assist** to disconnect from the Active Assist service once the session has finished.

## 5.9



### Icon Pop-Up Bubble: Battery and Time

#### 5.9.1

#### Bubble Icons

#### Bubble icons

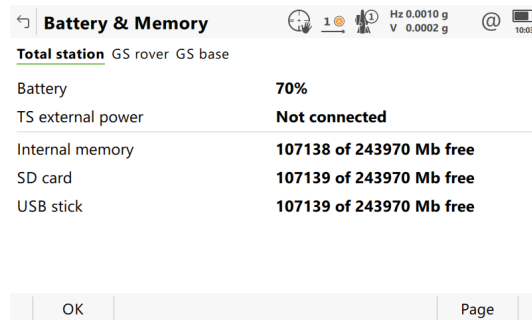
| Icon                    | Description  |
|-------------------------|--|
| <b>Change TS/GS</b>     | To switch between GS and TS mode.  |
| <b>Home</b>             | To return to the <b>Leica Captivate - Home</b> menu.   |
| <b>Help</b>             | To start the online help.  |
| <b>Battery / memory</b> | Information related to usage and status of battery and memory. Refer to <a href="#">5.9.2 Battery / memory</a> . |

| Icon  | Description   |
|---|---|
|  | To capture an image with the integrated camera. Available when the cameras are activated in <b>Leica Captivate - Home: Settings\TS instrument\Cameras</b> . Refer to <a href="#">5.9.3 Camera</a> . |
|  | To create a sketch on a virtual piece of paper. Refer to <a href="#">5.9.4 Sketch pad</a> .   |

## 5.9.2

## Battery / memory

### Battery & Memory



**Battery & Memory**

Total station GS rover GS base

Battery **70%**

TS external power **Not connected**

Internal memory **107138 of 243970 Mb free**




SD card **107139 of 243970 Mb free**

USB stick **107139 of 243970 Mb free**

OK Page

| Key         | Description                              |
|-------------|--|
| <b>Page</b> | To change to another page on this panel. |



### Description of fields

| Field  | Description  |
|--|--|
| <b>Battery, Battery 1 or Battery 2</b>                           | <p>The percentage of remaining power capacity for the internal battery is displayed numerically. If no information for a field is available, for example no battery is inserted, then ----- is displayed.</p> <p> On the TS60/MS60/TM60, if the battery gets charged, <b>(charging)</b> is stated behind the percentage of the battery power level.</p> <p> When an instrument is controlled remotely by another one, then the battery capacity of the controlled instrument is displayed on the controlling instrument. Example: When the battery is getting low on the TS, a warning message is displayed on the CS.</p> |
| <b>TS external power, GS external power or CS external power</b> | Shows if an external power supply is connected. If an external battery is connected, the percentage of remaining power capacity is displayed numerically. Applies also to wall plugs.  |
| <b>Internal memory, SD card or USB stick</b>                     | <p>The total/free memory for data storage on the data storage device. If no information for a field is available, for example no data storage device is inserted, then ----- is displayed.</p> <p> The CS30/CS35 has two USB ports. The USB stick, that was inserted first, is used.</p>  |

### 5.9.3

### Camera

#### Taking a picture step-by-step

1. Aim the camera to the desired target.
2. Check the view at the display.
3. Click **Capture** to take the picture.  
 **Capture** changes to **Store**.
4. Click **Store**.  
 The image is stored in the DBX\JOB\IMAGES folder of the data storage device.
5. Select an option from the message window to link or not link the image.

### 5.9.4

### Sketch pad

#### Description

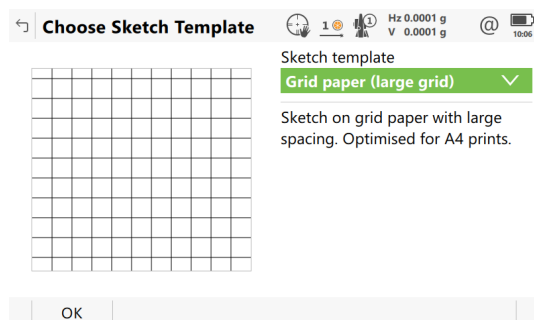
The field sketch functionality is used to create a sketch on virtual paper. Sketching is possible on predefined or on user-defined templates. User-defined templates can, for example, include a company logo or check boxes for tasks that must be done.

The sketch is stored as image in jpg format. The jpg file is stored in the DBX\JOB\IMAGES folder of the data storage device.

The predefined templates are optimised for A4 printout. User-defined templates can be optimised for any format.

A screenshot cannot be made from the field sketch.

#### Choose Sketch Template



| Key | Description  |
|-----|--|
| OK  | To create a copy of the selected sketch template and to start sketching. |

## Description of fields

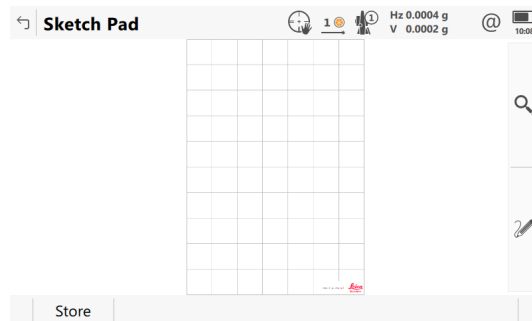
| Field           | Option   | Description  |
|-----------------|--|--|
| Sketch template | Plain paper,<br>Lined paper-narrow,<br>Lined paper-wide,<br>Grid paper (small grid)<br>or<br>Grid paper (large grid) | The predefined sketch templates.   |
|                 | User-defined templates   | The user-defined templates must be jpg files with a maximum of five megapixels. The templates are stored in the CONFIG\SKETCH_TEMPLATES folder of the data storage device. To make a user-defined template selectable in the list, transfer the template to the internal memory in <b>Leica Captivate - Home: Settings\Tools\Transfer user objects</b> . Refer to <a href="#">30.1 Transfer user objects</a> . |

## Next step

Select a template. **OK** to access **Sketch Pad**.

## Sketch Pad

Refer to [Tools](#) for information on the toolbar.



| Key   | Description                         |
|-------|-------------------------------------|
| Store | To store and link the field sketch. |

## 6 Job Menu - Jobs

### 6.1 Overview

|                     |   |
|---------------------|---|
| <b>Description</b>  | <p>Jobs</p> <ul style="list-style-type: none"><li>• structure surveying projects.</li><li>• contain all points, lines, images and scans that are measured/recorded and stored.</li><li>• can be downloaded to Infinity for post-processing or for data transfer to a further program.</li><li>• can be uploaded from Infinity, for example, for stake out operations.</li><li>• can be stored on the data storage device or the internal memory.</li></ul>  |
| <b>Type of jobs</b> | <ul style="list-style-type: none"><li>• Data jobs. Explained in this chapter.</li><li>• DTM files. Refer to <a href="#">54.6 Staking Out a DTM or Points &amp; DTM</a>.</li><li>• Road alignment files.</li></ul>   |
| <b>Default job</b>  | <p>A default job is available on the instrument after formatting the data storage device, inserting a previously formatted data storage device or deleting all jobs.</p>  |
| <b>Job</b>          | <p>Data is stored to a job. After formatting the data storage device, the default job is used until a user-defined job is created and selected.</p> <p>The properties of the job determine some system properties, such as the codelist, coordinate system and TS scale factor.</p> <p>When a job becomes the job, then the sort and filter settings of this job are saved in the System RAM. If the data storage device is formatted then these last used sort and filter settings are used for the default job.</p> |

### 6.2 Creating a New Job

|               |   |
|---------------|---|
| <b>Access</b> | <p>Select <b>Leica Captivate - Home: Tap here to create new job</b>.</p> <p>OR</p> <p>In <b>Leica Captivate - Home</b> press <b>Fn New job</b>.</p> |
|---------------|---|

#### New Job, General page

**New Job**

General Coordinate system Codelist Linked jobs Linked design data Refi <>

Name -----

Description -----

Creator -----

Job stored to Internal memory

Display in job carousel




After storing job, capture an image to display in the Home screen

Store Date time Page

| Key   | Description            |
|-------|------------------------|
| Store | To store the settings. |

| Key              | Description  |
|------------------|--|
| <b>Date time</b> | To fill the <b>Name</b> field with a name based on the current date and time. The format depends on the system setting defined in <b>Leica Captivate - Home/Settings/System/Regional</b> on the <b>Time</b> page.<br>Example:<br>01072021_161858, where 01072021 is the date and 161858 is the time. |
| <b>Page</b>      | To change to another page on this panel.   |

#### Description of fields

| Field  | Option          | Description   |
|--|-----------------|---|
| <b>Name</b>  | Editable field  | A unique name for the new job. The name can be up to 16 characters long and include spaces. Input required.   |
| <b>Description</b>   | Editable field  | Two lines for a detailed description of the job, for example, work to be performed or the classes contained in the job. Input optional.   |
| <b>Creator</b>   | Editable field  | The name of the person who is creating the job. Input optional.   |
| <b>Job stored to</b>   | Selectable list | The device on which the new job is stored. Depending on the instrument options, this field may be a display only field.<br><br> For CS30/CS35: Jobs must be created on the internal memory. The creation of jobs on the USB stick is not supported.<br><br> For jobs stored on the SD card, the  icon is shown on the job tile in the <b>Leica Captivate - Home</b> menu. |
| <b>Display in job carousel</b>   | Check box       | When this box is checked, the job is visible in the job carousel.<br><br>When this box is not checked, the job is invisible in the job carousel. Exclude jobs from the job carousel to reduce the scrolling effort.   |
| <b>After storing job, capture an image to display in the Home screen</b> | Check box       | When this box is checked: After pressing <b>Store</b> , the camera on the current instrument will start. A picture can then be captured. The picture is automatically added to the job image in <b>Leica Captivate - Home</b> .   |

#### Next step

**Page** changes to the **Coordinate system** page.



## New Job, Coordinate system page

### Description of fields

| Field                    | Option          | Description   |
|--------------------------|-----------------|---|
| <b>Coordinate system</b> | Selectable list | Choosing a coordinate system attaches it to the job. A coordinate system is necessary to transform GNSS coordinates to a local grid format. |

All other fields on this panel are display only fields. They depend on the transformation type of the selected coordinate system.

### Next step

Page changes to the **Codelist** page.

## New Job, Codelist page

### Description of fields

| Field           | Option          | Description   |
|-----------------|-----------------|---|
| <b>Codelist</b> | Selectable list | Choosing a codelist copies the codes to the job.<br>Codes are editable. Refer to <a href="#">6.5 Managing Job Codes</a> . |

### Next step

Page changes to the **Linked jobs** page.

## New Job, Linked jobs page

Multiple jobs can be linked to a working job. The advantage is, that the list of design points and lines available to be used in some applications can be read from these multiple linked jobs, instead of one single control job.

Linked jobs will overwrite the points and lines from the global design job selected in Design Data.



The source for a control job must be a job from Leica Captivate.

An external format, such as ASCII, XML or DXF must be converted into DBX format first.

| Key                | Description   |
|--------------------|---|
| <b>Store</b>       | To store the settings.  |
| <b>Add</b>         | To link a control job to the job. Accesses <b>Choose Linked Jobs</b> . Refer to <a href="#">Choose Linked Jobs</a> .  |
| <b>Remove</b>      | To delete the highlighted control job from the list of linked jobs. The corresponding points and lines will be removed from the data set.   |
| <b>Dataset</b>     | To list all points and lines contained in the available and visible linked jobs. The list is updated with the data from the selected jobs to link. Refer to <a href="#">Dataset</a> . |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Main job</b> | To make a linked job the main job where created points and lines are stored to.   |
| <b>Fn Log</b>      | To view, edit and delete points and lines stored with the job. Points and lines are sorted by time in one list.   |


| Key             | Description  |
|-----------------|--|
| <b>Fn State</b> | To change between the options in the metadata for <b>State</b> .<br>To show or hide the linked job data within the data set. |

### Description of metadata

| Metadata            | Description   |
|---------------------|---|
| -                   | The name of the job.  |
| <b>State</b>        | <p>The state of the job:</p> <ul style="list-style-type: none"> <li>• <b>Visible:</b> The data of the linked job are included in the data set.</li> <li>• <b>Hidden:</b> The data of the linked job are excluded from the data set.</li> <li>• <b>Not available:</b> The source job of the data is not available on any of the data storage devices.</li> </ul>   |
| <b>Main Job</b>     | <p>Created control data such as points and lines are stored in the main job.</p> <p>To make a job the main job, highlight the job and press <b>Fn Main job</b>.</p> <p>As long as there is at least one available linked job, there must be a main job where the created points and lines are stored if created.</p> <p>If no linked job is available, for example all are deleted, or all are on an SD card which is not inserted, then there is no main job.</p> <p>If the main job is deleted, then the role of main job jumps to another linked job.</p> <p>If the main job is set as <b>Hidden</b>, the role of main job stays in that job.</p>  |
| <b>Source</b>       | <p>The data storage device where the job is stored.</p> <p>If the working job and/or linked jobs are moved to another device, the link between both is remembered.</p> <p><b>Source: -----</b> indicates that the source job of the data is not available in the expected data storage device.</p> <p> If the data storage device containing one or more control jobs is taken out of the instrument, the jobs will NOT be available in the data set anymore.</p> <p> Every time an app is started, the availability of control jobs is checked. The check ensures the correspondency between the list of linked jobs and the data set.</p> |
| <b>Date created</b> | The date of when the job was created.   |

### Next step


**Page** changes to the **Linked design data** page.

-  The design data selected in this panel, are local design data. In the 3D viewer and when using the apps. the global design data will be overwritten by linked design data from the working job.

**New Job,  
Linked design data  
page**

| Key    | Description                              |
|--------|--|
| Store  | To store the settings.                   |
| Page   | To change to another page on this panel. |
| Fn Log | To view logged data.                     |

### Description of fields

| Field             | Option                          | Description   |
|-------------------|---------------------------------|---|
| Use a DTM         | Check box                       | When this box is checked, a DTM job can be selected. A DTM job holds DTM (Digital Terrain Model) or TIN (Triangular Irregular Network) data. The files are stored in the \DBX folder or a subfolder of \DBX.  |
| DTM               | Selectable list                 | <p>Holds DTM (<b>D</b>igital <b>T</b>errain <b>M</b>odel) data or TIN (<b>T</b>riangular <b>I</b>rrregular <b>N</b>etwork) data. The DTM job to be used must be stored in the \DBX directory on the active data storage device.</p> <p>The DTM job is a read-only source of information and cannot be selected as a job.</p> <p> The selected DTM job is visible in the 3D viewer.</p> |
| Layer             | Display only or selectable list | <p>A DTM job can consist of multiple DTM layers or surfaces. These DTM layers can cover different locations, be on top of each other or intersect each other.</p> <p>If there is only one layer in the DTM job, the layer name is displayed as an output. If there are multiple layers, the layer to display in 3D viewer can be selected.</p>  |
| Date created      | Display only                    | The date of when the job was created.   |
| Use a road design | Check box                       | When this box is checked, a road design can be selected. Contains all the information about the road design. For example, the geometry of the line, the formation layer of the road or the information related to the construction of cuttings and embankments.   |
| Road design       | Selectable list                 | <p>The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The data is either typed in manually in the Alignment editor app or converted from a road design package.</p> <p>The road job is a read-only source of information and cannot be selected as a job. The selected Road design is visible in 3D viewer.</p>   |
| Use a rail design | Check box                       | When this box is checked, a rail job can be selected.   |

| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Rail design</b>         | Selectable list | Contains all the information about the rail design including the geometry of the centreline and the rail definition (superelevation). The files are stored in the \DBX folder or a subfolder of \DBX.<br><br>The rail job is a read-only source of information and cannot be selected as a job. The selected Rail design is visible in 3D viewer. |
| <b>Use a tunnel design</b> | Check box       | When this box is checked, a tunnel job can be selected.   |
| <b>Tunnel design</b>       | Selectable list | Contains all the information about the tunnel design including the geometry of the centreline and the tunnel profile. The files are stored in the \DBX folder or a subfolder of \DBX.<br><br>The tunnel job is a read-only source of information. The selected Tunnel design is visible in 3D viewer.   |

### Next step

**Page** changes to the **Reference files** page.

## New Job, Reference files page

### CAD files

If a CAD file is checked, the file is attached to the job when **Store** is pressed.

The CAD file can be in the \DATA folder or subfolder of any data storage device. The new job and the CAD file do not have to be on the same data storage device. CAD heights are supported.

Folders are indicated by an icon. When a folder is highlighted, press Open to open the folder. The standard folders \Geocom, \Gps and \Map\_Images are not listed.

### DGN files

DGN is an abbreviation for "design."

DGN files are used to save designs for construction projects.

A DGN file is a 2D or 3D drawing created by various construction CAD software, such as Bentley Systems, MicroStation or Intergraph Interactive Graphics Design System.

### IFC files

The **I**ndustry **F**oundation **C**lasses data model is intended to describe building and construction industry data. It is a platform neutral, open file format specification that is not controlled by a single vendor or group of vendors. The focus is on ease of interoperability between software platforms. The IFC model specification is open and available and registered by ISO.

If an IFC file is checked, the file is attached to the job when **Store** is pressed. The IFC file is copied to the Map files folder within the job.

The IFC file can be in the \DATA folder or subfolder of any data storage device. The new job and the IFC file do not have to be on the same data storage device. IFC heights are supported.

Folders are indicated by an icon. When a folder is highlighted, press Open to open the folder. The standard folders \Geocom, \Gps and \Map\_Images are not listed.

### WFS files

Web Feature Service (WFS) allows Internet access to geo data from a Geo Information System. WFS provides only vector data as they can be saved to databases. As defined by the Open Geospatial Consortium, WFS allows access to geographical features in databases and provides the result in the independent file format Geography Markup Language (GML).

| Key           | Description  |
|---------------|--|
| <b>Store</b>  | To store the settings. Selected CAD/IFC files are available in the job as background maps.           |
| <b>Unit</b>   | To change the units used for the CAD file.   |
| <b>WFS</b>    | To display a list of available Web Feature Services. Refer to <a href="#">Web Feature Services</a> . |
| <b>Filter</b> | To choose the extension of files to be displayed as reference files.                                 |
| <b>Page</b>   | To change to another page on this panel.   |

### Description of metadata

| Metadata         | Description  |
|------------------|--|
| -                | The name of the CAD/IFC files available in the \DATA directory of any data storage device.   |
| <b>Format</b>    | The format of the CAD file: dxf, shp or Leica for CAD files that are already attached to other jobs and converted to Leica format. |
| <b>Size (MB)</b> | The size of the CAD/IFC file in megabytes.   |
| <b>Source</b>    | The data storage device where the CAD/IFC file is stored.  |
| <b>Unit</b>      | The units used for the CAD file.   |

### Next step

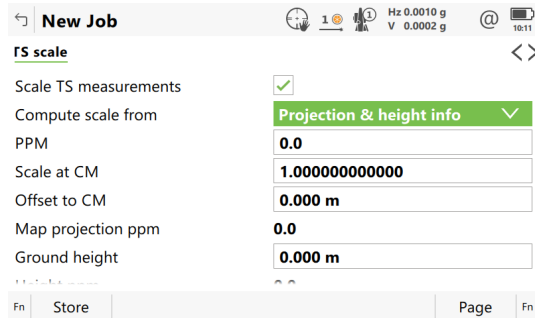
**Page** changes to the **TS scale** page.

The geometric distance correction (geometric ppm) is derived from the map projection distortion (map projection ppm), the height above reference datum correction (height ppm) and an individual correction (individual ppm).

The calculation of the map projection ppm follows the formula for the Transversal Mercator Projection. The individual factors are: the scale factor of the line of projection central meridian, Gauss-Krüger = 1.0, UTM = 0.9996, and so on, and the offset from the line of projection.

The calculation of the height ppm is derived from the height of the instrument setup above the reference datum. Normally this is the height above mean sea-level MSL.

**New Job,  
TS scale page**



| Key             | Description                              |
|-----------------|--|
| <b>Store</b>    | To store the settings.                   |
| <b>Page</b>     | To change to another page on this panel. |
| <b>Fn ppm=0</b> | To set <b>Geometric ppm: 0.0</b> .       |

#### Description of fields

| Field                        | Option                              | Description  |
|------------------------------|-------------------------------------|--|
| <b>Scale TS measurements</b> | Check box                           | When this box is unchecked, the scale factor is automatically set to <b>1</b> .<br>When this box is checked, the scale factor can be computed based on various options.  |
| <b>Compute scale from</b>    | <b>User entered scale factor</b>    | To enter only the scale factor.  |
|                              | <b>User entered ppm</b>             | To enter only the geometric ppm value.   |
|                              | <b>Current setup</b>                | To calculate the ppm/scale factor automatically from the coordinate system and setup position.   |
|                              | <b>Projection &amp; height info</b> | To enter all values for determining the geometric ppm.   |
| <b>Scale factor</b>          | Editable field                      | The user-entered scale factor.<br><b>Compute scale from: User entered scale factor.</b>  |
| <b>PPM</b>                   | Editable field                      | The individual ppm value.<br>Available for <b>Compute scale from: Projection &amp; height info</b> and <b>Compute scale from: User entered ppm</b> .   |
| <b>Map projection ppm</b>    | Display only                        | The map projection ppm value. If this value cannot be calculated, then ----- is displayed and is also ignored in the calculation of the geometric ppm value.<br>Available for <b>Compute scale from: Projection &amp; height info</b> and <b>Compute scale from: Current setup</b> . |

| Field                | Option         | Description   |
|----------------------|----------------|---|
| <b>Height ppm</b>    | Display only   | The height ppm value calculated from the height coordinates of the current setup stored in the internal memory. If this value cannot be calculated, then ----- is displayed and is also ignored in the calculation of the geometric ppm value. Available for <b>Compute scale from: Projection &amp; height info</b> and <b>Compute scale from: Current setup</b> . |
| <b>Geometric ppm</b> | Display only   | For <b>Projection &amp; height info</b> :<br><b>Geometric ppm = Map projection ppm + PPM + height ppm value calculated from Ground height.</b><br><br>For <b>Current setup</b> :<br><b>Geometric ppm = Map projection ppm + Height ppm.</b>   |
| <b>Scale at CM</b>   | Editable field | The scale at the central meridian. Available for <b>Compute scale from: Projection &amp; height info</b> .  |
| <b>Offset to CM</b>  | Editable field | The offset to the central meridian. Available for <b>Compute scale from: Projection &amp; height info</b> .   |
| <b>Ground height</b> | Editable field | The height of the instrument setup above the reference datum. Available for <b>Compute scale from: Projection &amp; height info</b> .   |

#### Additional calculation method for the geometric ppm value

The geometric ppm value can also be calculated by a resection calculation. The scale factor from the resection is used for **PPM**.

Individual ppm = (s-1)\*10<sup>6</sup>. s = 1 + ppm\*10<sup>-6</sup>. The **Geometric ppm** value is calculated with the following:

- **Scale at CM: 1,**
- **Offset to CM: 0,**
- **Map projection ppm: 0** and
- **Ground height: 0.**

## Automatic calculation of the geometric ppm value

When **Compute scale from: Current setup**:

- the ppm values for **Map projection ppm**, **Height ppm** and **Geometric ppm** are automatically calculated. The coordinates of the current instrument setup stored in the internal memory are used, which are based on the currently active coordinate system.
- each time an app is accessed, the geometric ppm value is automatically calculated. The coordinates of the current instrument setup stored in the internal memory are used (these coordinates may have been updated), which are based on the currently active coordinate system (this coordinate system may have changed). This way, the user is always working with the correct geometric ppm value.
- when the **None** coordinate system is chosen, then the geometric ppm value cannot be automatically calculated. A message appears, allowing the user to either manually enter the ppm values or accept ppm values of 0.

## Choose Linked Jobs





All jobs on the available data storage devices are listed.

Select the jobs you want to link.

Check a box if you want to link the control job to the job.

| Key | Description                                    |
|-----|--|
| OK  | To return to <b>New Job, Linked jobs</b> page. |

## Check box behaviour

|   | Description  |
|---|--|
|  | Checks or unchecks the check box of the highlighted job. The behaviour depends on the current status of the check box. |
|  | Checks or unchecks the check box of the highlighted job. The behaviour depends on the current status of the check box. |
|  | Move the focus on the screen upwards.  |
|  | Move the focus on the screen downwards.  |
| Tapping the check box   | Checks or unchecks the check box depending on the current status of the check box. Highlights the line.                |
| Space bar   | Starts the job search.   |

## Description of metadata

| Metadata | Description                                      |
|----------|--|
| -        | The name of the job.                             |
| Source   | The data storage device where the job is stored. |



| Metadata            | Description                           |
|---------------------|---------------------------------------|
| <b>Date created</b> | The date of when the job was created. |

## Dataset

The panel is similar to the panel that opens when **View & edit data** was selected from the job menu. Refer to [7.2 Accessing Data Management](#) for a description of the panel.

The differences are:

- All changes done in the data set are applied to the original jobs.
- For the key **New**: To create a point/line. New points/lines are stored in the main job and then displayed in the data set.
- For the metadata, **Source** is displayed. The linked job to which the point belongs.
- On the **3D viewer** page, the points and lines from the linked jobs are displayed. Selected filters for the data set points are applied.

The **Dataset** panel can also be accessed by a hot key or a favourites key.

## 6.3

### Choosing a Job

#### Access

Select **Leica Captivate - Home:Tap here to choose design data.**

#### Design Data

The pages that are always shown are: **Points & lines** and **DTM**.


The pages, **Road**, **Rail** and **Tunnel** are only shown if the appropriate app is loaded.



The design data selected in this panel, are global design data. In the 3D viewer and when using the apps, the global design data will be overwritten by linked design data from the working job.

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To accept the selected job.   |
| <b>Page</b>        | To change to another page on this panel.                            |
| <b>Fn Settings</b> | To activate or deactivate job selection at the beginning of an app. |

## Description of fields

| Field                              | Option                          | Description  |
|------------------------------------|---------------------------------|--|
| <b>Use points &amp; lines data</b> | Check box                       | When this box is checked, a separate design job can be selected. Target points can be selected from the design job. Individual lines and/or points of a separate design job can be staked out.<br>The selected design job is visible in 3D viewer.   |
| <b>Name</b>                        | Selectable list                 | Control points or lines are stored in the design job. The design job holds all control point information needed in the field, for example, control points, points with known coordinates used for a TS setup. Lines of the design job can be used for <b>Stake to line</b> or <b>Measure to line</b> .<br>A CAD file attached to a design job can be used to view and import the CAD lines for working with.   |
| <b>Description</b>                 | Display only                    | The detailed description of the job.   |
| <b>Date created</b>                | Display only                    | The date of when the job was created.  |
| <b>Last used</b>                   | Display only                    | The date of when the job was last accessed.  |
| <b>Use a DTM</b>                   | Check box                       | When this box is checked, a DTM job can be selected. A DTM job holds DTM (Digital Terrain Model) or TIN (Triangular Irregular Network) data. The files are stored in the \DBX folder or a subfolder of \DBX.   |
| <b>DTM</b>                         | Selectable list                 | Holds DTM ( <b>D</b> igital <b>T</b> errain <b>M</b> odel) data or TIN ( <b>T</b> riangular <b>I</b> rrregular <b>N</b> etwork) data. The DTM job to be used must be stored in the \DBX directory on the active data storage device.<br>The DTM job is a read-only source of information and cannot be selected as a job.<br> The selected DTM job is visible in the 3D viewer. |
| <b>Layer</b>                       | Display only or selectable list | A DTM job can consist of multiple DTM layers or surfaces. These DTM layers can cover different locations, be on top of each other or intersect each other.<br>If there is only one layer in the DTM job, the layer name is displayed as an output. If there are multiple layers, the layer to display in 3D viewer can be selected.  |

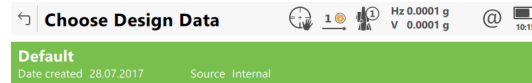
| Field                      | Option          | Description  |
|----------------------------|-----------------|--|
| <b>Use a road design</b>   | Check box       | When this box is checked, a road design can be selected. Contains all the information about the road design. For example, the geometry of the line, the formation layer of the road or the information related to the construction of cuttings and embankments.  |
| <b>Road design</b>         | Selectable list | <p>The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The data is either typed in manually in the Alignment editor app or converted from a road design package.</p> <p>The road job is a read-only source of information and cannot be selected as a job. The selected Road design is visible in 3D viewer.</p>                      |
| <b>Use a rail design</b>   | Check box       | When this box is checked, a rail job can be selected.  |
| <b>Rail design</b>         | Selectable list | <p>Contains all the information about the rail design including the geometry of the centreline and the rail definition (superelevation). The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The rail job is a read-only source of information and cannot be selected as a job. The selected Rail design is visible in 3D viewer.</p> |
| <b>Use a tunnel design</b> | Check box       | When this box is checked, a tunnel job can be selected.  |
| <b>Tunnel design</b>       | Selectable list | <p>Contains all the information about the tunnel design including the geometry of the centreline and the tunnel profile. The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The tunnel job is a read-only source of information. The selected Tunnel design is visible in 3D viewer.</p>   |

### Next step


Open the selectable list for jobs to view job metadata, data, create, edit or delete jobs.

**Choose Design Data,  
DTM,  
Road Design,  
Rail Design,  
Tunnel Design**

Listed are all jobs stored on the data storage device or in the internal memory depending on the device.



Fn OK New Edit Delete Data Fn

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To select the highlighted job and to return to the panel from where this panel was accessed.   |
| <b>New</b>    | Available for design jobs. To create a job. Refer to <a href="#">6.2 Creating a New Job</a> .  |
| <b>Edit</b>   | Available for design, Road, Rail and Tunnel jobs. To edit the highlighted job. Refer to <a href="#">6.4 Editing a Job</a> .  |
| <b>Delete</b> | To delete the highlighted job, including all map files from attached CAD files.  |
| <b>Data</b>   | Available for design, Road, Rail and Tunnel jobs. To view, edit and delete points, lines, images and scans stored with the job. Points, lines, images and scans are shown on separate pages. Selected sort and filter settings apply.<br><br> For Road, Rail or Tunnel jobs, review of the alignment design data, and edit the start chainage or centreline. A review of all design elements as well as a 3D viewer is available. |

**6.4**

**Editing a Job**

**Description**

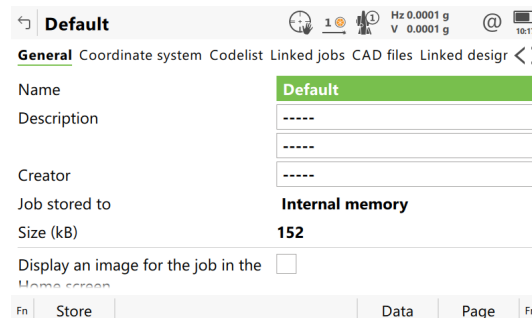
In the **Job Properties**, the settings for a job can be viewed and changed.

**Access**

From the job menu, select **View & edit job properties**.

**Job properties, General page**

The fields on this page are identical with the fields in **New Job, General**. Refer to [6.2 Creating a New Job](#).



## Job properties, Codelist page

| Key           | Description   |
|---------------|---|
| <b>Store</b>  | To store the settings.  |
| <b>Data</b>   | To view, edit and delete points and lines stored with the job. Points and lines are shown on separate pages. Selected sort and filter settings apply. |
| <b>Page</b>   | To change to another page on this panel.  |
| <b>Fn Log</b> | To view, edit and delete points and lines stored with the job. Points and lines are sorted by time in one list.                                       |

### Next step

**Page** changes to the **Codelist** page.

Refer to [New Job,Codelist page](#) for information on the **Coordinate system** page.



| Fn | Store | Data | Page | Fn |
|----|-------|------|------|----|
|----|-------|------|------|----|

| Key              | Description   |
|------------------|---|
| <b>Store</b>     | To store the settings.  |
| <b>Import</b>    | To add extra codes from a new codelist to the job. The name of this codelist is copied to the job.  |
| <b>Codes</b>     | To view codes currently stored in the job. Refer to <a href="#">6.5 Managing Job Codes</a> .  |
| <b>Data</b>      | To view, edit and delete points and lines stored with the job. Points and lines are shown on separate pages. Selected sort and filter settings apply. |
| <b>Page</b>      | To change to another page on this panel.  |
| <b>Fn Export</b> | To copy codes from the job to an existing or new codelist.  |
| <b>Fn Log</b>    | To view, edit and delete points and lines stored with the job. Points and lines are sorted by time in one list.                                       |

### Description of fields

| Field           | Option              | Description  |
|-----------------|---------------------|--|
| <b>Codelist</b> | <b>&lt;None&gt;</b> | No codes are stored in the job. This default setting can be changed. Choose a codelist to copy the codes to the job.   |
|                 | Display only        | Codes are stored in the job. If codes had been copied from a codelist in the internal memory, the name of the codelist is displayed. If codes have been typed in, then the name of the job is displayed. |

## Job properties, Linked jobs page

### Next step

Page changes to the **Linked jobs** page.

Multiple jobs can be linked to a working job. The advantage is, that the list of design points and lines available to be used in some applications can be read from these multiple linked jobs, instead of one single control job.

The source for a control job can be:



The source for a control job must be a job from Leica Captivate.

A external format, such as ASCII, XML or DXF must be converted into DBX format first.

| Key                | Description   |
|--------------------|---|
| <b>Store</b>       | To store the settings.  |
| <b>Add</b>         | To link a control job to the job. Accesses <b>Choose Linked Jobs</b> . Refer to <a href="#">Choose Linked Jobs</a> .  |
| <b>Remove</b>      | To delete the highlighted control job from the list of linked jobs. The corresponding points and lines will be removed from the data set.   |
| <b>Dataset</b>     | To list all points and lines contained in the available and visible linked jobs. The list is updated with the data from the selected jobs to link. Refer to <a href="#">Dataset</a> . |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Main job</b> | To make a linked job the main job where created points and lines are stored to.   |
| <b>Fn Log</b>      | To view, edit and delete points and lines stored with the job. Points and lines are sorted by time in one list.   |
| <b>Fn State</b>    | To change between the options in the metadata for <b>State</b> . To show or hide the linked job data within the data set.   |


### Description of metadata

| Metadata     | Description   |
|--------------|---|
| -            | The name of the job.  |
| <b>State</b> | The state of the job: <ul style="list-style-type: none"><li>• <b>Visible:</b> The data of the linked job are included in the data set.</li><li>• <b>Hidden:</b> The data of the linked job are excluded from the data set.</li><li>• <b>Not available:</b>The source job of the data is not available on any of the data storage devices.</li></ul> |

| Metadata            | Description  |
|---------------------|--|
| <b>Main Job</b>     | <p>Created control data such as points and lines are stored in the main job.</p> <p>To make a job the main job, highlight the job and press <b>Fn Main job</b>.</p> <p>As long as there is at least one available linked job, there must be a main job where the created points and lines are stored if created.</p> <p>If no linked job is available, for example all are deleted, or all are on an SD card which is not inserted, then there is no main job.</p> <p>If the main job is deleted, then the role of main job jumps to another linked job.</p> <p>if the main job is set as <b>Hidden</b>, the role of main job stays in that job.</p>   |
| <b>Source</b>       | <p>The data storage device where the job is stored.</p> <p>If the working job and/or linked jobs are moved to another device, the link between both is remembered.</p> <p><b>Source: -----</b> indicates that the source job of the data is not available in the expected data storage device.</p> <p> If the data storage device containing one or more control jobs is taken out off the instrument, the jobs will NOT be available in the data set anymore.</p> <p> Every time an app is started, the availability of control jobs is checked. The check ensures the correspondency between the list of linked jobs and the data set.</p> |
| <b>Date created</b> | The date of when the job was created.  |

### Next step

**Page** changes to the **Linked design data** page.


 The design data selected in this panel, are local design data. In the 3D viewer and when using the apps. the global design data will be overwritten by linked design data from the working job.

| Key           | Description                              |
|---------------|--|
| <b>Store</b>  | To store the settings.                   |
| <b>Page</b>   | To change to another page on this panel. |
| <b>Fn Log</b> | To view logged data.                     |

### Description of fields

| Field            | Option    | Description  |
|------------------|-----------|--|
| <b>Use a DTM</b> | Check box | When this box is checked, a DTM job can be selected. A DTM job holds DTM (Digital Terrain Model) or TIN (Triangular Irregular Network) data. The files are stored in the \DBX folder or a subfolder of \DBX. |

Job properties,  
Linked design data  
page

| Field                      | Option                          | Description   |
|----------------------------|---------------------------------|---|
| <b>DTM</b>                 | Selectable list                 | <p>Holds DTM (<b>D</b>igital <b>T</b>errain <b>M</b>odel) data or TIN (<b>T</b>riangular <b>I</b>rrregular <b>N</b>etwork) data. The DTM job to be used must be stored in the \DBX directory on the active data storage device.</p> <p>The DTM job is a read-only source of information and cannot be selected as a job.</p> <p> The selected DTM job is visible in the 3D viewer.</p> |
| <b>Layer</b>               | Display only or selectable list | <p>A DTM job can consist of multiple DTM layers or surfaces. These DTM layers can cover different locations, be on top of each other or intersect each other.</p> <p>If there is only one layer in the DTM job, the layer name is displayed as an output. If there are multiple layers, the layer to display in 3D viewer can be selected.</p>  |
| <b>Date created</b>        | Display only                    | The date of when the job was created.   |
| <b>Use a road design</b>   | Check box                       | When this box is checked, a road design can be selected. Contains all the information about the road design. For example, the geometry of the line, the formation layer of the road or the information related to the construction of cuttings and embankments.   |
| <b>Road design</b>         | Selectable list                 | <p>The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The data is either typed in manually in the Alignment editor app or converted from a road design package.</p> <p>The road job is a read-only source of information and cannot be selected as a job. The selected Road design is visible in 3D viewer.</p>   |
| <b>Use a rail design</b>   | Check box                       | When this box is checked, a rail job can be selected.   |
| <b>Rail design</b>         | Selectable list                 | <p>Contains all the information about the rail design including the geometry of the centreline and the rail definition (superelevation). The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The rail job is a read-only source of information and cannot be selected as a job. The selected Rail design is visible in 3D viewer.</p>  |
| <b>Use a tunnel design</b> | Check box                       | When this box is checked, a tunnel job can be selected.   |




| Field                | Option          | Description   |
|----------------------|-----------------|---|
| <b>Tunnel design</b> | Selectable list | <p>Contains all the information about the tunnel design including the geometry of the centreline and the tunnel profile. The files are stored in the \DBX folder or a subfolder of \DBX.</p> <p>The tunnel job is a read-only source of information.</p> <p>The selected Tunnel design is visible in 3D viewer.</p> |

### Next step

**Page** changes to the **Reference files** page.

### Job properties, Reference files page

| Key                 | Description   |
|---------------------|---|
| <b>Store</b>        | To store the settings. Selected CAD/IFC files are available in the job as background maps.  |
| <b>Add</b>          | <p>To select a CAD/IFC file to be added to the job. Refer to <a href="#">Reference Files</a> for a description of the panel.</p> <p>Only the files that are currently not attached to the job are displayed in the <b>Reference Files</b> panel. The files listed are all dgn, dwg, dxf, shp files and mpl files from the \Data directory on a data storage device or in the internal memory. If a dwg file (vector drawing database from AutoCAD) is selected, then this file is converted into dxf file and copied to the appropriate job folder. If an mpl file is selected, then this file, including all related files, is copied to the appropriate job folder.</p> |
| <b>Remove</b>       | <p>To delete the highlighted Map file from the job.</p> <p> If deleted accidentally, the file must be attached again.</p>  |
| <b>Classes</b>      | To defining the loaded classes.   |
| <b>State</b>        | To show or hide the CAD/IFC data.   |
| <b>Page</b>         | To change to another page on this panel.  |
| <b>Fn Settings</b>  | <p>To configure the CAD file import parameters. Refer to <a href="#">Reference Files Import, General page</a>.</p> <p>To define IFC import settings. The settings are applied when importing the IFC data from within the 3D viewer. Refer to <a href="#">Reference Files Import</a>.</p>   |
| <b>Fn Layers</b>    | To change to the CAD layers panel. On this panel, it is possible to make layers from the CAD file visible or hidden for 3D viewer.  |
| <b>Fn Tree view</b> | To display a tree view created out of the IFC file.   |
| <b>Fn Log</b>       | To view, edit and delete points and lines stored with the job. Points and lines are sorted by time in one list.   |

## Description of metadata

| Metadata     | Description   |
|--------------|---|
| -            | The name of the CAD/IFC files that can be used.<br>The CAD files displayed are the converted Leica Map files (*.mpl) within the job. The original file extension is added to the file name with an underscore, for example example_dxf. |
| <b>State</b> | If set to <b>Visible</b> , the CAD/IFC file is visible as background map in 3D viewer.  |

## Next step

Press **Page** to change to the **TS scale** page.

OR

Press **Fn Layers** to access **CAD Layer Management**.

OR

Press **Fn Settings** to access **Reference Files Import**.

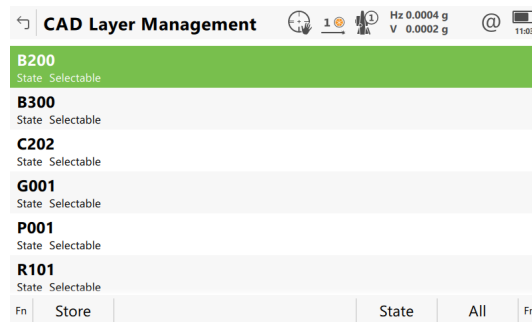
OR

Press **Classes** to access **IFC Classes**.

OR

Press **FnTree view** to access **IFC Tree View**.

## CAD Layer Management



| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store the settings.   |
| <b>State</b> | To change between the options in the metadata for <b>State</b> .           |
| <b>All</b>   | To make all layers have the same state as the currently highlighted layer. |

## Description of metadata

| Metadata | Description  |
|----------|--|
| -        | The name of the layer.<br>For dxf files, all layers are listed, no matter if the layer is filled or empty. |

| Metadata     | Description  |
|--------------|--|
| <b>State</b> | The state of the layer: <ul style="list-style-type: none"> <li>• <b>Hidden</b><br/>These layers are not shown on the <b>3D viewer</b> page and their positions are not used when zooming to extents. Nothing in these layers can be selected.</li> <li>• <b>Visible</b><br/>These layers are shown on the <b>3D viewer</b> page and their positions are used when zooming to extents. Nothing in these layers can be selected. Empty dxf layers can be set to visible.</li> <li>• <b>Selectable</b><br/>These layers are shown on the <b>3D viewer</b> page and their positions are used when zooming to extents. Objects on these layers are available to be selected.</li> </ul> |

Reference Files  
Import, General page

| Key         | Description                              |
|-------------|--|
| <b>Page</b> | To change to another page on this panel. |

Description of fields

| Field   | Option                    | Description  |
|---|---------------------------|--|
| <b>Prefix / Suffix to use for points</b> or <b>Prefix / Suffix to use for lines</b> | Editable field            | The identifier with up to four characters is added in front of the ID of the imported CAD points, lines or areas.  |
| <b>Objects to create when importing entities</b>                                    | <b>Vertices and lines</b> | <ul style="list-style-type: none"> <li>• Imports the CAD lines into the job.</li> <li>• Creates points at the starting and the ending coordinates of the imported line/arc/polyline elements.</li> </ul> |
|   | <b>Only at vertices</b>   | Creates points at the starting and the ending coordinates of the line/arc/polyline elements. The elements are not imported.  |
|   | <b>Only lines</b>         | Imports only the CAD lines into the job. No points are created.  |

Reference Files  
Import, CAD page

| Key         | Description                              |
|-------------|--|
| <b>Page</b> | To change to another page on this panel. |

Description of fields

| Field                            | Option         | Description  |
|----------------------------------|----------------|--|
| <b>Ignore data at height</b>     | Editable field | Height values inside the DXF file are considered invalid and are not converted.                        |
| <b>Apply a height to 2D data</b> | Check box      | When this box is checked, a height can be defined which is then applied to all imported 2D CAD points. |
| <b>Height to apply</b>           | Editable field | Available when <b>Apply a height to 2D data</b> is checked. The height to apply to 2D CAD points.      |

| Field                                     | Option    | Description  |
|---|-----------|--|
| <b>Import block insertion points</b>      | Check box | When a DXF file is imported, a high number of insertion points in the DXF file can cause performance issues during the data import. When this box is checked, block insertion points are included in the import. This might reduce the performance.  |
| <b>Ignore the extents in the dxf file</b> | Check box | When this box is checked then the values for the extents defined in the dxf file will be ignored. This may be necessary if these values are very large meaning that the data will not be displayed in the 3D viewer after importing or attaching the file.<br>When this box is not checked then the values in the dxf file for the extents are used. |

## IFC Classes

All classes within the IFC file containing at least one object are listed. Each class shows a check box. When checked, the class and all objects within this class will be attached to the job. When not checked, all objects contained in that class are not loaded.


| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To continue with the attaching process accepting the current selection of classes. |
| <b>All</b>    | To select or deselect all classes at once.   |
| <b>Cancel</b> | To return to the previous panel without making any changes.                        |

### Description of metadata

| Metadata       | Description                                   |
|----------------|---|
| -              | The name of the class.                        |
| <b>Objects</b> | The number of objects contained in the class. |




## IFC Tree View

When the check box for an item is checked, then it is displayed in 3D viewer.

| Key               | Description  |
|-------------------|--|
| <b>OK</b>         | To accept the selection and return to the previous panel.  |
| <b>Fn Isolate</b> | To set all the items but the one with the focus as unchecked. The parent of the isolated object should be set as  . When the isolated item is a parent, all the children will stay the same and the rest of items will be set as unchecked/filled. |
| <b>Fn Classes</b> | To open the IFC Classes panel where the active classes can be changed. The tree view is updated according to the new class selection.  |

| Key                | Description  |
|--------------------|--|
| <b>Fn Settings</b> | To define IFC import settings. The settings are applied when importing the IFC data from within the 3D viewer. Refer to <a href="#">Reference Files Import</a> . |

#### Check box status

| Icon  | Description                              |
|---|--|
|  | Class or object selected                 |
|  | Class or object not selected             |
|  | A class in a lower level is not selected |

#### Reference Files Import

#### Description of fields

| Field   | Option                    | Description  |
|---|---------------------------|--|
| <b>Prefix / Suffix to use for points</b> or <b>Prefix / Suffix to use for lines</b> | Editable field            | The identifier with up to four characters is added in front of the ID of the imported IFC points or lines.   |
| <b>Name points using</b> or <b>Name lines using</b>                                 | Editable field            | The identifier with up to four characters is added in front of or at the end of the IFC points or lines  |
| <b>Objects to create when importing entities</b>                                    | <b>Vertices and lines</b> | <ul style="list-style-type: none"> <li>Imports the IFC lines into the job.</li> <li>Creates points at the starting and the ending coordinates of the imported line/arc/polyline elements.</li> </ul> |
|   | <b>Only at vertices</b>   | Creates points at the starting and the ending coordinates of the line/arc/polyline elements. The elements are not imported.  |
|   | <b>Only lines</b>         | Imports only the IFC lines into the job. No points are created.  |

#### Choose Linked Jobs





All jobs on the available data storage devices are listed.

Select the jobs you want to link.

Check a box if you want to link the control job to the job.

| Key | Description                                    |
|-----|--|
| OK  | To return to <b>New Job, Linked jobs</b> page. |

### Check box behaviour

|   | Description  |
|---|--|
|  | Checks or unchecks the check box of the highlighted job. The behaviour depends on the current status of the check box. |
|  | Checks or unchecks the check box of the highlighted job. The behaviour depends on the current status of the check box. |
|  | Move the focus on the screen upwards.  |
|  | Move the focus on the screen downwards.  |
| Tapping the check box   | Checks or unchecks the check box depending on the current status of the check box. Highlights the line.                |
| Space bar   | Starts the job search.   |

### Description of metadata

| Metadata            | Description                                      |
|---------------------|--|
| -                   | The name of the job.                             |
| <b>Source</b>       | The data storage device where the job is stored. |
| <b>Date created</b> | The date of when the job was created.            |

## Reference Files

### CAD files

If a CAD file is checked, the file is attached to the job when **Store** is pressed.

The CAD file can be in the \DATA folder or subfolder of any data storage device. The new job and the CAD file do not have to be on the same data storage device. CAD heights are supported.

Folders are indicated by an icon. When a folder is highlighted, press Open to open the folder. The standard folders \Geocom, \Gps and \Map\_Images are not listed.

### IFC files

The Industry Foundation Classes (IFC) data model is intended to describe building and construction industry data. It is a platform neutral, open file format specification that is not controlled by a single vendor or group of vendors. The focus is on ease of interoperability between software platforms. The IFC model specification is open and available and registered by ISO.

If an IFC file is checked, the file is attached to the job when **Store** is pressed. The IFC file is copied to the Map files folder within the job.

The IFC file can be in the \DATA folder or subfolder of any data storage device. The new job and the IFC file do not have to be on the same data storage device. IFC heights are supported.

Folders are indicated by an icon. When a folder is highlighted, press Open to open the folder. The standard folders \Geocom, \Gps and \Map\_Images are not listed.

### WFS files

Web Feature Service (WFS) allows Internet access to geo data from a Geo Information System. WFS provides only vector data as they can be saved to databases. As defined by the Open Geospatial Consortium, WFS allows access to geographical features in databases and provides the result in the independent file format Geography Markup Language (GML).

| Key           | Description  |
|---------------|--|
| <b>Store</b>  | To store the settings. Selected CAD/IFC/WFS files are available in the job as background maps.       |
| <b>Unit</b>   | To change the units used for the CAD file.   |
| <b>WFS</b>    | To display a list of available Web Feature Services. Refer to <a href="#">Web Feature Services</a> . |
| <b>Filter</b> | To choose the extension of files to be displayed as reference files.                                 |
| <b>Page</b>   | To change to another page on this panel.   |

### Description of metadata

| Metadata         | Description  |
|------------------|--|
| -                | The name of the CAD/IFC files available in the \DATA directory of any data storage device.   |
| <b>Format</b>    | The format of the CAD file: dxf, shp or Leica for CAD files that are already attached to other jobs and converted to Leica format. |
| <b>Size (MB)</b> | The size of the CAD/IFC file in megabytes.   |
| <b>Source</b>    | The data storage device where the CAD/IFC file is stored.  |
| <b>Unit</b>      | The units used for the CAD file.   |

### Next step

**Page** changes to the **TS scale** page.

### Web Feature Services

Listed are all available Web Feature Services.

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To return to the previous panel.   |
| <b>Add</b>    | To start the wizard for adding a new WFS. The name of the service, the URL (= website) and user name plus password, if needed must be entered.<br>Follow the instructions on the screen. |
| <b>Edit</b>   | To edit the data of the highlighted WFS.   |
| <b>Remove</b> | To delete the highlighted WFS from the list.   |

| Key             | Description   |
|-----------------|---|
| <b>Features</b> | To view a list of all feature layers within the highlighted WFS.<br>To select or deselect feature layers to be downloaded from the WFS. |

#### Description of metadata

| Metadata        | Description                                      |
|-----------------|--|
| -               | The name of the Web Feature Service.             |
| <b>Features</b> | The number of features available within the WFS. |

#### Next step

**Features** to access the **Feature Layers** panel.

### Feature Layers

Listed are all layers with features within the Web Feature Services. Check the box in front of a feature layer to select it for download. Uncheck the box in front of a feature layer to exclude it from download.

| Key                                   | Description  |
|---------------------------------------|--|
| <b>Next</b>                           | To confirm the settings and to continue to the next panel. |
| <b>Fn All</b><br>or<br><b>Fn None</b> | To deactivate or activate all layers.                      |


#### Next step

**Next** to access the **Coordinate Systems** panel.

### Coordinate Systems

Shown is the active coordinate system from the job and the coordinate system from the WFS.

Information is provided if an automatic conversion from the WFS coordinate system to the coordinate system of the job can be done.

 If WGS84 is selected for the WFS and the job has an active coordinate system, then an automatic conversion to the active coordinate system is done automatically. Otherwise, the WFS is downloaded with the selected WFS coordinate system.

| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |

#### Next step

**Next** to access the **Download Settings** panel.

### Download Settings

| Key         | Description                      |
|-------------|----------------------------------|
| <b>Back</b> | To return to the previous panel. |



| Key             | Description   |
|-----------------|---|
| <b>Define</b>   | Available for <b>Select features to download: Within a defined extension</b> .<br>To access the Define Extension panel where the limits of the download can be defined. |
| <b>Info</b>     | To display the name of the service, the description and the possible fees.  |
| <b>Download</b> | To generate the dxf files.<br>The files will be selected to be attached to the current working job.   |

#### Description of fields

| Field  | Option                               | Description  |
|--|--------------------------------------|--|
| <b>To device</b>                             | Selectable list                      | Data storage device to transfer the files to.  |
| <b>Currently selected number of features</b> | Display only                         | The number of features which will be downloaded with the current area or bounding box. |
| <b>Store features with color</b>             | Selectable list                      | A colour in which the features are displayed.  |
| <b>Select features to download</b>           | <b>All features within the layer</b> | To download all features within the layer.   |
|  | <b>Within a defined extension</b>    | To define a specific area of which the features will be downloaded.                    |
| <b>Top left easting</b>                      | Display only                         | Coordinates of the top left corner of the defined area.                                |
| <b>Top left northing</b>                     | Display only                         | Coordinates of the top right corner of the defined area.                               |
| <b>Bottom right easting</b>                  | Display only                         | Coordinates of the bottom left corner of the defined area.                             |
| <b>Bottom right northing</b>                 | Display only                         | Coordinates of the bottom right corner of the defined area.                            |

#### Dataset

The panel is similar to the panel that opens when **View & edit data** was selected from the job menu. Refer to [7.2 Accessing Data Management](#) for a description of the panel.

The differences are:

- All changes done in the data set are applied to the original jobs.
- For the key **New**: To create a point/line. New points/lines are stored in the main job and then displayed in the data set.
- For the metadata, **Source** is displayed. The linked job to which the point belongs.
- On the **3D viewer** page, the points and lines from the linked jobs are displayed. Selected filters for the data set points are applied.

The **Dataset** panel can also be accessed by a hot key or a favourites key.

## 6.5

### Managing Job Codes

#### Description

To view, edit, group and sort all codes currently stored in the job.

#### Access step-by-step

1. Select **View & edit job properties** from the job menu in **Leica Captivate - Home**.
2. **Page** until the **Codelist** page is active.
3. When creating a job: Open the selectable list for **Codelist**.
4. When editing a job: **Edit**
5. **Codes** to access **Job Codes**.

#### Job Codes

| Code desc                       | Code group | Line work | Quickcode |
|---------------------------------|------------|-----------|-----------|
| <b>H&amp;TK</b><br>Hub & Tack   | CONTROL    | No        | ----      |
| <b>NAIL</b><br>PK Nail          | CONTROL    | No        | ----      |
| <b>CLNE</b><br>Center Line      | ROAD       | No        | ----      |
| <b>EPAV</b><br>Edge of Pavement | ROAD       | No        | ----      |
| <b>ESHD</b><br>Edge of Shoulder | ROAD       | No        | ----      |
| <b>TRED</b><br>Tree deciduous   | VEGETATION | No        | ----      |

Fn OK New Edit Fn

| Key             | Description  |
|-----------------|--|
| <b>OK</b>       | To return to the previous panel.   |
| <b>New</b>      | To create a code. Refer to <a href="#">8.4.2 Creating/Editing a Code</a> .   |
| <b>Edit</b>     | To edit the highlighted code. Accesses <b>Edit Code</b> where new attributes can be added to a code and line styles can be changed.      |
| <b>Fn Group</b> | To access <b>Code Groups</b> . To view, create, activate and deactivate code groups. Refer to <a href="#">8.5 Managing Code Groups</a> . |
| <b>Fn Sort</b>  | To access <b>Sort Codes</b> . To sort codes by code name, code description, quick code or last used.                                     |

#### Next step

**Edit** to edit an existing job code.

## Edit Code

← **Edit Code** Hz 0.0004 g V 0.0002 g 11:11

|                  |                          |
|------------------|--------------------------|
| Code             | <b>H&amp;TK</b>          |
| Code description | <b>Hub &amp; Tack</b>    |
| Code group       | <b>CONTROL</b>           |
| Code type        | <b>Point</b>             |
| Linework         | <input type="checkbox"/> |

| Key              | Description   |
|------------------|---|
| <b>Store</b>     | To store the code including any newly created attributes. |
| <b>New attrb</b> | To add an attribute to a code.                            |

The behaviour of this panel varies with the type of code to be edited.

When creating a job, more code metadata are editable. When editing a job, less code metadata are editable.

The differences are explained in the table.

| Type of code       | Description  |
|--------------------|--|
| <b>Point codes</b> | <ul style="list-style-type: none"><li>New attributes can be added with <b>New attrb</b>.</li><li>For new jobs: The line style, line colour and string number can be changed. This selections are stored to the code.</li></ul> |
| <b>Free codes</b>  | New attributes can be added with <b>New attrb</b> .  |

For attributes for which an attribute name can be typed in:

Tap on the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in.

# 7 Job Menu - View & edit data

## 7.1 Overview

**Description** Data management is the administration of data stored in the job, including

- viewing data and related information.
- editing data.
- creating new data.
- deleting existing data.
- filtering existing data.

## 7.2 Accessing Data Management

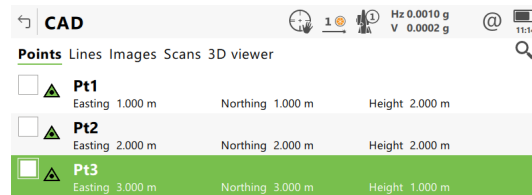
**Access** Select **View & edit data** from the job menu.




The objects listed on the pages belong to the edited job. The objects listed and their order depend on the active sort and filter settings. Refer to [7.6 Point Sorting and Filters](#) for information about sort and filter settings.



**Job name,  
Points page**

Check one or multiple points for editing. Use **Fn All** to select all points at once.







Fn OK New Edit Delete More Page Fn

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To close the panel and return to the panel from where this panel was accessed.  |
| <b>New</b>    | To create a point.  |
| <b>Edit</b>   | To edit the highlighted point.<br>In case of multiple point selection, editing the target height for all selected points is possible.<br> Editing the target height for multiple points is possible for TS points of class <b>Measured</b> , <b>Adjusted</b> and <b>None</b> . |
| <b>Delete</b> | To delete the highlighted point.<br>In case of multiple point selection, all selected points are deleted.   |
| <b>More</b>   | To display information about the codes and code information if stored with any point, the 3D coordinate quality, the class, Easting, Northing and Elevation, the time and the date of when the point was stored.  |


| Key   | Description   |
|---|---|
|  | The order in which the Easting and Northing columns are shown depends on the <b>Grid format</b> configured to be used in <b>Regional, Coordinates</b> page. |
|  | The Easting, Northing and Elevation values are shown in the unit configured in <b>Regional, Distance</b> page.  |
| <b>Page</b>   | To change to another page on this panel.  |
| <b>FnLog</b>  | To view points, lines and free codes stored with the job sorted by time. Refer to <a href="#">7.5 Data Log</a> .  |
| <b>Fn Filter</b>  | To define sort and filter settings. Refer to <a href="#">7.6 Point Sorting and Filters</a> .  |
| <b>Fn All</b> or <b>Fn None</b>   | To select or deselect all points at once.   |






### Check box behaviour

| Action  | Description  |
|---|--|
|    | Checks or unchecks the check box of the highlighted point. The behaviour depends on the current status of the check box. |
|  | Checks or unchecks the check box of the highlighted point. The behaviour depends on the current status of the check box. |
|  | Move the focus on the screen upwards.  |
|  | Move the focus on the screen downwards.  |
| Tapping the check box   | Checks or unchecks the check box depending on the current status of the check box. Highlights the line.                  |
| Tapping the image linked to the point   | Enlarges the images. Highlights the line.  |
| Space bar   | Starts the point search.   |

### Description of symbols

The symbols match the symbols in the 3D viewer.

| Symbol  | Description   |
|---|---|
|  | Point of class <b>Control (Ctrl)</b> with full coordinate triplet |

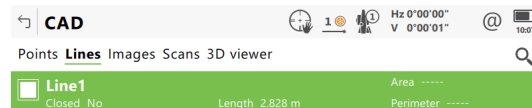
| Symbol  | Description   |
|---|---|
|  | Point of class <b>Adjusted (Adj)</b> or <b>Average (Avge)</b>   |
|  | Point of class <b>Reference (Ref)</b>   |
|  | Point of class <b>Measured (Meas)</b>   |
|  | Single Point Position uploaded from Infinity<br>Point of class <b>Navigated (Nav)</b> or <b>Estimated (Est)</b> |
|  | Point measured within a Stake app   |

### Next step

Page changes to the **Lines** page.

Job name,  
Lines page

Check one or multiple lines for deleting.



Fn OK New Edit Delete More Page Fn

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To close the panel and return to the panel from where this panel was accessed.  |
| <b>New</b>    | To create a line. After storing the new line, all existing lines which are open are closed. Refer to <a href="#">7.4.2 Creating a New Line</a> .        |
| <b>Edit</b>   | To edit the highlighted line.   |
| <b>Delete</b> | To delete the highlighted line with or without the points defining its geometry.<br>In case of multiple line selection, all selected lines are deleted. |

| Key              | Description  |
|------------------|--|
| <b>More</b>      | To display information about the codes if stored with any line, the start time, the end time of when the last point was added to the line, the length of the line, the perimeter and the area. |
| <b>Page</b>      | To change to another page on this panel.   |
| <b>Fn Filter</b> | To define sort and filter settings. Refer to <a href="#">7.6 Point Sorting and Filters</a> .   |

#### Description of metadata

| Metadata      | Description  |
|---------------|--|
| -             | The listed lines already stored in the job.  |
| <b>Closed</b> | The status of a line.<br>If a line is closed, it means that it is physically closed onto itself, effectively becoming an area. |

#### Next step

**Page** until the **3D viewer** page is active.



For information on camera and images refer to [34.4 Image Management](#).

#### Job name, Scans page

Check one or multiple scans for a perspective display of the 3D point clouds in the **3D viewer**. Use **Fn All** to select all scans at once.

| Key                                | Description  |
|------------------------------------|--|
| <b>OK</b>                          | To close the panel and return to the panel from where this panel was accessed. |
| <b>Page</b>                        | To change to another page on this panel.                                       |
| <b>Fn Delete</b>                   | To delete the highlighted scan.  |
| <b>Fn All</b> or<br><b>Fn None</b> | To select or deselect all scans at once.                                       |

#### Description of metadata

Information about the date, the time, the status and the number points.



For information on image groups refer to [58.5 Managing Image Groups](#).

## 7.3

### Point Management

### 7.3.1

#### Creating a New Point

#### Access

In **Job name, Points** page, press **New**.

## New Point, Coordinates page

The screenshot shows the 'New Point' interface with the following fields and values:

|          |          |
|----------|----------|
| Point ID | Pt4      |
| Easting  | 10.000 m |
| Northing | 10.000 m |
| Height   | 10.000 m |

At the top, there are status indicators: 'Hz 0.0004 g', 'V 0.0002 g', and a battery icon showing 11:17.

Fn Store Page Fn

| Key                   | Description  |
|-----------------------|--|
| <b>Store</b>          | To store the new point entered and all associated information.   |
| <b>North or South</b> | Available for local geodetic or WGS 1984 geodetic coordinates when <b>WGS84 latitude</b> is highlighted. Changes between North and South latitude. |
| <b>East or West</b>   | Available for local geodetic or WGS 1984 geodetic coordinates when <b>WGS84 longitude</b> is highlighted. Changes between East and West longitude. |
| <b>Next</b>           | To store the point and to remain in the panel. The point ID increments according to point ID template.   |
| <b>Page</b>           | To change to another page on this panel.   |
| <b>Fn Coord</b>       | To view other coordinate properties.   |
| <b>Fn Tools</b>       | For an individual name independent of the ID template or to change back to the next ID from the configured ID template.                            |

### Description of fields

| Field             | Option         | Description   |
|-------------------|----------------|---|
| <b>Point ID</b>   | Editable field | The name of the new point. The configured point ID template is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of point IDs, type over the point ID.</li> <li>For an individual name independent of the ID template <b>Fn Tools</b> and then <b>Individual point ID. Fn Tools</b> and then <b>Sequential point ID</b> changes back to the next ID from the configured ID template.</li> </ul> |
| Coordinate fields | Editable field | Negative geodetic coordinates are interpreted as being of the opposite hemisphere or other side of the central meridian. For example, entering -25 °N is stored as 25 °S, entering -33 °E is stored as 33 °W.   |

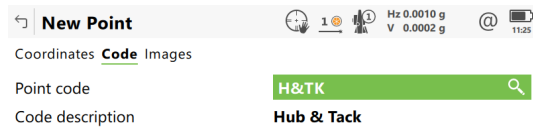
### Next step

**Page** changes to the **Code** page.



## New Point, Code page

The settings for **Code & attributes** in **Leica Captivate - Home: Settings\Customisation\Coding** determine the availability of the subsequent fields and softkeys.



|       |           |      |         |      |
|-------|-----------|------|---------|------|
| Store | New attrb | Last | Default | Page |
|-------|-----------|------|---------|------|

| Key              | Description  |
|------------------|--|
| <b>Store</b>     | To store the new point entered and all associated information.                   |
| <b>New attrb</b> | To create more attributes for this point code.                                   |
| <b>Last</b>      | To recall the last used attribute values which were stored with this point code. |
| <b>Default</b>   | To recall the default attribute values for the selected code.                    |
| <b>Page</b>      | To change to another page on this panel.   |

### Description of fields

| Field             | Option          | Description   |
|-------------------|-----------------|---|
| <b>Point code</b> | Selectable list | The codes from the job codelist are used. All point codes of the job codelist can be selected. The description of the code is shown as a display only field. The attributes are shown as display only, editable fields or selectable lists depending on their definition. |
|                   | Editable field  | Codes for points can be typed in. A check is performed to see if a point code of this name exists in the job. If so, an information message is displayed. If <b>Suggested attribute values: Last used</b> in <b>Coding</b> , the attributes are also shown.               |
| <b>Attribute</b>  | Editable field  | Up to 20 attribute values are available.  |

### Next step

**Store** stores the new point entered and all associated information.

The properties stored with the point are:

- Class: **Control**
- Sub class: **Fixed (Pos & Ht)**
- Source: **User entered**
- Instrument source: **GS**



It may happen that a point with the same point ID exists in the job. If the codes and/or attribute values of the new and the existing point do not match, a panel opens where they can be corrected.

### 7.3.2

## Editing a Point

### Access

In **Job name, Points** page, press **Edit**.



If multiple points are selected when **Edit** is pressed, only the target height is editable. Editing the target height for multiple points is possible for TS points of class **Measured, Adjusted** and **None**.

### Point ID, Coordinates page

The visible pages on this panel depend on the properties of the point being edited.

It is possible to edit the point ID and for points of **Class: Control** and **Class: Estimated** also the coordinates. Other point-related data is shown in display only fields.



Changing the point ID of a point, applies this new point ID to all other points with the same original name, regardless of their class.



Points of **Class: Reference** cannot be renamed.



Changing coordinates of a point which has been previously used in other apps, for example COGO, or hidden point measurements does not update the app results.



An edited point retains the creation value for **Time**.

| Key      | Description   |
|----------|---|
| Store    | To store the changes.   |
| Previous | To display the previous point in the list of points displayed in <b>Job name, Points</b> page. Available unless the beginning of the list is reached.   |
| Next     | To display the next point in the list of points displayed in <b>Job name, Points</b> page. Available unless the end of the list is reached.   |
| More     | To display information about class, sub class, 3D coordinate quality, time and date of when point was stored, instrument source, source and the flag for Linework if available.<br>For tilt compensated points: To display also if <b>Tilt compensation</b> was used, tilt value and quality. |
| Page     | To change to another page on this panel.  |

| Key      | Description   |
|----------|---|
| Store    | To store the changes.   |
| Previous | To display the previous point in the list of points displayed in <b>Job name, Points</b> page. Available unless the beginning of the list is reached.   |
| Next     | To display the next point in the list of points displayed in <b>Job name, Points</b> page. Available unless the end of the list is reached.   |
| More     | To display information about class, sub class, 3D coordinate quality, time and date of when point was stored, instrument source, source and the flag for Linework if available.<br>For tilt compensated points: To display also if <b>Tilt compensation</b> was used, tilt value and quality. |
| Page     | To change to another page on this panel.  |

| Key                                  | Description  |
|--------------------------------------|--|
| <b>Fn Coord</b>                      | To view other coordinate properties.   |
| <b>Fn Ell Ht</b> or <b>Fn Height</b> | Available for local coordinates. Changes between the ellipsoidal and the orthometric height. Changing the height type does not edit the point. |

### Next step

**Page** changes to the next page.

### Point ID, Stake results page

On this page, the stakeout results are displayed.



When changing **Target height** on the **Obs** page, the **Measured height** value is updated. The offset values used for staking the point will not be editable on the **Offset** page.

| Key          | Description                              |
|--------------|--|
| <b>Store</b> | To store the changes.                    |
| <b>Page</b>  | To change to another page on this panel. |

### Description of fields

| Field                         | Option       | Description   |
|-------------------------------|--------------|---|
| <b>Design point ID</b>        | Display only | The name of the design point that was staked.   |
| <b>Difference in easting</b>  | Display only | The difference between the <b>Design easting</b> and the <b>Measured easting</b> .      |
| <b>Difference in northing</b> | Display only | The difference between the <b>Design northing</b> and the <b>Measured northing</b> .    |
| <b>Cut/Fill</b>               | Display only | The height difference between the <b>Design height</b> and the <b>Measured height</b> . |
| <b>2D distance</b>            | Display only | Displays the horizontal difference between the design point and the staked point.       |
| <b>3D distance</b>            | Display only | Displays the spatial difference between the design point and the staked point.          |
| <b>Design easting</b>         | Display only | The entered design Easting.   |
| <b>Design northing</b>        | Display only | The entered design Northing.  |
| <b>Design height</b>          | Display only | The entered design elevation.   |
| <b>Measured easting</b>       | Display only | The Easting measured at the stored point.   |
| <b>Measured northing</b>      | Display only | The Northing measured at the stored point.  |
| <b>Measured height</b>        | Display only | The height measured at the stored point.  |

### Next step

Page changes to the next page.

Point ID,  
Obs page

---




Available when the edited point is **Class: Measured**.

### For GS points

The name of the real-time base station from where the GNSS point was measured, the name of antenna used to measure the point and the baseline values, are shown in display only/observations fields.

### For TS point

It is possible to edit the reflector height. The name of the setup from where the point was measured is shown in a display only field.


-  Changing the reflector height recalculates the point height. The values for **Cut** and **Fill** in **Stake results** page are also updated.
-  For tilt compensated points, changing the reflector height recalculates the point height, as well as Easting and Northing. The values for **Cut** and **Fill** in **Stake results** page are also updated.
-  For tilt compensated points, changing the reflector height recalculates the displayed **H<sub>z</sub> (compensated)**, **V (compensated)** and **SD (compensated)** values to a virtually levelled pole. The used target height value is considered.

The distance variables **Difference in H<sub>z</sub> angle**, **Difference in V angle**, **Difference in slope distance** are shown in a display only field, whenever a measurement has been taken in both faces.

**More** displays the horizontal angle or the azimuth from the point to the instrument.

### For TS points measured with Measure Foresight

Listed are the setup ID, the backsight point, the set number and the average measurement values.

-  Press **Sets** to include or exclude measured sets in the calculation of a foresight point.

### Next step

Page changes to the next page.

Point ID,  
Offset page

---

Available when the edited point was measured with offsets using TS.

Check and change, if required, the entered offset values. When an offset value has been changed, the coordinates for the stored point will be updated.

| Key          | Description                              |
|--------------|--|
| <b>Store</b> | To store the changes.                    |
| <b>Page</b>  | To change to another page on this panel. |

## Description of fields

| Field                    | Option         | Description   |
|--------------------------|----------------|---|
| <b>Offset left/right</b> | Display only   | The cross offset of the target point, perpendicular to the line of sight.<br>For staked points.     |
|                          | Editable field | For measured points.  |
| <b>Offset in/out</b>     | Display only   | The length offset of the target point, in the direction of the line of sight.<br>For staked points. |
|                          | Editable field | For measured points.  |
| <b>Offset height</b>     | Display only   | The height offset of target point.<br>For staked points.  |
|                          | Editable field | For measured points.  |
| <b>Easting</b>           | Display only   | The Easting measured at the stored point. Offset applied. Updated, if offset has been edited.       |
| <b>Northing</b>          | Display only   | The Northing measured at the stored point. Offset applied. Updated, if offset has been edited.      |
| <b>Height</b>            | Display only   | The height measured at the stored point. Offset applied. Updated, if offset has been edited.        |

## Next step

**Page** changes to the next page.

## Point ID, RTK info page

Available for GNSS points which were recorded in real-time mode, however not for average or mean points.

All fields are display only fields and cannot be edited.

The information is obtained from **Settings** and data coming across with the real-time information and the Ntrip connection.

| MAXNEAR.004                              |                    |
|--|--------------------|
| Coordinates                              | Obs                |
| RTK info                                 | Code Annots Images |
| Network solution type                    | Network solution   |
| Network type                             | MAX                |
| RTK data format                          | RTCM v3            |
| Number of reference stations in solution | 1                  |
| IP address                               | 217.193.169.30     |
| Port                                     | 2103               |
| Store                                    | Page               |

## Description of fields

| Field   | Option                      | Description  |
|---|-----------------------------|--|
| <b>Network solution type</b>                    | <b>Single baseline</b>      | Displayed when <b>Use RTK network</b> is not checked in <b>RTK Rover Settings, RTK network</b> page.   |
|   | <b>Network solution</b>     | Displayed when <b>Use RTK network</b> is checked in <b>RTK Rover Settings, RTK network</b> page.   |
| <b>Network type</b>                             | <b>FKP, VRS, MAX, i-MAX</b> | The type of reference network selected in <b>RTK Rover Settings</b> . Refer to <a href="#">RTK Rover Settings,RTK network</a> page.  |
|   | <b>Nearest</b>              | If <b>Network type: Nearest</b> is selected in <b>RTK Rover Settings</b> , a singlebase solution is calculated and the number of base stations equals 1.   |
| <b>RTK data format</b>                          | Display only                | Refer to <a href="#">RTK Rover Settings,General</a> page.  |
| <b>Number of reference stations in solution</b> | Display only                | <ul style="list-style-type: none"> <li>For single-baseline solutions, this number is always 1.</li> </ul>  |
|   |                             | <ul style="list-style-type: none"> <li>For VRS and i-MAX, this number is always 1 since it is not possible to derive the number of base stations contributing to the VRS or i-MAX corrections from the data format.</li> </ul>   |
|   |                             | <ul style="list-style-type: none"> <li>For network solutions, this information is derived from the content of the data format. Only <b>RTCM v3</b> and <b>Leica 4G</b> are able to provide this number.</li> </ul>   |
| <b>Mountpoint</b>                               | Display only                | <p>The name of the correction data stream that was selected from the source table received in the <b>TCP/IP port</b>. Available for network RTK with Ntrip.</p> <p>The information is available for all Ntrip connections independent from the <b>Network type</b> used. The information is derived from the <b>Connection Settings</b>, either manually defined or selected from the <b>NTRIP Source Table</b>.</p> |
| <b>Point measured inside network</b>            | Display only                | Available for network RTK with Ntrip and MAX and data format <b>RTCM v3</b> or <b>Leica 4G</b> .   |
| <b>User ID</b>                                  | Display only                | Available for single baseline RTK, network RTK with/without Ntrip.   |

## Next step

**Page** changes to the next page.

**Point ID,  
Elevations page**

On this page, multiple elevations which have been stored with a staked point can be edited. Additional multiple elevations can be entered.

Refer to [Stake Results,Elevations page](#) for more information on multiple elevations.

| Key  | Description                              |
|------|--|
| OK   | To store the changes.                    |
| Page | To change to another page on this panel. |

**Description of fields**

| Field       | Option         | Description   |
|-------------|----------------|---|
| Elevation   | Editable field | The entered elevation is stored with the point and used to calculate the cut and fill values.   |
| Cut/Fill    | Display only   | Height of the point being stored<br>- Entered elevation<br>-----<br>= Cut or fill value (always positive)<br><br><b>Examples</b><br>For cut:<br>Height of the point being stored<br>- Entered elevation<br>-----<br>Result > 0<br><br>598.5672 m - 596.4856 m = 2.0816 m = cut<br>The displayed value is 2.0816 m.<br><br>For fill:<br>Height of the point being stored<br>- Entered elevation<br>-----<br>Result < 0<br><br>598.5672 m - 599.7826 m = -1.2154 m = fill<br>The displayed value is 1.2154 m. |
| Information | Editable field | Additional information that must be stored with the elevation.<br>Only the entered Information which also has an entered elevation is stored to the point being stored.   |

**Next step**

**Page** changes to the next page.

**Point ID,  
Code page**

Available when the edited point is **Class: Measured**.

The point code and code information can be edited. All point codes in the job can be selected.

The description of the code is shown as a display only field.

The attributes are shown as display only, editable fields or selectable lists depending on their definition.

The attribute values shown depend on the setting in **Coding**. **Suggested attribute values: Last used** shows the last used attribute values which are stored for this point code in the active codelist. **Suggested attribute values: Default** shows the default attribute values for this point code if existing.



It may happen that a point with the same point ID exists in the job. If the codes and/or attribute values of the new and the existing point do not match, a panel opens where they can be corrected.

#### Next step

**Page** changes to the next page.

### Point ID, Annots page

Available when the edited point is **Class: Navigated** or **Class: Measured** and no offset point.

The comments to be stored with the point can be edited.

#### Next step

**Page** changes to the next page.

### Point ID, Mean page

Available when the edited point is **Class: Average**.

Refer to [7.3.3 Mean Page](#) for a detailed description.

## 7.3.3

### Mean Page

#### Description

In order to check measurements, the same point can be measured more than once.

These measured points are assigned the class **Measured**. The various measured coordinate triplets for one point can be recorded using the same point ID. If the **Duplicate points** mode is activated, an average is calculated when more than one measured coordinate triplet is available for the same point ID.

The averaged point is given the class **Average**. It is checked if the deviations of each single point are within the limits configured in **Duplicate Points**.

After averaging, the **Mean** page becomes available when editing the point and accessible from the Measure app. Available functionality on the **Mean** page depends on the selected **Duplicate points** mode.

#### Averaging

##### Defining the mode and configuring the limits

The mode and the limits are configured in **Duplicate Points**.

##### Description of modes

| Mode              | Description  |
|-------------------|--|
| Check the average | When more than one measured coordinate triplet is recorded for the same point, the average for the position and the height is computed. Depending on the selected method, the average is computed weighted or arithmetic (no weighting). The class <b>Average</b> is assigned to the averaged point. |



| Mode                      | Description  |
|---------------------------|--|
|                           | The horizontal and height distances from the measured points to the average are computed and displayed on the <b>Mean</b> page.<br>A check is performed that the differences in position and height, between the <b>averaged point</b> and the point being stored, do not exceed the defined limits. |
| <b>Check the abs diff</b> | What is described for <b>Don't check</b> also applies for <b>Absolute differences</b> . Additionally, the <b>absolute difference</b> between two points selected from a list of measured points with the same point ID, is checked to be within the defined limits.                                  |
| <b>Don't check</b>        | The points are saved with no checks against existing points with the same point ID.  |

### Averaging with position only or height only points

Position only points, height only points and points with full coordinate triplets are handled in the averaging.

### Access step-by-step

The **Mean** page can be accessed if

**When a point is stored with same point ID as existing point: Check the average** or **When a point is stored with same point ID as existing point: Check the abs diff** is configured in **Duplicate Points**.

AND

more than one measured coordinate triplet is recorded for the same point using the same point ID.

1. In **Job name, Points** page, highlight a point to be edited.
2. **Edit** to access **Job name, Mean** page.

### Point ID, Mean page

All measured coordinate triplets recorded using the same point ID are shown.

| Measure   | Use  | Status           | dPos    | dHt     |
|-----------|------|------------------|---------|---------|
| Measure 2 | Auto | Out of limit --- | 0.000 m | 0.000 m |
| Measure 1 | ---- | Out of limit --- | ----    | ----    |

Fn Store Use Edit Delete More Page Fn

| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store the changes.  |
| <b>Use</b>   | To change between the options in <b>Use</b> metadata for the highlighted coordinate triplet. To include or exclude this triplet in or from the calculation of the average. |

| Key            | Description  |
|----------------|--|
| <b>Edit</b>    | To view and edit the highlighted measured coordinate triplet. It is possible to edit the point ID and the antenna height without impact on all other classes of the point with the same original name. The coordinates are updated. A change in codes must be an overall change for the average point.<br>Example: One of the measured coordinate triplets has a wrong point ID and should not be included in the average. By editing the point ID, the point is renamed and no longer contributes to the average. |
| <b>Delete</b>  | To delete the highlighted coordinate triplet. The average is recomputed.   |
| <b>More</b>    | To change between time and date of when the point was stored and the 3D coordinate quality.  |
| <b>Page</b>    | To change to another page on this panel.   |
| <b>Fn Diff</b> | Available for <b>When a point is stored with same point ID as existing point: Check the abs diff</b> and <b>Yes</b> for the <b>Use</b> metadata for exactly two measurements. To display the absolute coordinate differences when a local coordinate system is active. Differences exceeding the defined limit are indicated by !.   |

#### Description of metadata

| Metadata    | Description  |
|-------------|--|
| <b>Use</b>  | The use of a measured coordinate triplet in the averaging. <ul style="list-style-type: none"> <li>• <b>Auto</b><br/>The coordinate triplet is included in the averaging computation if within the averaging limit defined.</li> <li>• <b>Yes</b><br/>The coordinate triplet is always included in the averaging computation even if it would fall outside the averaging limit defined.</li> <li>• <b>No</b><br/>The coordinate triplet is never included in the averaging computation.</li> <li>• <b>-----</b><br/>The coordinate triplet cannot be included in the averaging computation. Automatically set by the system.</li> </ul> <b>Use</b> changes between the options. |
| <b>Time</b> | The time the measured coordinate triplet was stored.   |
| <b>Date</b> | The date the measured coordinate triplet was stored. The format is as defined in <b>Regional, Time</b> page.   |
| <b>dPos</b> | The horizontal distance from the measured coordinate triplet to the average. <b>dPos: -----</b> indicates unavailable information, for example for a height only point.  |
| <b>dHt</b>  | The height distance from the measured coordinate triplet to the average. <b>dHt: -----</b> indicates unavailable information, for example for a position only point.   |

| Metadata            | Description   |
|---------------------|---|
| <b>Out of limit</b> | Available for measured coordinate triplets with <b>Auto</b> or <b>Yes</b> in the <b>Use</b> metadata if <b>When a point is stored with same point ID as existing point: Check the average</b> . Indicates an exceeding of the limits. |

### Next step

**Store** stores the changes.

## 7.4

## Line Management

### 7.4.1

### Overview

#### Description

A line consists of points and can be created/edited. The individual points are measured within any app. All points can be used except auxiliary points. Points can be simultaneously assigned to one or more lines.

### 7.4.2

### Creating a New Line

#### Access

In **Job name**, **Lines** page, press **New**.

#### New Line, General page

Fn Store Page Fn

| Key   | Description   |
|---|---|
| <b>Store</b>                                | To store the new line entered and all associated information.   |
| <b>Page</b>                                 | To change to another page on this panel.  |
| <b>Fn Individ ID</b><br>or<br><b>Fn Run</b> | For an individual name independent of the ID template or to change back to the next ID from the configured ID template. |

#### Description of fields

| Field          | Option         | Description  |
|----------------|----------------|--|
| <b>Line ID</b> | Editable field | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of line IDs, type over the line ID.</li> <li>For an individual name independent of the ID template <b>Fn Individ ID</b>. <b>Fn Run</b> changes back to the next ID from the configured ID template.</li> </ul> |

| Field  | Option          | Description   |
|--------|-----------------|---|
| Style  | Selectable list | The line style in which lines are represented in <b>3D viewer</b> and Infinity. |
| Colour | Selectable list | A colour in which the line is displayed.  |

### Next step

**Page** changes to the **Geometry** page.

## New Line, Images page

Images are displayed as thumbnail images in a list, together with the image name. Attach one or more images to the line.

| Key   | Description                               |
|-------|---|
| Store | To store the changes and update the line. |
| New   | To take an image.                         |
| Page  | To change to another page on this panel.  |

### Description of metadata

Information about the image size and the time and the date of when the image was stored.

### Next step

**Page** changes to another page on this panel.

## Creating lines most efficiently

To create lines with certain codes use quick coding. The job codelist must contain quick codes for lines. By typing the quick code a new line is created and immediately stored with that line code and attributes. For the line ID, the line ID template as defined in **ID Templates** is used.

### 7.4.3

## Editing a Line

### Access

In **Job name, Lines** page, press **Edit**.

## Line ID, General page

Line1

General Geometry Code Images

Line ID: Line1

Style: [dropdown]

Colour: [red] [dropdown]

Number of points: 3

Length: 2.828 m



Start date: 11.09.17

Start time: 11:16:02

Store More Page

| Key   | Description                                      |
|-------|--|
| Store | To store the changes.                            |
| More  | To display <b>End time</b> and <b>End date</b> . |
| Page  | To change to another page on this panel.         |

## Description of fields

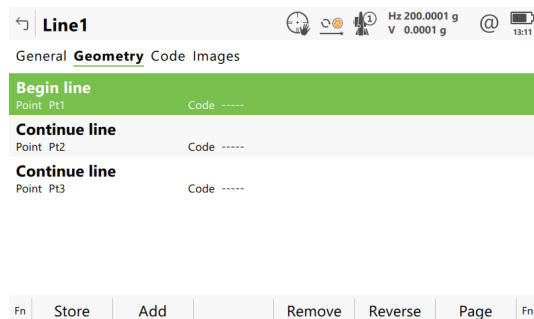
| Field                            | Option         | Description   |
|----------------------------------|----------------|---|
| <b>Line ID</b>                   | Editable field | The name of the line can be edited.<br> A line cannot be renamed to an existing line ID.   |
| <b>Style</b>                     | Editable field | The line style in which lines are represented in <b>3D viewer</b> and Infinity.   |
| <b>Colour</b>                    | Editable field | A colour in which the line is displayed.  |
| <b>Number of points</b>          | Display only   | The number of points contained within the line.   |
| <b>Length</b>                    | Display only   | The sum of the distances between the points in the sequential order in which they are stored for the line. This length can be a horizontal grid distance or a geodetic distance on the WGS 1984 ellipsoid.                                  |
| <b>Start date and Start time</b> | Display only   | The time/date when the line was created.<br> An edited line retains the creation value for <b>Start time</b> .   |
| <b>End date and End time</b>     | Display only   | The time/date when the last point was added to the line. This can be different to the time the point was created. The values do not change after deleting the last added point or after editing unless an extra point is added to the line. |

## Next step

Page changes to the **Geometry** page.

## Line ID, Geometry page

Listed is the geometry of the nodes that make up the line object. The order corresponds the position of the nodes along the line.



| Key            | Description   |
|----------------|---|
| <b>Store</b>   | To store the changes and update the line.                       |
| <b>Add</b>     | To add a node below the highlighted node.                       |
| <b>Edit</b>    | To edit the highlighted node, including the linework operation. |
| <b>Delete</b>  | To remove the highlighted node.                                 |
| <b>Reverse</b> | To reverse the order of the nodes and their geometry.           |

| Key  | Description                              |
|------|--|
| Page | To change to another page on this panel. |

#### Next step


| IF   | THEN                                    |
|--|---|
| <b>Allow lines to be coded independently of points</b> is checked in <b>Coding, Code &amp; attributes</b> page     | Page changes to the <b>Code</b> page.   |
| <b>Allow lines to be coded independently of points</b> is not checked in <b>Coding, Code &amp; attributes</b> page | Page changes to the <b>Images</b> page. |

#### Line ID, Code page

Available when **Allow lines to be coded independently of points** is checked in **Coding, Code & attributes** page.

| Key       | Description   |
|-----------|---|
| Store     | To store the changes and update the line.   |
| New attrb | To add an attribute of type normal and of value type text. Up to twenty attributes can be added. Attributes of type mandatory or fixed and of value type real or integer must be created in Infinity. |
| Last      | Available if a code has been previously used in the job. To select from a list of last used codes. The codes are sorted by time with the most recently used code at the top of the list.              |
| Default   | To recall the default attribute values for the selected code.   |
| Page      | To change to another page on this panel.  |

#### Description of fields

| Field            | Option                            | Description   |
|------------------|-----------------------------------|---|
| Line ID          | Editable field                    | The name of the line can be edited.<br> A line cannot be renamed to an existing line ID.   |
| Line code        | Selectable list or editable field | The line code to be stored with the point. Depending on the setting for <b>Allow new codes to be created in Coding, Code &amp; attributes</b> page, the field is a simple list or a selectable list and an editable field at the same time. |
| Code description | Display only                      | A description of the code.  |

#### Next step

Page changes to the **Images** page.

#### Line ID, Images page

The list shows all images linked to the line. Each image has a thumbnail image and an image name.

| Key              | Description                                    |
|------------------|--|
| <b>Store</b>     | To store the changes and update the line.      |
| <b>Sketch</b>    | To sketch over an image taken with a camera.   |
| <b>Delete</b>    | To delete the highlighted image.               |
| <b>Page</b>      | To change to another page on this panel.       |
| <b>Fn Unlink</b> | To remove the link from the image to the line. |

### Next step

**Page** changes to another page on this panel.

## 7.5

### Data Log

#### Description

A list of all objects and free codes in the job is displayed in order of time.

#### Access step-by-step

##### Access within data management

In **Job name**, **Points** page, press **Fn Log**.

##### Access within job management

In **Job name**, **General** page, press **Fn Log**.

#### Data log

All points, lines and free codes stored within the job are displayed. They are always sorted by time with the most recent record at the top. For lines, the value for **Start time** is relevant.

| fixpoint job  |                 |                   |
|---------------|-----------------|-------------------|
| All data      |                 |                   |
| <b>1016</b>   |                 | Code FNCM         |
| Time 20:17:13 | Date 06.03.2006 | Record type Point |
| <b>1011</b>   |                 | Code ----         |
| Time 20:17:04 | Date 06.03.2006 | Record type Point |
| <b>1010</b>   |                 | Code FNCM         |
| Time 20:16:52 | Date 06.03.2006 | Record type Point |
| <b>1016</b>   |                 | Code FNCM         |
| Time 20:16:41 | Date 06.03.2006 | Record type Point |
| <b>1011</b>   |                 | Code ----         |
| Time 20:16:31 | Date 06.03.2006 | Record type Point |
| <b>1010</b>   |                 | Code FNCM         |

Fn OK New Edit Delete Fn

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To close the panel.  |
| <b>New</b>    | To insert a free code below/before the currently highlighted object or record. The functionality of inserting a free code is identical to the functionality of entering a free code during a survey.         |
| <b>Edit</b>   | To edit the highlighted object or free code. The functionality of editing a free code is identical to the functionality of entering a free code during a survey. Refer to <a href="#">28.4 Free Coding</a> . |
| <b>Delete</b> | To delete the highlighted object or free code.   |

## Description of metadata

Information about the type of data recorded, the time and the date of when it was stored or for lines when they were created and the codes if stored with any object.

---

## 7.6 Point Sorting and Filters

---

### 7.6.1 Sorting and Filters for Points and Lines

---

#### Description

The sort settings define the order of the objects in the job. The filter settings define the objects to be viewed.

Two types of filters are available:

| Type          | Description   |
|---------------|---|
| Point filter: | An active point filter shows selected points in <b>Job name, Points</b> page. |
| Line filter:  | An active line filter shows selected lines in <b>Job name, Lines</b> page.    |

---



For information on camera and images refer to [34.4 Image Management](#).

---



The sort and filter settings are stored in the job. They are remembered after turning off the instrument.

When a job becomes active, then the sort and filter settings of this job are saved in the internal memory. If the data storage device is formatted then these last used sort and filter settings are used for the default job.

When a new job is created, the sort and filter settings from what was the job are copied to the new job.

---



Changing the job influences the sort and filter settings for the objects. The settings are changed to those of the selected job.

---

#### Access

On the **Points** or **Lines**, press **Fn Filter** to access **Sort & Filter**.

---

#### Sort & Filter, Points page

The available fields on this panel depend on the selected setting for **Filter to show**.

**Sort & Filter**

Points Lines Images

Sort by **Date - newest first** ▾

Filter to show **Highest point class only** ▾

---


OK Stake Page



| Key   | Description   |
|-------|---|
| OK    | To close the panel and return to the panel from where this panel was accessed. The selected sort and filter settings are applied.               |
| Codes | Available for <b>Filter to show: Points with certain codes</b> . To define the code filters. Refer to <a href="#">7.6.2 Point Code Filter</a> . |
| Stake | To filter points for the Stake app. Refer to <a href="#">7.6.3 Stakeout Filter</a> .  |
| Page  | To change to another page on this panel.  |

### Description of fields

| Field          | Option   | Description  |
|----------------|--|--|
| Sort by        | <b>Point ID - ascending, Point ID - descending, Date - oldest first or Date - newest first</b> | Always available. The method points are sorted by.   |
|                | <b>Filter definition</b>   | Available for <b>Filter to show: Multiple point ID ranges</b> .<br>The filtered points are sorted in the order they were entered. In the Stake points app, the points are suggested in this same order.<br>Example:<br>Defined list of range:<br>GS0110-GS0120, GS0150-GS0160, GS0130-GS0140<br>Order in list:<br>First GS110 to GS120, then GS150 to GS160, then GS130 to GS140 |
| Filter to show | <b>All</b>   | Always available. The method the points are filtered by.<br>Shows all points.  |
|                | <b>Highest point class only</b>  | Shows points of highest class.   |
|                | <b>Range of point IDs</b>  | Shows points with point IDs between the entered start and end ID. The points are left aligned and sorted by the first digit.   |
|                | <b>Pt IDs matching wildcard</b>  | Shows points with point IDs matching the wildcard.   |
|                | <b>Time</b>  | Shows points which were recorded within a defined time window.   |
|                | <b>Certain point classes only</b>  | Shows points of the selected class.  |

| Field             | Option                           | Description   |
|-------------------|----------------------------------|---|
|                   | <b>Pts created by instrument</b> | Shows points originating from the selected instrument or software program type.   |
|                   | <b>Points with certain codes</b> | Shows points with selected codes attached.  |
|                   | <b>Multiple point ID ranges</b>  | <p>Shows points with point IDs between several entered start and end ID.<br/>The filtered points appear in the order they were entered.<br/>In the Stake points app, the points are suggested in the order they are shown in the list.<br/>Duplicated points appear as many times as they were defined in the multiple range.<br/>For <b>View: Points to stake in Stakeout Filter</b>, points with the same point ID are removed from the list once a duplicated points is staked.</p> <p> Instead of using this setting, select a range of points graphically in the <b>3D viewer</b>. Tap on the object and/or use the window selection to select multiple objects at the same time. The resulting list of points includes all points falling within the selection. The points list and the map are updated.<br/>If the selected points come from different sources such as working job or control job, the selection can be applied to either one or both sources.<br/>To remove a graphically selected filter, define another filter manually or use <b>Revert graphic filter</b> from the context menu in the <b>3D viewer</b>.</p> |
| <b>Start ID</b>   | Editable field                   | Available for <b>Filter to show: Range of point IDs</b> . The first point to be displayed.  |
| <b>End ID</b>     | Editable field                   | Available for <b>Filter to show: Range of point IDs</b> . The last point to be displayed.   |
| <b>Wildcard</b>   | Editable field                   | Available for <b>Filter to show: Pt IDs matching wildcard</b> . * and ? are supported. * indicates an undefined number of unknown characters. ? indicates a single unknown character.   |
| <b>Start date</b> | Editable field                   | Available for <b>Filter to show: Time</b> . The date of the first point to be displayed.  |
| <b>Start time</b> | Editable field                   | Available for <b>Filter to show: Time</b> . The time of the first point to be displayed.  |

| Field   | Option  | Description  |
|---|---|--|
| <b>End date</b>   | Editable field  | Available for <b>Filter to show: Time</b> . The date of the last point to be displayed.  |
| <b>End time</b>   | Editable field  | Available for <b>Filter to show: Time</b> . The time of the last point to be displayed.  |
| <b>Control (Ctrl), Adjusted (Adj), Reference (Ref), Measured (Meas), Navigated (Nav), Estimated (Est), None</b> | <b>Show</b> or <b>Hide</b>  | Available for <b>Filter to show: Certain point classes only</b> . Defined classes are shown or hidden.   |
| <b>View</b>   |   | Available for <b>Filter to show: Certain point classes only</b> .  |
|   | <b>Highest triplet</b><br><b>All triplets</b>                                   | The coordinate triplets of the highest class are shown.<br>All classes for one coordinate triplet are shown.   |
| <b>Instrument</b>   | <b>All, TS, GS, Office, Level, Controller, Third party SW</b> or <b>Unknown</b> | Available for <b>Filter to show: Pts created by instrument</b> . Points originating from this instrument type are shown.   |
| <b>List of ranges</b>   | Editable field  | Available for <b>Filter to show: Multiple point ID ranges</b> .<br>Enter the first and the last point of a range to be displayed. Single point entry is valid. <ul style="list-style-type: none"> <li>• ,: Separates the ranges.</li> <li>• -: Separates the first and the last point of a range</li> </ul> Example: 1-20,25,30-40 |
|   | <b>Graphically defined</b>  | Displayed when a range of points was selected graphically in the <b>3D viewer</b> .<br>To remove a graphically selected filter, define another filter manually or use <b>Revert graphic filter</b> from the context menu in the <b>3D viewer</b> .   |

#### Next step

**Page** changes to the **Lines** page.

## Sort & Filter, Lines page



OK Page

| Key  | Description   |
|------|---|
| OK   | To close the panel and return to the panel from where this panel was accessed. The selected sort and filter settings are applied. |
| Page | To change to another page on this panel.  |

### Description of fields

| Field   | Option   | Description   |
|---------|--|---|
| Sort by | Line ID - ascending,<br>Line ID - descending,<br>Start point - oldest first,<br>Start point - newest first,<br>End point - oldest first,<br>End point - newest first | Always available. The method the lines are sorted by. |

### Next step

OK closes the panel.

## 7.6.2

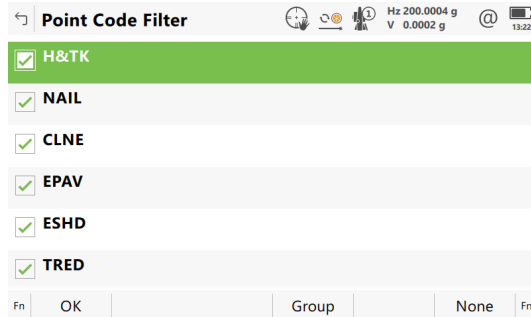
### Point Code Filter

#### Access step-by-step

1. In **Sort & Filter** select **Filter to show: Points with certain codes.**
2. **Codes** to access **Point Code Filter.**

## Point Code Filter

This panel shows the point codes from the job and codes currently used as filter. Point codes are sorted according to the settings in **Sort Codes**.



| Key         | Description  |
|-------------|--|
| OK          | To close the panel and return to the panel from where this panel was accessed.   |
| Group       | To activate and deactivate code groups. Accesses <b>Code Groups</b> . Any code group that has been previously deactivated are displayed as deactivated here. Codes belonging to a deactivated code group are not displayed in <b>Point Code Filter</b> . |
| Use         | To activate and deactivate the filter for the highlighted code.  |
| None or All | To deactivate or activate all point codes.   |
| Fn Sort     | To define the order of the codes. Accesses <b>Sort Codes</b> .   |

### 7.6.3

## Stakeout Filter

### Description

The settings on this panel define a filter for the Stake app. The Stake filter can be applied to show points which are already staked or points that are still to be staked.



Instead of using this setting, select a range of points graphically in the **3D viewer**. Tap on the object and/or use the window selection to select multiple objects at the same time. The resulting list of points includes all points falling within the selection. The points list and the map are updated.

If the selected points come from different sources such as working job or control job, the selection can be applied to either one or both sources.

To remove a graphically selected filter, define another filter manually or use **Revert graphic filter** from the context menu in the **3D viewer**.



The stakeout filter acts in addition to any other filter set in **Sort & Filter**. For example, points still to be staked out with a particular code can be filtered.

### Access

In **Sort & Filter, Points** page, press **Stake** to access **Stakeout Filter**.

## Stakeout Filter



OK Reset

| Key          | Description  |
|--------------|--|
| <b>OK</b>    | To close the panel and return to the panel from where this panel was accessed. |
| <b>Reset</b> | To reset the staked flag for all points of the currently job.                  |

### Description of fields

| Field       | Option                 | Description                                |
|-------------|------------------------|--|
| <b>View</b> | <b>All points</b>      | Shows all points.                          |
|             | <b>Points to stake</b> | Shows points not yet staked out.           |
|             | <b>Staked points</b>   | Shows points which are already staked out. |

## 8

## Codelists

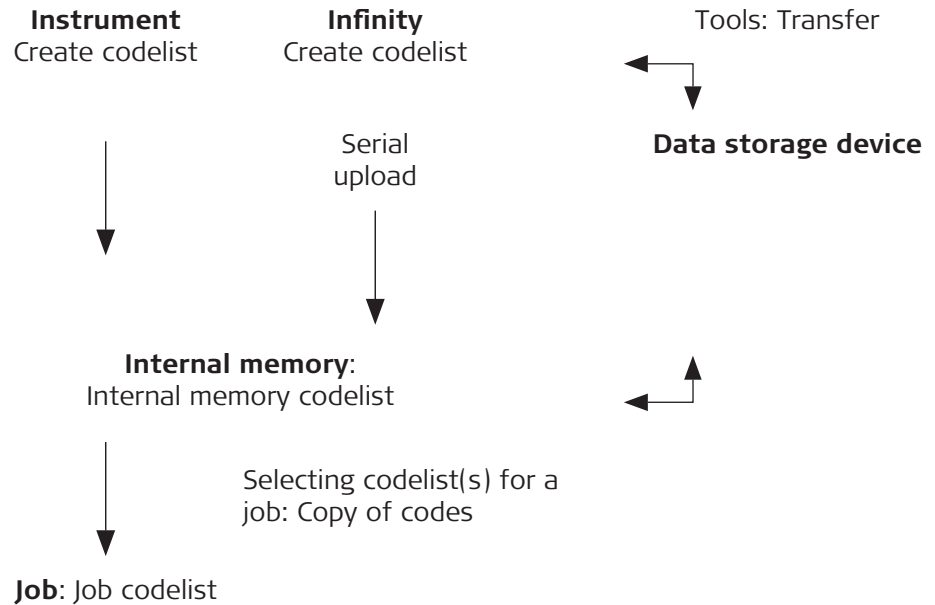
### 8.1

### Overview



It is recommended to create a codelist in Infinity. A codelist can be transferred from Infinity to the internal memory of the instrument using the data storage device.

#### Steps from creating to using a codelist



The creating, editing and managing of codelists is explained in this chapter. In order to use a codelist on the instrument, it must be transferred from the data storage device to the internal memory.

### 8.2

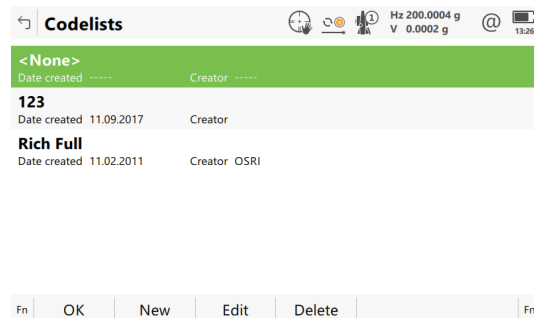
### Accessing Codelist Management

#### Access

1. Select **Tap here to create new job** from the job menu in **Leica Captivate - Home**.
2. Go to the **Codelist** page.
3. Open the selectable list for **Codelist**.

#### Codelists

Listed are all codelists stored in the internal memory.



| Key    | Description   |
|--------|---|
| OK     | To return to the panel from where this panel was accessed. The codes from the highlighted codelist are copied to the job. |
| New    | To create a codelist. Refer to <a href="#">8.3 Creating/Editing a Codelist</a> .  |
| Edit   | To edit the highlighted codelist. Refer to <a href="#">8.3 Creating/Editing a Codelist</a> .                              |
| Delete | To delete the highlighted codelist.   |

## 8.3

### Creating/Editing a Codelist

#### Access

In **Codelists** press **New** or **Edit**.

#### New Codelist or Edit Codelist

| Key   | Description   |
|-------|---|
| Store | To store the codelist.  |
| Codes | To access <b>Codes</b> where codes can be created, edited or deleted and code groups can be accessed. |

#### Description of fields

| Field       | Option         | Description   |
|-------------|----------------|---|
| Name        | Editable field | A unique name for the codelist. The name can be up to 16 characters long and include spaces. Input required.        |
| Description | Editable field | A detailed description of the codelist. This description can be, for example, work to be performed. Input optional. |
| Creator     | Editable field | The name of the person who is creating the codelist. Input optional.  |

## 8.4

### Managing Codes

#### 8.4.1

#### Accessing Codes

#### Description

Managing codes includes

- creating new codes
- viewing codes with their related information
- editing codes
- deleting existing codes.



## Access step-by-step

1. In **Codelists**, highlight the codelist of the codes which are to be managed.
2. **Edit** to access **Edit Codelist**.
3. **Codes** to access **Codes**.

## Codes

Codes from currently active code groups are shown.

Metadata such as the code description, the quick codes if available, the code groups and the code type are displayed for each code.

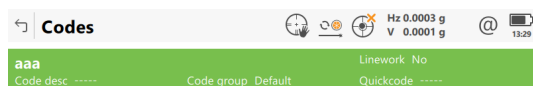
The listed codes belong to

the codelist selected from the internal memory when creating a job.

OR

to the job codelist when editing a job.

The \* indicates codes which have attributes attached.



| Key             | Description   |
|-----------------|---|
| <b>OK</b>       | To close the panel and return to the panel from where this panel was accessed.                                    |
| <b>New</b>      | To create a code. Refer to <a href="#">8.4.2 Creating/Editing a Code</a> .  |
| <b>Edit</b>     | To edit the highlighted code. Refer to <a href="#">8.4.2 Creating/Editing a Code</a> .                            |
| <b>Delete</b>   | To delete the highlighted code.   |
| <b>Fn Group</b> | To view, create, delete, activate and deactivate code groups. Refer to <a href="#">8.5 Managing Code Groups</a> . |
| <b>Fn Sort</b>  | To sort codes by code name, code description, quick code or the last use.   |

## 8.4.2

### Creating/Editing a Code



The values for code groups, codes and attributes are case sensitive. For example, the code group Tree is not the same as the code group TREE.



Attribute names that have already been typed in cannot be edited in a job codelist.



A new code can also be created within an app. In this case, the new code is added to the job codelist.

## New Code or Edit Code

**New Code**

Code: 123

Code description: -----

Code group: 1

Code type: Point


Linework:

Store    New attrb

| Key              | Description   |
|------------------|---|
| <b>Store</b>     | To add the new code and any associated attributes to the codelist in the internal memory.     |
| <b>New attrb</b> | To add a new editable field for an attribute of attribute type normal and of value type text. |

### Description of fields

| Field                   | Option          | Description   |
|-------------------------|-----------------|---|
| <b>Code</b>             | Editable field  | A unique name for the new code. Input required.<br>The name can be up to 48 characters long and include spaces. If using characters other than from the ASCII character set, the allowed length of the code name is shortened, depending on the characters used.  |
| <b>Code description</b> | Editable field  | A detailed description of the code. This description can be, for example, the full designation if <b>Code</b> is an abbreviation. Input optional.<br>The description can be up to 48 characters long and include spaces. If using characters other than from the ASCII character set, the allowed length of the code name is shortened, depending on the characters used.   |
| <b>Code group</b>       | Selectable list | The code group to which the code is assigned.   |
| <b>Code type</b>        | Selectable list | Defines the use of the code. It can be used as point code or as a free code.  |
| <b>Linework</b>         | Check box       | Available for <b>Coding functionality: Create linework</b> .<br>The setting of this box defines how a smart-box is filled by default.<br>When this box is checked, the stringing and linework metadata are displayed in the code box on the user definable page .<br>When the code is newly selected, a new line is started. When the same point code remains selected, the next point being stored is added to the current line. |

| Field           | Option          | Description  |
|-----------------|-----------------|--|
|                 |                 | When this box is not checked, the code box is set for point coding by default. Linework can still be activated.  |
| <b>Style</b>    | Selectable list | Available when <b>Linework</b> is checked. The style in which lines are represented in 3D viewer and Infinity.   |
| <b>Colour</b>   | Selectable list | A colour in which the line is displayed.   |
| Attribute field | Editable field  | Up to 20 attributes can be created.  |
|                 |                 |  Attributes of attribute type mandatory or fixed and of value type real or integer must be created in Infinity. |

## 8.5

### Managing Code Groups

#### Access

In **Codes**, press **Fn Group**.

#### Code Groups

The listed code groups belong to

the codelist selected from the internal memory when creating a job.

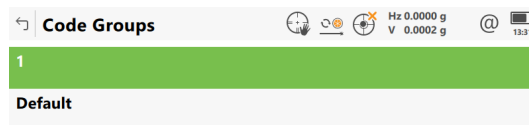
OR

to the job codelist when editing a job.

Codes from currently active code groups are shown.

Check the box in front of a code group to activate the code group.

Uncheck the box in front of a code group to deactivate the code group. Codes belonging to a deactivated code group are not displayed in **Codes**.







| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To close the panel and return to the panel from where this panel was accessed.  |
| <b>New</b>  | To create a code group. In <b>New Code Group</b> type in a unique name for <b>Name</b> . <b>Store</b> stores the new code group typed in and returns to <b>Code Groups</b> .  |
| <b>Edit</b> | Available for codelists in the internal memory. To edit the highlighted code group. In <b>Edit Code Group</b> type in the changes for <b>Name</b> . <b>Store</b> stores the changes and returns to <b>Code Groups</b> . |

| Key                       | Description                                |
|---------------------------|--|
| <b>None</b> or <b>All</b> | To deactivate or activate all code groups. |

---

## 9 Coordinate Systems

### 9.1 Overview

|   |  |
|---|--|
| <b>Description</b>  | <p>A coordinate system</p> <ul style="list-style-type: none"><li>• allows the conversion from WGS 1984 geodetic or cartesian coordinates to, local cartesian, geodetic or grid coordinates and back.</li><li>• can be attached to jobs.</li><li>• can be manually defined.</li><li>• can be computed in the field.</li><li>• can be directly received from a reference network. Refer to <a href="#">19.7.1 Configuration of a Rover Real-Time Connection</a>.</li><li>• can be downloaded to Infinity.</li><li>• can be uploaded from Infinity.</li></ul> |
| <b>Using coordinate systems</b>   | <p>Coordinate systems are used on the TS and the CS to combine GNSS data with TS data.</p>   |
|    | <p>For TS:</p> <p>An attached coordinate system is not used to reduce any measured distance on a TS instrument.</p>  |
|    | <p>All GNSS surveyed points are always stored as WGS 1984 geodetic coordinates regardless of the coordinate system being used. Using a different coordinate system converts the coordinates displayed on the panel, but does <b>not</b> convert and restore the coordinate values in the database DBX.</p>   |
|  | <p>For TS:</p> <p>Points surveyed with a TS instrument are always stored in local grid coordinates regardless of the coordinate system being used.</p>   |
|  | <p>One coordinate system can be attached to a job at one time. This coordinate system remains attached to the job unless it is changed.</p>  |
| <b>Default coordinate systems</b>   | <p>The default coordinate system is <b>WGS 1984</b>. It cannot be deleted. It is not possible to create a coordinate system called <b>WGS 1984</b>.</p> <p>Additional default coordinate systems may be available for certain countries.</p>   |
| <b>Active coordinate system</b>   | <p>The active coordinate system is the one attached to the job. One coordinate system is always considered as the active coordinate system.</p>  |
| <b>Automatic coordinate system (RTCM transformation parameters)</b>                 | <p>When <b>Use auto coordinate system</b> is checked in the <b>RTK Rover Wizard</b>, the coordinate system is directly received from the reference network via RTCM correction data. Refer to <a href="#">19.7.1 Configuration of a Rover Real-Time Connection</a>.</p>  |

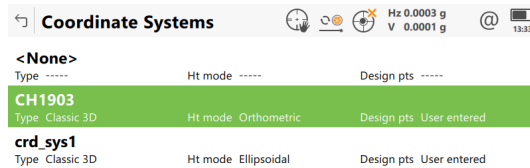
### 9.2 Accessing Coordinate System Management

|               |   |
|---------------|---|
| <b>Access</b> | <ol style="list-style-type: none"><li>1. From the job menu, select <b>View &amp; edit job properties</b>.</li></ol> |
|---------------|---|

2. Go to the **Coordinate system**.
3. Open the selectable list for **Coordinate system**.

## Coordinate Systems

Listed are all coordinate systems stored in the database DBX. Any unavailable information is shown as -----.



Fn OK New Edit Delete More Fn

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To select the highlighted coordinate system and to return to the previous panel. The selected coordinate system is attached to the job.   |
| <b>New</b>          | To create a coordinate system manually. Refer to <a href="#">9.3 Coordinate Systems - Creating and Editing</a> .  |
| <b>Edit</b>         | To edit the highlighted coordinate system. Refer to <a href="#">9.3 Coordinate Systems - Creating and Editing</a> .   |
| <b>Delete</b>       | To delete the highlighted coordinate system. Deletion is not possible if the highlighted coordinate system is active and its source is RTCM.  |
| <b>More</b>         | To display information about the type of transformation used, the type of heights computed, the number of control points used for the determination and the date of when the coordinate system was created. |
| <b>Fn Set deflt</b> | To turn the highlighted coordinate system into a user-defined default coordinate system stored in the instrument.   |
| <b>Fn Default</b>   | To recall the deleted default coordinate systems.   |

### 9.3

## Coordinate Systems - Creating and Editing



Coordinate systems can be defined by manual creation or determined by calculation.

In this chapter, the manual creation of coordinate systems is explained. Refer to [41 Determine Coordinate System](#) for information on the determination by calculation.



Coordinate systems with a Classic 3D transformation can be defined by manual creation.



The type of transformation of the selected coordinate system determines which elements of a coordinate system can be edited. The name of the

coordinate system, the method of residual distribution and the geoid model in use are always editable.



For coordinate systems with source RTCM, only the geoid model in use can be changed.

However, if no projection is received with the automatic coordinate system, then the projection can also be defined.

## Access

In **Coordinate Systems**, highlight a coordinate system. A copy of this coordinate system is taken for further configurations. Press **New** or **Edit**.

## New Coordinate System or Edit Coordinate System

| Key          | Description                     |
|--------------|---------------------------------|
| <b>Store</b> | To store the coordinate system. |

### Description of fields

| Field                 | Option   | Description  |
|-----------------------|--|--|
| <b>Name</b>           | Editable field   | A unique name for the new coordinate system. The name can be up to 16 characters long and include spaces.  |
| <b>Residuals</b>      | <p>Available for transformations with control points. Manually entered transformations do not have control points. The method by which residuals are distributed throughout the transformation area. The transformation results become more realistic and any strain is dispersed in the transformation.</p> <p><b>1/distance,</b><br/><b>1/distance<sup>2</sup>,</b><br/><b>1/distance<sup>3</sup>/2</b></p> <p><b>Multiquadratic</b></p> | <p>Distribute the residuals of the control points according to the distance between each control point and the newly transformed point.</p> <p>Distributes the residuals using a multi-quadratic interpolation approach.</p> |
| <b>Transformation</b> | Selectable list  | The type of transformation.  |

| Field                     | Option          | Description  |
|---------------------------|-----------------|--|
| <b>Pre-transformation</b> | Selectable list | Available when editing a coordinate system and for Twostep transformations. The name of a preliminary 3D transformation, which, together with the selected projection, is used to obtain preliminary grid coordinates for a final 2D transformation. |
| <b>Ellipsoid</b>          | Selectable list | The local coordinates are based on this ellipsoid.   |
| <b>Projection</b>         | Selectable list | The map projection.  |
| <b>Geoid model</b>        | Selectable list | The geoid model.   |
| <b>CSCS model</b>         | Selectable list | The Country Specific Coordinate System model.  |

## 9.4

## Transformations

### 9.4.1

### Accessing Transformation Management



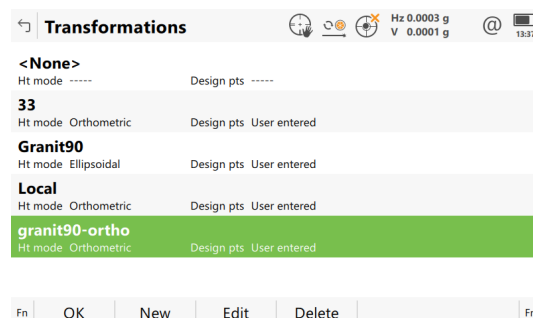
**Transformations** cannot be accessed for coordinate systems with source RTCM. Refer to [Automatic coordinate system \(RTCM transformation parameters\)](#).

#### Access step-by-step

1. In **Coordinate Systems**, highlight a coordinate system.
2. Press **New** or **Edit**.
3. Highlight **Transformation**.
4. **ENTER** to access **Transformations**.

#### Transformations

Listed are all Classic 3D transformations stored in the database DBX. Any unavailable information is shown as -----.



| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To select the highlighted transformation and to return to the previous panel.                              |
| <b>New</b>    | To create a transformation. Refer to <a href="#">9.4.2 Creating/Editing a Transformation</a> .             |
| <b>Edit</b>   | To edit the highlighted transformation. Refer to <a href="#">9.4.2 Creating/Editing a Transformation</a> . |
| <b>Delete</b> | To delete the highlighted transformation.  |



| Key                 | Description   |
|---------------------|---|
| <b>Fn Set deflt</b> | To turn the highlighted transformation into a user-defined default transformation stored in the instrument. |

## 9.4.2

## Creating/Editing a Transformation



Classic 3D transformations can be created.

### Access

In **Transformations**, highlight a transformation. A copy of this transformation is taken for further configurations. Press **New** or **Edit**.

### New Transformation or Edit Transformation, General page

|       |      |
|-------|------|
| Store | Page |
|-------|------|

| Key          | Description   |
|--------------|---|
| <b>Store</b> | To store the transformation.  |
| <b>Clear</b> | To set the editable fields to 0. Available on the <b>Parameters</b> and the <b>Advanced</b> page. |
| <b>Page</b>  | To change to another page on this panel.  |

### Description of fields

| Field       | Option         | Description  |
|-------------|----------------|--|
| <b>Name</b> | Editable field | A unique name for the new transformation. The name can be up to 16 characters long and include spaces. |
| <b>Type</b> | Display only   | No other transformations than Classic 3D can be created.   |

### Next step

**Page** changes to the **Parameters** page.

### New Transformation or Edit Transformation, Parameters page

Enter the known values of the transformation parameters.

### Next step

**Page** changes to the **Advanced** page.

### New Transformation or Edit Transformation, Advanced page

Select at least a height mode and a transformation model.

## Description of fields

| Field              | Option          | Description   |
|--------------------|-----------------|---|
| <b>Height mode</b> | Selectable list | The type of heights to be computed.   |
| <b>Model</b>       | Selectable list | The transformation model to be used. For <b>Model: Molodensky-Badekas</b> , more editable fields are available. |

## Next step

**Store** stores the transformation.

## 9.5

## Ellipsoids

### 9.5.1

### Accessing Ellipsoid Management



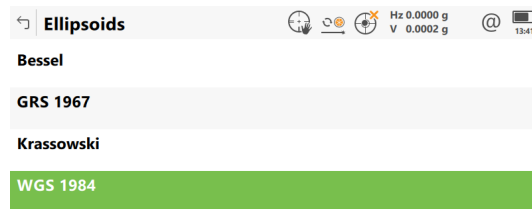
**Ellipsoids** cannot be accessed for coordinate systems with source RTCM. Refer to [Automatic coordinate system \(RTCM transformation parameters\)](#).

### Access step-by-step

1. In **Coordinate Systems**, highlight a coordinate system.
2. Press **New** or **Edit**.
3. Highlight **Ellipsoid**.
4. **ENTER** to access **Ellipsoids**.

## Ellipsoids

Listed are all ellipsoids stored in the database DBX.

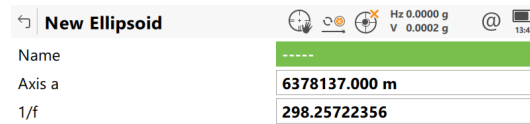


| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To select the highlighted ellipsoid and to return to the previous panel.                          |
| <b>New</b>          | To create an ellipsoid. Refer to <a href="#">9.5.2 Creating/Editing an Ellipsoid</a> .            |
| <b>Edit</b>         | To edit the highlighted ellipsoid. Refer to <a href="#">9.5.2 Creating/Editing an Ellipsoid</a> . |
| <b>Delete</b>       | To delete the highlighted ellipsoid.  |
| <b>Fn Set deflt</b> | To turn the highlighted ellipsoid into a user-defined default ellipsoid stored in the instrument. |
| <b>Fn Default</b>   | To recall the deleted default ellipsoids.   |

## Access

In **Ellipsoids**, highlight an ellipsoid. A copy of this ellipsoid is taken for further configurations. Press **New** or **Edit**.

## New Ellipsoid or Edit Ellipsoid



Store

| Key   | Description             |
|-------|-------------------------|
| Store | To store the ellipsoid. |

## Description of fields

| Field  | Option         | Description   |
|--------|----------------|---|
| Name   | Editable field | A unique name for the new ellipsoid. A name is mandatory, can be up to 16 characters long and include spaces. |
| Axis a | Editable field | The semi-major axis a.  |
| 1/f    | Editable field | The reciprocal value of flattening f.   |

## 9.6

## Projections

## 9.6.1

## Accessing Projection Management



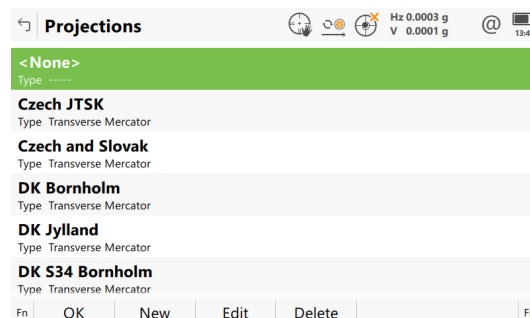
**Projections** cannot be accessed for coordinate systems with source RTCM. Refer to [Automatic coordinate system \(RTCM transformation parameters\)](#).

## Access step-by-step

1. In **Coordinate Systems**, highlight a coordinate system.
2. Press **New** or **Edit**.
3. Highlight **Projection**.
4. **ENTER** to access **Projections**.

## Projections

Listed are all projections stored in the database DBX. Any unavailable information is shown as -----.



| Key          | Description   |
|--------------|---|
| OK           | To select the highlighted projection and to return to the previous panel.   |
| New          | To create a projection. Refer to <a href="#">9.6.2 Creating/Editing a Projection</a> .  |
| Edit         | To edit the highlighted projection. Refer to <a href="#">9.6.2 Creating/Editing a Projection</a> .  |
| Delete       | To delete the highlighted projection.   |
| Fn Set deflt | Available unless a default projection is highlighted. To turn the highlighted projection into a user-defined default projection stored in the instrument. |
| Fn Default   | To recall the deleted default projections.  |

#### Description of metadata

| Metadata           | Option   | Description   |
|--------------------|--|---|
| Type               |  | The projection type. Refer to standard surveying literature for details on projections.   |
|                    | Customised   | Customised projection. Certain fixed projections which cannot be defined by any of the following options.   |
|                    | Transverse Mercator  | Transverse Mercator. Conformal projection onto a cylinder with its axis lying on the equatorial plane. The cylinder is tangential to a meridian.  |
|                    | TMx  | A customised projection for use in the UK, based on the UTM projection.   |
|                    | UTM  | Universal Transverse Mercator. Transverse Mercator Projection with fixed zone-defining constants. The central meridian is selected automatically according to the selected zone number. |
|                    | Oblique Mercator   | Oblique Mercator. Oblique Mercator Conformal projection onto a cylinder. The cylinder is tangent to any circle other than the equator or a meridian.                                    |
|                    | Mercator   | Mercator. Conformal projection onto a cylinder with its axis lying on a meridian plane. The cylinder is tangent to the sphere along the equator.  |
|                    | Lambert 1 parallel   | Lambert 1 Parallel. Conformal projection onto a cone, with its axis coinciding with the z-axis of the ellipsoid.  |
| Lambert 2 parallel | Lambert 2 Parallel. Conformal projection onto a cone, with its axis coinciding with the z-axis of the ellipsoid. The cone is secant to the sphere. |   |

| Metadata | Option                 | Description  |
|----------|------------------------|--|
|          | <b>Cassini Soldner</b> | Soldner-Cassini. Projection onto a cylinder. It is not an equal area or conformal. The scale is true along the central meridian and along lines perpendicular to central meridian.                       |
|          | <b>Polar stereo</b>    | Polar Stereographic. Conformal azimuthal projection onto a plane. The point of projection is on the surface of the ellipsoid diametrically opposite of the origin which is the centre of the projection. |
|          | <b>Double stereo</b>   | Double Stereographic. Conformal azimuthal projection onto a plane. The point of projection is on the surface of the sphere diametrically opposite of the centre of the projection.                       |
|          | <b>RSO</b>             | Rectified Skewed Orthomorphic. This is a special type of Oblique Mercator projection.  |

## 9.6.2

### Creating/Editing a Projection

#### Access

In **Projections**, highlight a projection. A copy of this projection is taken for further configurations. Press **New** or **Edit**.

#### New Projection or Edit Projection

| Key          | Description              |
|--------------|--------------------------|
| <b>Store</b> | To store the projection. |

#### Description of fields

| Field       | Option          | Description   |
|-------------|-----------------|---|
| <b>Name</b> | Editable field  | A unique name for the new projection. A name is mandatory, can be up to 16 characters long and include spaces.  |
| <b>Type</b> | Selectable list | The projection type. The setting determines the availability of the subsequent fields for the parameters of the projection. Refer to <a href="#">9.6.1 Accessing Projection Management</a> for a description of the projection types. |

## 9.7

## Geoid Models

### 9.7.1

### Overview

#### Use in the field

For use on the instrument in the field, geoid field files are created from the geoid model.

#### Create geoid models on the instrument

Geoid models can be created on the instrument in one of two ways:

1. The geoid field file is stored on a data storage device and can be used when the data storage device is inserted in the instrument.
2. The geoid field file is stored in the internal memory of the instrument. Refer to [9.7.3 Adding a New Geoid Model from the Data Storage Device / Internal Memory](#) for information on how to transfer geoid field files to the internal memory on the instrument.

### 9.7.2

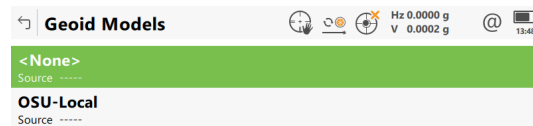
### Accessing Geoid Model Management

#### Access step-by-step

1. In **Coordinate Systems**, highlight a coordinate system.
2. Press **New** or **Edit**.
3. Highlight **Geoid model**.
4. **ENTER** to access **Geoid Models**.

#### Geoid Models

Listed are all geoid models stored in the database DBX. Any unavailable information is shown as -----. For example, ----- would be shown if the geoid field file associated to the geoid model is not available on the data storage device/internal memory.



Fn OK Edit Delete Import Fn

| Key    | Description  |
|--------|--|
| OK     | To select the highlighted geoid model and to return to the previous panel.   |
| Edit   | To view the highlighted geoid model. None of the fields can be edited. The geoid field file from which the geoid model was created must be stored in the internal memory or in the \DATA\GPS\GEOID directory on the data storage device. |
| Delete | To delete the highlighted geoid model. The geoid field file which was associated with this geoid model is then also deleted.   |

| Key           | Description   |
|---------------|---|
| <b>Import</b> | To add a geoid model. The \DATA\GPS\GEOID directory on the data storage device is automatically scanned for geoid field files. Refer to <a href="#">9.7.3 Adding a New Geoid Model from the Data Storage Device / Internal Memory</a> . |


### 9.7.3

### Adding a New Geoid Model from the Data Storage Device / Internal Memory

#### Requirement

At least one geoid field file with the extension \*.gem is in the \DATA\GPS\GEOID directory on the data storage device / internal memory.

#### Add geoid model step-by-step

1. Listed in **Geoid Models** are all geoid models stored in the internal memory.  
OR  
Press **Import** to scan the \DATA\GPS\GEOID directory on the data storage device.
2. For each geoid field file on the data storage device or in the internal memory, one geoid model is automatically created. The names given to the geoid models are those names which were entered in Infinity.  
 Existing geoid models are automatically overwritten by new models with the same name.

### 9.8

### CSCS Models

#### Use in the field

For use on the instrument in the field, CSCS field files are created from the CSCS model.



Adding a CSCS model on the instrument and the functionality of all panels and fields are similar to those for geoid models. Refer to [9.7.3 Adding a New Geoid Model from the Data Storage Device / Internal Memory](#).

The directory on the data storage device / internal memory for CSCS field files with the extension \*.csc is \DATA\GPS\CSCS.

## 10

## Job Menu - Import data

### 10.1

### Overview

#### Description

The data to import must be stored on the data storage device or in the internal memory.

Data can be imported to a job

- on the data storage device.
- on the internal memory.

Where Road or Rail design values are selected, the imported data can be linked to a job.

#### Import formats

| Format                            | Characteristic                           | Description  |
|-----------------------------------|--|--|
| ASCII                             | Import variables                         | Point ID, grid coordinates, point codes. No free codes, no attributes.   |
|                                   | Format definition                        | Free format. Use and order of variables and delimiter can be defined during import.  |
|                                   | Units                                    | As currently configured on the instrument  |
|                                   | Height                                   | Orthometric or ellipsoidal   |
|                                   | <b>Specialities</b>                      |  |
|                                   | Local heights but no coordinates in file | Points are imported without coordinates but with local height and code if available.   |
|                                   | Coordinates but no heights in file       | Points are imported without height but with coordinates and code if available.   |
| No coordinates or heights in file | No import                                |  |
| No point IDs in file              | No import                                |  |
| GSI8<br>GSI16                     | Import variables                         | Point ID (WI 11), local coordinates (WI 81, WI 82, WI 83), point codes (WI 71). No free codes, no attributes. Example for GSI8:<br>110014+00001448<br>81..01+00001363<br>82..01-00007748<br>83..01-00000000<br>71....+000sheep |
|                                   | Format definition                        | Fixed format. Easting and Northing can be switched during import.  |
|                                   | Units                                    | As defined in the GSI file   |
|                                   | Heights                                  | Orthometric or ellipsoidal   |
| <b>Specialities</b>               |  |  |



| Format                              | Characteristic                           | Description   |
|-------------------------------------|--|---|
|                                     | Local heights but no coordinates in file | Points are imported without coordinates but with local height and code if available.  |
|                                     | Coordinates but no heights in file       | Points are imported without height but with coordinates and code if available.  |
|                                     | No coordinates or heights in file        | No import   |
|                                     | No point IDs in file                     | No import   |
| Autodesk Point Layout Project (APL) | -  | *.zip file with point data from Autodesk Revit models in xml format<br>Can contain linked references to files of types dxf, dwg and/or ifc. If so, such files are included in the *.zip file. |
| <b>DXF</b>                          | Import variables                         | Block, point, line, arc, polyline. Local coordinates. No free codes, no attributes.   |
|                                     | Format definition                        | Fixed format (X/Y/Z).   |
|                                     | Units                                    | Not predefined.   |
|                                     | Heights                                  | Z value imported as orthometric.  |
|                                     | <b>Specialities</b>                      |   |
|                                     | No coordinates or heights in file        | No import   |
| <b>MxGenio</b>                      | -  | -   |
| <b>LandXML</b>                      | -  | -   |
| <b>Terramodel</b>                   | -  | -   |
| <b>Carlson</b>                      | -  | -   |
| <b>Japan XML</b>                    | -  | -   |
| <b>DTM data</b>                     | Format definition                        | DXF file containing DTM data  |
| <b>XML data</b>                     | Import variables                         | Definable:<br>points, lines, coordinate system, codes, global codelist, alignments, DTM   |

## Checks

Points are always imported with the class **Control** and a coordinate quality of -----. Refer to [I Glossary](#).

While importing points to a job, checks are performed against point ID, class and coding of points already existing in the job.

## 10.2

## Importing ASCII/GSI Data

### Requirements

At least one ASCII file with any file extension, is stored in the \DATA or \GSI directory of the data storage device.



Do not remove the data storage device while importing the data.

### Access

From the job menu select **Import data\ASCII / GSI**.

### Import ASCII/GSI Data

Import ASCII/GSI Data

Hz 0.0004 g  
V 0.0002 g

Data type to import: ASCII data

From: SD card

From file: Sets.txt

To job: Sets

Create new job on import:

Store imported data: In job

Store new job to: SD card

Display in job carousel:

Fn OK Display Fn

| Key         | Description   |
|-------------|---|
| OK          | To import the data.                                 |
| Display     | To view the file from which data is imported.       |
| Fn Settings | To define the format of the data to be imported.    |
| Fn Heights  | To define how heights and the Easting are imported. |

### Description of fields

| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Data type to import</b> | Selectable list | Defines if ASCII or GSI data are imported.  |
| <b>From</b>                | Selectable list | Defines from which storage device the data are imported.  |
| <b>From file</b>           | Selectable list | For <b>Data type to import: ASCII data</b> : Files and folders in the \DATA directory on the data storage device can be selected. Folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed. To select files from the root directory, highlight .. and press <b>Return</b> .<br>For <b>Data type to import: GSI data</b> : All files with extension *.gsi in the \GSI directory and subfolders on the data storage device can be selected. Folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed. To select files from the root directory, highlight .. and press <b>Return</b> . |

| Field                           | Option          | Description   |
|---------------------------------|-----------------|---|
| <b>To job</b>                   | Selectable list | Available when <b>Create new job on import</b> is not checked.  |
|                                 | Editable field  | Available when <b>Create new job on import</b> is checked. The name of the new job.   |
| <b>Create new job on import</b> | Check box       | When this box is checked and the file from which the data should be imported is selected the <b>To job</b> field displays a suggested job name. The suggested job name is the name of the file without the extension. |
| <b>Store imported data</b>      | Selectable list | Available when <b>Create new job on import</b> is checked.<br>The new job can either be a job or a design job.  |
| <b>Store new job to</b>         | Selectable list | Available when <b>Create new job on import</b> is checked.<br>The device on which the new job is stored.  |
| <b>Display in job carousel</b>  |                 | Available when <b>Create new job on import</b> is checked.  |
|                                 | Check box       | When this box is checked, the job is visible in the job carousel.<br><br>When this box is not checked, the job is invisible in the job carousel. Exclude jobs from the job carousel to reduce the scrolling effort.   |

### Next step

**Fn Settings** accesses, depending on selection for **Data type to import**, either **Settings** or **Settings (GSI)**.

## Settings

| Key               | Description                            |
|-------------------|--|
| <b>OK</b>         | To return to the previous panel.       |
| <b>Fn Default</b> | To recall the default import settings. |

### Description of fields

| Field               | Option          | Description  |
|---------------------|-----------------|--|
| <b>Header lines</b> | Selectable list | This option allows up to ten header lines which can exist in an ASCII file to be skipped. Select the number of header lines. |

| Field  | Option   | Description   |
|--|--|---|
| <b>Delimiter</b>   | Selectable list  | The separator between the import variables.   |
| <b>Point ID position, Easting position, Northing position, Height position and Code position</b> | <b>None</b> (not for <b>Point ID position</b> ) and from <b>1</b> to <b>20</b> | Select the positions of the particular variables. An example is shown at the bottom of the panel.   |
| <b>Multiple spaces between data</b>  | Check box  | Available for <b>Delimiter: Space</b> .<br><br>Check this box for space delimited data having multiple spaces between the variables.<br>Uncheck this box for space delimited data having one space between the variables. |
| <b>Number of lines/pt</b>  | Selectable list  | Available for <b>Delimiter: Line feed</b> . The number of lines used to describe each point.  |

#### Next step

1. **OK** leads back to **Import ASCII/GSI Data**.
2. **Fn Heights** to access **Define Ht Type & Easting**.

## Settings (GSI)

#### Description of fields

| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Switch WI81/WI82</b>   | Check box       | If this box is checked, then all WI 81 data, normally Easting, is imported as Northing and all WI 82 data, normally Northing, is imported as Easting. This coordinate switch is necessary for "left handed" coordinate systems. |
| <b>Definition of feet</b> | Selectable list | The type of feet used in the GSI file.  |

#### Next step

1. **OK** leads back to **Import ASCII/GSI Data**.
2. **Fn Heights** to access **Define Ht Type & Easting**.

## Define Ht Type & Easting

#### Description of fields

| Field            | Option          | Description                            |
|------------------|-----------------|--|
| <b>Import as</b> | Selectable list | The height type for the imported data. |

| Field          | Option          | Description   |
|----------------|-----------------|---|
| <b>Easting</b> | Selectable list | The Easting can be imported as written in the ASCII file or it can be multiplied by -1. This change is required by some coordinate systems. |

**OK** leads back to **Import ASCII/GSI Data**.

## 10.3

### Importing Autodesk Point Layout Project

#### Requirements

At least one file with the file extension \*.zip containing an xml file from an Autodesk Point Layout Project must be stored in the \DATA directory of the data storage device.

 Create such an \*.zip file with the Autodesk Revit model.



Do not remove the data storage device while importing the data.

#### Access



From the job menu select **Import data\Autodesk point layout project**.

#### Import Point Layout Data

| Key       | Description         |
|-----------|---------------------|
| <b>OK</b> | To import the data. |

#### Description of fields

| Field                           | Option          | Description   |
|---------------------------------|-----------------|---|
| <b>From</b>                     | Selectable list | Defines from which storage device the data are imported.  |
| <b>From file</b>                | Selectable list | Files with the extension *.zip and folders in the \DATA directory on the data storage device can be selected. Folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed. To select files from the root directory, highlight <b>..</b> and press <b>Return</b> . |
| <b>To job</b>                   | Selectable list | Available when <b>Create new job on import</b> is not checked.  |
|                                 | Editable field  | Available when <b>Create new job on import</b> is checked. The name of the new job.   |
| <b>Create new job on import</b> | Check box       | When this box is checked and the file from which the data should be imported is selected the <b>To job</b> field displays a suggested job name. The suggested job name is the name of the file without the extension.   |
| <b>Set new job as</b>           | Selectable list | Available when <b>Create new job on import</b> is checked. The new job can either be a job, a design job or only linked to a job.   |

| Field                   | Option          | Description   |
|-------------------------|-----------------|---|
| <b>Store new job to</b> | Selectable list | Available when <b>Create new job on import</b> is checked.<br>The device on which the new job is stored.  |
| <b>Linked files</b>     | Display only    | Listed are the linked references in xml to files of types dxf, dwg and/or ifc.<br> Linked references to files of types dxf, dwg and/or ifc are automatically attached to the job as reference files. They can then be found under View & edit job properties.<br> The point data contained in the xml file are imported into job. |

#### Next step


**OK** starts the import.

## 10.4

### Importing XML Data

#### Requirements

At least one file in XML format with the file extension \*.xml has to be stored in the \DATA directory of the data storage device.

 The file can contain points, lines, alignments (Road/Rail/Tunnel jobs) and DTM's/PLA's.

#### Access

From the job menu select **Import data\XML**.

#### Import XML Data

| Key       | Description         |
|-----------|---------------------|
| <b>OK</b> | To import the data. |

#### Description of fields

| Field   | Option          | Description  |
|---|-----------------|--|
| <b>From</b>   | Selectable list | Defines from which storage device the data is imported.  |
| <b>From file</b>  | Selectable list | All files with extension *.xml in the \DATA directory and subfolders on the data storage device can be selected.<br>Folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed<br>To select files from the root directory, highlight .. and press <b>Return</b> . |
| <b>Import points, lines, coordinate systems &amp; point codes</b> | Check box       | When the box is checked, a job can be selected to import the data to.  |

| Field                             | Option    | Description   |
|-----------------------------------|-----------|---|
| <b>Import global codelist</b>     | Check box | When this box is checked, a global codelist is imported. The codelist must be stored in the \CODE directory of the data storage device.   |
| <b>Import alignments</b>          | Check box | When the box is checked, the import can be defined as <b>Road design, Rail design</b> or <b>Tunnel design</b> .<br>A file name for the imported data can be entered.                              |
| <b>Import DTM</b>                 | Check box | When this box is checked, a file name for the DTM import data can be entered.   |
| <b>Link design to current job</b> | Check box | Available when <b>Import alignments</b> or <b>Import DTM</b> is checked.<br>When this box is checked, the imported design job will become linked to the job which was tapped in the job carousel. |

### Next step

OK starts the import.

## 10.5

### Importing DXF Data

#### Requirements

At least one file in DXF format with the file extension \*.dxf has to be stored in the \DATA directory of the data storage device.



Do not remove the data storage device while importing the data.

#### Access

From the job menu select **Import data\DXF**.

#### Import DXF Data

| Key                | Description                                      |
|--------------------|--|
| <b>OK</b>          | To import the data.                              |
| <b>Fn Settings</b> | To define the format of the data to be imported. |

#### Description of fields

| Field              | Option          | Description   |
|--------------------|-----------------|---|
| <b>From device</b> | Selectable list | Defines from which storage device the data is imported. |

| Field            | Option          | Description  |
|------------------|-----------------|--|
| <b>From file</b> | Selectable list | All files with extension *.dxf in the \DATA directory and subfolders on the data storage device can be selected.<br>Folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed<br>To select files from the root directory, highlight .. and press <b>Return</b> . |
| <b>To job</b>    | Selectable list | Choosing a job as destination for import makes this job the job.   |

#### Next step

**Fn Settings** accesses **DXF Import Settings**.

## DXF Import Settings

### Description of fields

| Field  | Option                    | Description  |
|--|---------------------------|--|
| <b>Block prefix</b>                              | Editable field            | Optional prefix to imported blocks.  |
| <b>Prefix to use for points</b>                  | Editable field            | Optional prefix to imported points.  |
| <b>Prefix to use for lines</b>                   | Editable field            | Optional prefix to imported lines.   |
| <b>Units used within .dxf file</b>               | Selectable list           | Choosing the unit for the DXF data to be imported.   |
| <b>Objects to create when importing entities</b> | <b>Vertices and lines</b> | <ul style="list-style-type: none"> <li>Imports the CAD lines into the job.</li> <li>Creates points at the starting and the ending coordinates of the imported line/arc/polyline elements.</li> </ul> |
|  | <b>Only at vertices</b>   | Creates points at the starting and the ending coordinates of the line/arc/polyline elements. The elements are not imported.  |
|  | <b>Only lines</b>         | Imports only the CAD lines into the job. No points are created.  |
| <b>Convert white elements</b>                    | Check box                 | Option if white coloured elements are converted to black coloured elements.  |
| <b>Ignore data at height</b>                     | Selectable list           | Height values inside the DXF file are considered invalid and are not converted.  |
| <b>Apply a height to 2D data</b>                 | Check box                 | When this box is checked, a height can be defined which is then applied to all imported 2D CAD points.   |
| <b>Height to apply</b>                           | Editable field            | Available when <b>Apply a height to 2D data</b> is checked. The height to apply to 2D CAD points.  |



### Next step

OK leads back to **Import DXF Data**.

## 10.6

### Importing DTM Data

#### Requirements

- At least one file in DXF format with the file extension \*.dxf has to be stored in the \DATA directory of the data storage device.
- The DXF file must contain a 3D face layer.



Do not remove the data storage device while importing the data.

#### Access

From the job menu select **Import data\DTM**.

#### Import DTM Data

| Key         | Description  |
|-------------|--|
| OK          | To import the data.                                    |
| Fn Settings | To define the linear units of the data to be imported. |

#### Description of fields

| Field                             | Option          | Description   |
|-----------------------------------|-----------------|---|
| <b>From device</b>                | Selectable list | Defines from which storage device the data are imported.  |
| <b>From file</b>                  | Selectable list | All files with extension *.dxf in the \DATA directory and subfolders on the data storage device can be selected. Folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed. To select files from the root directory, highlight .. and press <b>Return</b> . |
| <b>To file</b>                    | Editable field  | The name of the new DTM file. The file is created once the data is imported.  |
| <b>To device</b>                  | Selectable list | Defines to which storage device the data are imported.  |
| <b>Link design to current job</b> | Check box       | When this box is checked, the imported DTM will become linked to the job which was tapped in the job carousel.  |

**Next step**  
**Fn Settings** accesses **Settings**.

## Settings

### Description of fields

| Field                               | Option          | Description  |
|-------------------------------------|-----------------|--|
| <b>Linear unit used within file</b> | Selectable list | Choosing the unit for the DXF data to be imported. |

**Next step**  
**OK** leads back to **Import DTM Data**.

## 10.7

### Importing Alignment Data

#### Requirements

The requirements depend on the file type:

- For **DXF**: At least one file in **DXF** format with the file extension \*.dxf is stored in the \DATA directory of the data storage device.
- For **LandXML/Terramodel/Japan XML**: At least one file in **LandXML/Terramodel/Japan XML** format with the file extension \*.xml is stored in the \DATA directory of the data storage device.
- For **MX Genio**: At least one file in **MX Genio** format with the file extension \*.txt is stored in the \DATA directory of the data storage device.
- For **Carlson**: At least one file in **Carlson** format with the file extension \*.cl is stored in the \DATA directory of the data storage device.

#### Access



From the job menu select **Import data\Alignment**.

#### Import Alignment Data

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To import the data.   |
| <b>Fn Settings</b> | To define the format of the data to be imported. Available for <b>Data type to import: MX Genio</b> , <b>Data type to import: DXF</b> and <b>Data type to import: Carlson</b> . |

### Description of fields

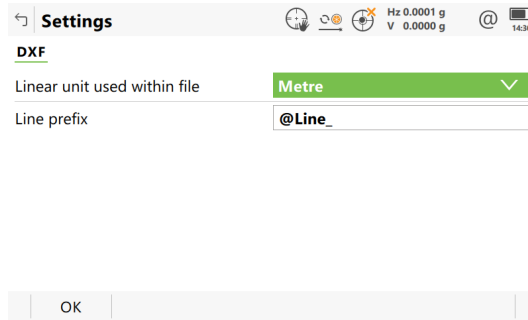
| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Data type to import</b> | Selectable list | Defines which type of data is imported.                 |
| <b>From</b>                | Selectable list | Defines from which storage device the data is imported. |

| Field                       | Option          | Description   |
|-----------------------------|-----------------|---|
| <b>From file</b>            | Selectable list | <p>When opening the list, folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed.</p> <p>To select files from the root directory, highlight .. and press <b>Return</b>.</p> <p>For <b>Data type to import: DXF</b>: All files with extension *.dxf in the \DATA directory and subfolders on the data storage device can be selected.</p> <p>For <b>Data type to import: LandXML/Carlson/Japan XML</b>: All files with the extension *.xml in the \DATA directory and subfolders on the data storage device can be selected.</p> <p> For cross section-based <b>LandXML</b> data, vertex connection definitions are mandatory.</p> <p> For <b>Terramodel</b> data, the file must contain the centreline.</p> <p>For <b>Data type to import: MX Genio</b>: All files with the extension *.txt in the \DATA directory and subfolders on the data storage device can be selected.</p> <p>For <b>Data type to import: Carlson</b>: All Carlson centreline files with the extension *.cl in the \DATA directory and subfolders on the data storage device can be selected.</p> |
| <b>Horizontal alignment</b> | Selectable list | <p>For <b>Data type to import: Carlson</b>: All Carlson horizontal (centreline) elements with the extension *.cl in the \DATA directory and subfolders on the data storage device can be selected.</p> <p>When opening the list, folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed.</p> <p>To select files from the root directory, highlight .. and press <b>Return</b>.</p>   |

| Field                             | Option  | Description   |
|-----------------------------------|---|---|
| <b>Vertical alignment</b>         | Selectable list or <None>                                     | For <b>Data type to import: Carlson</b> : All Carlson vertical (profile) elements with the extension *.pro in the \DATA directory and subfolders on the data storage device can be selected.<br>When opening the list, folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed.<br>To select files from the root directory, highlight .. and press <b>Return</b> .  |
| <b>Section file</b>               | Selectable list or <None>                                     | When opening the list, folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder. The standard folders \Geocom, \Gps and \Map_Images are not listed.<br>To select files from the root directory, highlight .. and press <b>Return</b> .<br>For <b>Data type to import: Terramodel</b> : All ASCII cross section files with the extension *.txt in the \DATA directory and subfolders on the data storage device can be selected.<br>For <b>Data type to import: Carlson</b> : All Carlson cross section files with the extension *.sct in the \DATA directory and subfolders on the data storage device can be selected. |
| <b>Import as</b>                  | <b>Road design , Rail design and Alignment in current job</b> | The type of job the data are converted to.  |
| <b>To file</b>                    | Editable field  | When importing data, a new file must be created for the data to be stored in.   |
| <b>Link design to current job</b> | Check box   | Available for <b>Import as: Road design</b> and <b>Import as: Rail design</b><br>When this box is checked, the imported design job will become linked to the job which was tapped in the job carousel.  |

## Settings

This panel is available for **Data type to import: DXF**, **Data type to import: MX Genio** and **Data type to import: Carlson**.



| Key | Description                      |
|-----|----------------------------------|
| OK  | To return to the previous panel. |

### Description of fields

| Field                               | Option          | Description  |
|-------------------------------------|-----------------|--|
| <b>Linear unit used within file</b> | Selectable list | The units used in the file to import.                                  |
| <b>Line prefix</b>                  | Editable field  | Available for <b>Data type to import: DXF</b> . The prefix to be used. |




### Next step

1. **OK** leads back to **Import Alignment Data**.
2. **OK** opens, depending on the selections made, a panel for the line, layer or track selection.

## Import MX Genio Data, for Road jobs

| Key    | Description  |
|--------|--|
| OK     | To start the import.   |
| Centre | To set the highlighted line as centreline.   |
| Use    | To set <b>Yes</b> or <b>No</b> in the <b>Use</b> metadata for excluding/including the highlighted line from/to import. |

 Line selection is also possible in **3D viewer**.

| IF                                 | THEN  |
|------------------------------------|---|
| a single line must be selected     | tap on the line.  |
| multiple lines must be selected    | click the icons:<br> and <br>Drag the stylus on the panel in a diagonal line to make a rectangular area. |
| the context menu must be activated | hold down the supplied stylus anywhere on the map for 0.5 second. Refer to <a href="#">37.6 Context Menu</a> .  |
|                                    |  To deselect all objects for import, select <b>Clear selection</b> .  |

### Description of metadata

| Metadata          | Description   |
|-------------------|---|
| -                 | Displays the name of all the lines in the layer.  |
| <b>Centreline</b> | Shows <b>Centreline</b> for the line selected as centreline.  |
| <b>Use</b>        | For <b>Yes</b> : The selected line is used for the import.<br>For <b>No</b> : The selected line is not used for the import. |

### Next step

OK start the import.

## Define Track Design, MxGenio for Rail jobs

For MxGenio, only single track Rail jobs can be created.

| Key        | Description   |
|------------|---|
| OK         | To start the import.  |
| Ch CL      | To select/deselect the highlighted line as external chainage centreline. The selection is optional. |
| Track cl   | To select/deselect the highlighted line as track centreline. The selection is mandatory.            |
| Left rail  | To select/deselect the highlighted line as left rail. The selection is optional.                    |
| Right rail | To select/deselect the highlighted line as right rail. The selection is optional.                   |



Line selection is also possible in **3D viewer**.

| IF  | THEN   |
|---|--|
| a single line must be selected/deselected | tap on the line.   |
| the context menu must be activated        | hold down the supplied stylus anywhere on the map for 0.5 second. Refer to <a href="#">37.6 Context Menu</a> . |





### Description of metadata

| Metadata      | Description  |
|---------------|--|
| -             | Displays the name of all the lines.  |
| <b>Use as</b> | Displays a line selected as external chainage centreline, track centreline, left rail or right rail. |

### Next step

OK start the import.

Select Layers to Import, for DXF Road/Rail data, LandXML Road/Rail data, Terramodel Road data and Carlson Road data

| Key                            | Description   |
|--------------------------------|---|
| OK                             | To start the import.  |
| Edit                           | <ul style="list-style-type: none"> <li>For Road: To define the centreline and to exclude/include the highlighted line from/to import.</li> <li>For Rail: To define the external chainage centreline (optional), to define the track centreline (mandatory), to define the left rail (optional) and to define the right rail (optional).</li> </ul> <p> By default, the longest line is set as the centreline.</p> <p> For DXF and LandXML data (Road and Rail), line selection, per layer, is also possible in <b>3D viewer</b>. Names of the Road lines from design data are displayed in black. Names of the selected line is displayed in red.</p> <ul style="list-style-type: none"> <li>To select a single line, tap on the line.</li> <li>For Road: To select multiple lines, click the  and  icon, drag the stylus on the panel in a diagonal line to make a rectangular area.</li> <li>To activate the context menu, hold down the supplied stylus anywhere on the map for 0.5 second. Refer to <a href="#">37.6 Context Menu</a>.</li> </ul> |
| Use                            | To set <b>Yes</b> or <b>No</b> in the <b>Import:</b> metadata for excluding/including the highlighted layer from/to import.   |
| Fn All or Fn None              | To change the setting for the <b>Import:</b> metadata for all layers at once.   |
| <b>Description of metadata</b> |   |
| Metadata                       | Description   |
| -                              | Displays the name of all layers available for importing.  |
| Centreline                     | Shown for the line selected as centreline.  |
| Import:                        | For <b>Yes:</b> The selected layer is used for the import.<br>For <b>No:</b> The selected layer is not used for the import.   |

**Next step**

OK start the import.

# 11

## Job Menu - Export data

### 11.1

#### Overview

#### Description

Data can be exported

- to a file on the data storage device.
- to a file on the internal memory.

#### Export format

| Format                                | Characteristic        | Description   |
|---------------------------------------|-----------------------|---|
| <b>ASCII</b>                          | Export variables      | Point ID, grid coordinates, point codes, code description, up to four attributes and linework. No free codes.   |
|                                       | Format definition     | Free format. Use and order of variables and delimiter can be defined during export.   |
|                                       | Units                 | As currently configured on the instrument   |
|                                       | Height                | Orthometric or ellipsoidal  |
| <b>ASCII with format file</b>         | Export variables      | Refer to the online help of Leica Geo Office or Leica Instrument Tools.   |
|                                       | Format definition     | Composed individually as format file using Leica Geo Office or Leica Instrument Tools. Refer to the online help of Leica Geo Office or Leica Instrument Tools for information on creating format files. |
|                                       | Units                 | Defined within the format file.   |
|                                       | Coordinate conversion | All coordinate types are supported.   |
|                                       | Height                | All height types are supported. If the desired height cannot be computed, the default value for the missing variable is output.   |
|                                       | <b>Specialities:</b>  |   |
| Points in file outside of CSCS model  |                       | If the variable is missing, the default value is output.  |
| Points in file outside of geoid model |                       | If the variable is missing, or a geoid separation is available, the default value is output.  |
| <b>DXF</b>                            | Coordinate conversion | All points are converted to local grid position using the coordinate system.  |
|                                       | Height                | Orthometric height and ellipsoidal height are supported.  |
|                                       | <b>Specialities:</b>  |   |
| Points in file outside of CSCS model  |                       | Points outside of CSCS model are not exported.  |



| Format               | Characteristic   | Description  |
|----------------------|--|--|
|                      | Points in file outside of geoid model                        | The ellipsoidal height is exported.  |
| <b>XML</b>           | Coordinate conversion  | All points are converted to local grid position using the coordinate system.                             |
|                      | Height   | Orthometric height and ellipsoidal height are supported.   |
|                      | <b>Specialities:</b><br>Points in file outside of CSCS model | Local grid position of the points outside of CSCS model is not exported.                                 |
|                      | Points in file outside of geoid model                        | The ellipsoidal height is exported.  |
| <b>Fbk, Rw5, Raw</b> | Coordinate conversion  | All points are converted to local grid position using the coordinate system.                             |
|                      | Height   | If a geoid model exists, then orthometric height is supported, otherwise ellipsoidal height is exported. |
|                      | Units  | Metre, US Ft or Int Feet, Gons, Dec Deg, DMS   |

## 11.2

### Exporting Data from a Job to an ASCII Format

#### Description

The settings on this panel define the data that is converted and exported and what format is used.

Data is exported from the selected job. Currently active view, filter and sort settings are applied.

#### Access


From the job menu select **Export data\ASCII**.

#### Export ASCII Data

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To select the highlighted format file.   |
| <b>Fn Settings</b> | To define the format of the data to be exported.   |
| <b>Fn Filter</b>   | To define the order in which points and lines are exported as well as which points are exported. |

| Key                 | Description  |
|---------------------|--|
| <b>Fn Coord sys</b> | To update the coordinate system in which the coordinates are exported. |

#### Description of fields

| Field              | Option          | Description  |
|--------------------|-----------------|--|
| <b>Job</b>         | Selectable list | To select the job to export.   |
| <b>To device</b>   | Selectable list | Defines where the exported data are saved to.<br> For <b>To device: Internal memory</b> the data is always exported to the \DATA directory. |
| <b>To folder</b>   | Selectable list | The data can be exported to the \DATA or the root directory or to the folder where the selected job is located.  |
| <b>Output file</b> | Editable field  | The name of the file to which the data is exported.  |

#### Next step

**Fn Settings** accesses **Settings**.

## Settings

| Key               | Description                            |
|-------------------|--|
| <b>OK</b>         | To return to the previous panel.       |
| <b>Fn Default</b> | To recall the default import settings. |

#### Description of fields

| Field            | Option          | Description                                 |
|------------------|-----------------|---|
| <b>Delimiter</b> | Selectable list | The separator between the import variables. |

| Field                         | Option   | Description   |
|-------------------------------|--|---|
| 1st position to 16th position | None, Point ID, Easting, Northing, Height, Code, Code information, Code & code info, Code description, 3D quality, 2D quality, 1D quality, Hz angle, V angle, Horizontal distance, Slope distance, Time stamp, GDOP, Attribute 1 to Attribute 4 and Linework | Select the variable of the particular positions. An example is shown on the <b>Export ASCII Data</b> panel. |

### 11.3

### Exporting Data from a Job to a Custom Format

#### Description

The settings on this panel define the data that is converted and exported and what format is used.

Data is exported from the selected job. Currently active view, filter and sort settings are applied.

#### Requirements

At least one format file was created using Leica Geo Office or Leica Instrument Tools and transferred to the internal memory.

#### Access


From the job menu select **Export data\ASCII with format file**.

## Export ASCII (Format File)

Fn OK Fn

| Key          | Description  |
|--------------|--|
| OK           | To select the highlighted format file.   |
| Fn Settings  | To configure the default extension to be used.   |
| Fn Filter    | To define the order in which points and lines are exported as well as which points are exported. |
| Fn Coord sys | To update the coordinate system in which the coordinates are exported.                           |

### Description of fields

| Field         | Option          | Description  |
|---------------|-----------------|--|
| Job           | Selectable list | To select the job to export.   |
| Format file   | Selectable list | The format files currently available in the internal memory.   |
| To device     | Selectable list | Defines where the exported data are saved to.<br> For <b>To device: Internal memory</b> the data is always exported to the \DATA directory.   |
| To folder     | Selectable list | Available for <b>To device: SD card</b> , and <b>To device: USB</b> . The data can be exported to the \DATA, the \GSI or the root directory or to the folder where the selected job is located. Data must be stored to the \GSI directory to be read in a TS instrument. |
| Connect using | Display only    | Available for <b>To device: RS232</b> . The port currently configured for the RS232 interface.   |
| Device        | Display only    | Available for <b>To device: RS232</b> . The device currently configured for the RS232 interface.   |
| Output file   | Editable field  | The name of the file to which the data is exported.  |

## 11.4

### Exporting Data in DXF Format

#### General

Data can be exported to a DXF file in a data storage device or the internal memory.



Do not remove the data storage device while exporting the data.

## Access

From the job menu select **Export data\DXF**.

## Export DXF Data

Export DXF Data

Job: Default

To device: Internal memory

To folder: Data

Output file: Default.dxf

Fn OK Fn

| Key         | Description                 |
|-------------|-----------------------------|
| OK          | To accept the settings.     |
| Fn Settings | To define what is exported. |

### Description of fields

| Field       | Option          | Description   |
|-------------|-----------------|---|
| Job         | Selectable list | To select the job to export.  |
| To device   | Selectable list | Available for <b>To folder: Data</b> . Defines which data storage device the data is exported to.           |
|             | Display only    | Available for <b>To folder: Same as job</b> . Displays the data storage device of the selected <b>Job</b> . |
| To folder   | Selectable list | Defines if the data is exported to the \DATA directory or to the folder where the selected job is located.  |
| Output file | Editable field  | The name of the file to which the data is exported.   |

### Next step

**Fn Settings** goes to **Settings, Objects to be exported** page.

## Settings, Objects to be exported page

Settings

Objects to be exported DXF specific: Label creation

Points

Lines

Closed lines

Images

OK Page

| Key | Description         |
|-----|---------------------|
| OK  | To export the data. |

| Key           | Description   |
|---------------|---|
| <b>Filter</b> | To define the order in which points and lines are exported as well as which points are exported. Refer to <a href="#">7.6 Point Sorting and Filters</a> . |
| <b>Page</b>   | To change to another page on this panel.  |

#### Description of fields

| Field         | Option    | Description                                    |
|---------------|-----------|--|
| <b>Points</b> | Check box | When this box is checked, points are exported. |
| <b>Lines</b>  | Check box | When this box is checked, lines are exported.  |
| <b>Images</b> | Check box | When this box is checked, images are exported. |

#### Next step

**Page** changes to the **DXF specific** page.



#### Settings, DXF specific page

For information on camera and images refer to [34.6 Exporting Images](#).

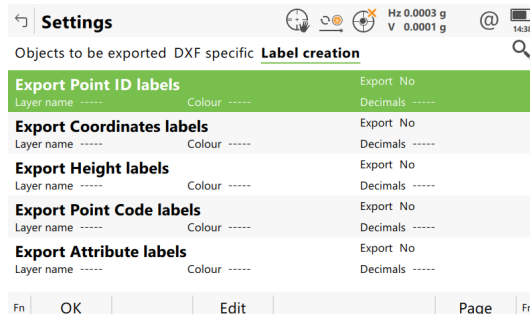
#### Description of fields

| Field                                  | Option          | Description  |
|--|-----------------|--|
| <b>Export lines &amp; closed lines</b> | Selectable list | Defines if lines and closed lines are exported as line or polyline entities. |
| <b>Symbol size</b>                     | Editable field  | Defines the size used for creation of symbols.                               |
| <b>Dimensions</b>                      | Selectable list | Defines if the data is exported as 2D or 3D.                                 |
| <b>DXF layer to export to</b>          | Selectable list | Defines the DXF layer.   |
| <b>Export symbols</b>                  | Check box       | When this box is checked, the relevant symbols are also exported.            |

#### Next step

**Page** changes to the **Label creation** page.

#### Settings, Label creation page



| Key  | Description  |
|------|--|
| OK   | To accept the settings.  |
| Edit | To define if the label is exported, its colour, the number of decimal places to use and what layer or block it is exported to. |
| Page | To change to another page on this panel.   |

#### Description of metadata


| Metadata   | Description   |
|------------|---|
| -          | The name of the label.  |
| Export     | Shows if the label is exported or not.  |
| Layer name | The name of the layer that is exported which can be: <ul style="list-style-type: none"> <li>Name of a user-defined layer<br/>If the label is exported to a user-defined layer.</li> <li><b>Same layer as point</b><br/>If the label is exported to the same layer as the point symbol.</li> <li><b>Block with point</b><br/>If the label is exported to a block with the point symbol.</li> <li>-----<br/>The label is not exported.</li> </ul> |
| Colour     | The colour of the label.  |
| Decimals   | The number of decimals used.  |

#### Next step

**Edit** access a panel to define the export labels.

## Export label

#### Description of fields

| Field                    | Option   | Description  |
|--------------------------|--|--|
| First check box in panel | Check box  | When this box is checked, the chosen label types are exported.<br> All other fields on the panel are active and can be edited.  |
| Colour                   | Selectable list  | Defines the colour for the label.  |
| Export to                | <b>User defined</b><br><b>Same layer as point</b><br><b>Block with point</b> | The label is exported to a user-defined layer.<br>The label is exported to the layer which the point symbols are exported to.<br>The label is exported to a block with the point symbol and all other labels which are also set to be exported to <b>Block with point</b> . Only one block is created for a point and there can be one or more labels in this block. |

| Field                           | Option          | Description  |
|---------------------------------|-----------------|--|
| <b>Layer name</b>               | Selectable list | Available for <b>Layer name: User defined</b> is checked. The name of the layer.   |
| <b>Export code descriptions</b> | Check box       | Available when <b>Export Point Code labels</b> is highlighted in <b>Settings, Label creation</b> page. Defines if the code descriptions are exported with the point code.    |
| <b>Export attribute names</b>   | Check box       | Available when <b>Export Attribute labels</b> is highlighted in <b>Settings, Label creation</b> page. Defines if the attribute names are exported with the attribute values. |

### Next step

OK returns to **Settings**.

## 11.5

### Exporting Data in XML Format

#### General

Data can be exported to an XML file in the

- \DATA directory or
- same directory as the job is in

on the

- data storage device or
- internal memory.



Do not remove the data storage device while exporting the data.

#### Access

From the job menu select **Export data\XML**.

#### Export XML Data

| Key         | Description                 |
|-------------|-----------------------------|
| OK          | To export the data.         |
| Fn Settings | To define what is exported. |



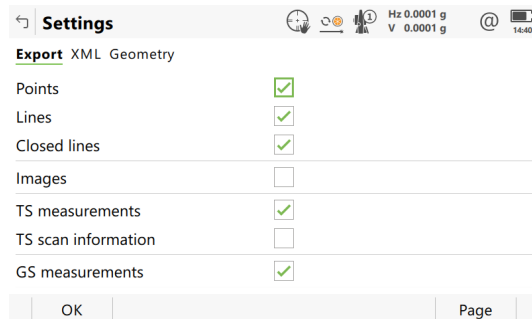
### Description of fields

| Field              | Option   | Description   |
|--------------------|--|---|
| <b>Job type</b>    | <b>Points/lines, Road design, Rail design or Tunnel design</b> | The type of job to be exported. To use this option, select <b>LandXML version: 1.2</b> and check <b>Use Hexagon XML extension</b> in <b>Settings, XML</b> page. |
| <b>Job</b>         | Selectable list  | To select the job to export. The selectable list depends on the setting for <b>Job type</b> .   |
| <b>To device</b>   | Selectable list  | Defines where the exported data are saved to.   |
| <b>To folder</b>   | Selectable list  | The data can be exported to the \DATA directory or to the folder where the selected job is located.   |
| <b>Output file</b> | Editable field   | The name of the file to which the data is exported.   |

### Next step

Fn **Settings** goes to **Settings, Export** page.

### Settings, Export page



| Key         | Description                              |
|-------------|--|
| <b>OK</b>   | To return to the previous panel.         |
| <b>Page</b> | To change to another page on this panel. |

### Description of fields

| Field                  | Option    | Description  |
|------------------------|-----------|--|
| <b>Points</b>          | Check box | When this box is checked, points are exported.                               |
| <b>Lines</b>           | Check box | When this box is checked, lines are exported.                                |
| <b>Closed lines</b>    | Check box | When this box is checked, closed lines are exported.                         |
| <b>Images</b>          | Check box | When this box is checked, all onboard, TS and panoramic images are exported. |
| <b>TS measurements</b> | Check box | When this box is checked, TS observations are exported.                      |

| Field                      | Option    | Description   |
|----------------------------|-----------|---|
| <b>TS scan information</b> | Check box | When this box is checked, information about any scans is exported. This includes the scan definition information, but not the current scan points.  |
| <b>GS measurements</b>     | Check box | When this box is checked, GPS observations are exported.  |
| <b>Codes</b>               | Check box | When this box is checked, point codes and line codes are exported.  |
| <b>Free codes</b>          | Check box | When this box is checked, the free code, free code description, free code group and the free code attributes, are all exported to the LandXML file associated to each exported point.<br><br>Free code export works also when <b>Use Hexagon XML extension</b> is checked on the <b>XML</b> page. |
| <b>App results</b>         | Check box | When this box is checked, all app results are exported. They are only exported when <b>Use Hexagon XML extension</b> is checked on the <b>XML</b> page.   |

#### Next step

**Page** changes to the **XML** page.



For information on camera and images refer to [34.6 Exporting Images](#).

#### Settings, XML page

#### Description of fields

| Field                            | Option          | Description  |
|----------------------------------|-----------------|--|
| <b>Dimensions</b>                | Selectable list | Defines the dimension of the exported entities.  |
| <b>LandXML version</b>           | Selectable list | Defines the LandXML version of the file exported file.   |
| <b>Use Hexagon XML extension</b> | Check box       | Available for <b>LandXML version: 1.2</b> . When this box is checked, a job type can be selected for the export in the <b>Export XML Data</b> panel. |

#### Next step

**Page** changes to the **Geometry** page.

Description of fields

| Field                                       | Option    | Description  |
|---|-----------|--|
| <b>Export splines as Civil 3D multi arc</b> | Check box | When this box is checked, splines will be exported as multi-arcs. This is needed since some CAD software does not support splines. The use of this check box allows long, meandering objects in the field, such as fence lines, can be measured as splines and still be accurately represented in all CAD packages - even those where splines are not supported  |
| <b>Export closed lines as Parcels</b>       | Check box | When this box is checked, closed lines are exported as parcels.<br>When this box is not checked, the closed lines are exported as plan features but with the same the contents as for parcels. Then software such as Carlson can import closed lines from a LandXml file, as they only read plan features in their field-to-finish routine. Parcel objects are used in AutoCAD Civil 3D. Parcels represent lots in a subdivision of real estates or features with closed boundaries, such as bodies of water and soil regions. |

11.6

Exporting Data using Stylesheets

Access

From the job menu select **Export data\XML with stylesheet.**

Export XML  
(Stylesheet)

| Key | Description         |
|-----|---------------------|
| OK  | To export the data. |

Description of fields

| Field                            | Option   | Description   |
|----------------------------------|--|---|
| <b>Job type</b>                  | <b>Points/lines, Road design, Rail design or Tunnel design</b> | The type of job to be exported.   |
| <b>Job</b>                       | Selectable list  | To select the job to export.  |
| <b>Use protected stylesheets</b> | Check box  | When this box is checked, a protected stylesheet is used. *.lss files currently available in the \CONVERT folder on the internal memory are listed.<br><br>When this box is not checked, a standard stylesheet is used. *.xsl files currently available in the \CONVERT folder on the internal memory are listed. |

| Field                    | Option          | Description  |
|--------------------------|-----------------|--|
| <b>Password</b>          | Editable field  | Available when <b>Use protected stylesheets</b> is checked.<br>The password allows the use of *.lss protected stylesheets. The password can have 16 characters at maximum.<br><br>If the password is correct and <b>OK</b> is pressed, then the export will be carried out<br><br>If the password is incorrect and <b>OK</b> is pressed, then the export cannot be carried out.<br><br>An error message is displayed in case of a wrong password or a problem derived from the export. |
| <b>Stylesheet to use</b> | Selectable list | The style sheets currently available in the \CONVERT folder on the internal memory.  |
| <b>Description</b>       | Display only    | A detailed description of the style sheet.<br>When <b>Use protected stylesheets</b> is not checked, then this information is entered by the user in a variable within the style sheet.<br>When <b>Use protected stylesheets</b> is checked and the correct password was typed in, then this information read and displayed from the style sheet.   |
| <b>To device</b>         | Selectable list | Defines where the exported data is saved to.   |
| <b>To folder</b>         | Selectable list | The data can be exported to the \DATA directory or to the folder where the selected job is located.  |
| <b>Output file</b>       | Editable field  | The name of the file to which the data is exported. The file extension is defined by the user in a variable inside the style sheet. Default is "txt" if the extension has not been defined.  |

## 11.7

### Exporting Data in FBK/RW5/RAW Format

#### General

Data can be exported to file with the format of:

- AutoDesk FBK
- TDS RAW
- TDS RW5
- Carlson RW5
- MicroSurvey RW5
- Bentley's software solutions

The newly created file is stored in the \DATA directory of the data storage device or to the folder where the export job is located.

The formatted FBK files can be imported directly into Autodesk products.

The created RW5, RAW and RWD files can be processed with various survey office packages.

Although the export operation converts any job to an FBK/RW5/RAW/RWD file, the figure creation is based on existing lines present in the job.



Do not insert "best fit arc" geometry in the linework. CAD packages do not support "best fit arc" geometry via FBK or RW5 formats. Line geometry modifications (editing or reversing) that are done after linework measurements are only supported by the FBK format.

### Point codes

Each point collected should have a point code.

| IF you are creating  | THEN  |
|----------------------|---|
| Autodesk FBK file    | Point codes are used to match the Description Keys in Autodesk LDT and Civil 3D to each position located. |
| TDS RW5 file         | Point codes are used to generate raw linework in TDS Foresight.   |
| MicroSurvey RW5 file | Point codes are used to match the Description Keys in MicroSurvey CAD to each position located.           |

### Line ID

| IF you are creating  | THEN   |
|----------------------|--|
| Autodesk FBK file    | The figure ID follows the user selection as defined in the setting menu. |
| TDS RW5 file         | The line IDs are not used when importing data into TDS Foresight.        |
| MicroSurvey RW5 file | The line IDs are not used when importing data into MicroSurvey CAD 2005. |



Do not remove the data storage device while exporting the data.

### Access

From the job menu select **Export data\Fbk, Rw5, Raw**.

### Export Fbk/Rw5/Raw/Rwd

Export Fbk/Rw5/Raw/Rwd

Job: Default

Export format: Autodesk FBK

To device: SD card


To folder: Data

Output file: Default

Fn OK Fn

| Key         | Description                                |
|-------------|--|
| OK          | To export the data.                        |
| Fn Settings | To configure some format-specific options. |

### Description of fields

| Field                | Option   | Description  |
|----------------------|--|--|
| <b>Job</b>           | Selectable list  | To select the job to export.   |
| <b>Export format</b> | <b>Autodesk FBK, TDS RW5, TDS RAW, Carlson RW5, MicroSurvey RW5 or Bentley RWD</b> | Ensure that this field is set properly.  |
| <b>To device</b>     | Selectable list  | Defines where the exported data are saved to.  |
| <b>To folder</b>     | Display only   | The data can be exported to the \DATA directory or to the folder where the export job is located.  |
| <b>Output file</b>   | Editable field   | Default is the name of the selected <b>Job</b> . It can be changed.<br> The extension designation (.FBK, .RW5, .RAW or RWD) is added automatically. |

### Next step

**Fn Settings** to access the setting panel.

Settings for Fbk Export, General page

### Description of fields

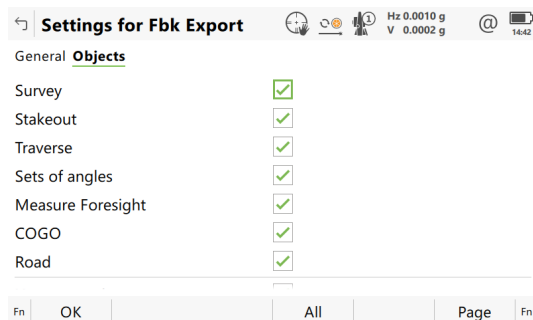
| Field                                 | Option            | Description   |
|---------------------------------------|-------------------|---|
| <b>Use numerical point ID</b>         | Check box         | Available unless <b>Export format: TDS RW5</b> .  |
| <b>Point ID offset</b>                | Editable field    | Available when <b>Use numerical point ID</b> is checked. The point IDs are offset by this value.  |
| <b>Use angle right</b>                | Check box         | Define if angle right values are exported.  |
| <b>Split measurements and figures</b> | Check box         | When this box is checked, TS linework is shifted after the measurements. This setting supports cases where the line is edited or reversed.  |
| <b>Figure ID</b>                      |                   | Available for <b>Export format: Autodesk FBK, Export format: Carlson RW5 and Export format: MicroSurvey RW5</b> . The name that will be assigned to the figure or linework geometry in the CAD program. |
|                                       | <b>Point code</b> | The point code is used as ID.   |

| Field  | Option         | Description   |
|--|----------------|---|
|  | <b>Line ID</b> | Selecting <b>Line ID</b> is the only way to support simultaneous lines for <b>Carlson RW5</b> and <b>MicroSurvey RW5</b> formats. <b>TDS RW5</b> and <b>TDS RAW</b> formats have no way to support simultaneous lines.  |
| <b>Create feature code (FC) and attribute (AT) records</b>                 | Check box      | Available for <b>Export format: TDS RAW</b> . When this box is checked, the <b>Feature Code</b> and <b>Attribute</b> records are used to provide point code and attributes in a more detailed format.   |
| <b>Append first 2 attributes to pt code instead of creating AT records</b> | Check box      | Available for <b>Export format: TDS RAW</b> and when <b>Create feature code (FC) and attribute (AT) records</b> is checked. When this box is checked, then the two first attributes are appended directly to the code and not written as <b>Attribute</b> record. |

### Next step

Page changes to the **Objects** page.

## Settings for Fbk Export, Objects page



| Key         | Description                                  |
|-------------|--|
| <b>OK</b>   | To return to <b>Export Fbk/Rw5/Raw/Rwd</b> . |
| <b>All</b>  | To check all boxes at once.                  |
| <b>Page</b> | To change to another page on this panel.     |

### Description of fields

| Field      | Option    | Description                                 |
|------------|-----------|---|
| All fields | Check box | To include points from an app, check a box. |

### Next step

**OK** returns to **Export Fbk/Rw5/Raw/Rwd**.

## 11.8

### Description



## Copy Data Between Jobs

This chapter explains the process of copying data from one job to another.

Important features:

- Points are copied as defined by the point filter settings.
- Points selected for copying can be viewed in a points listing. The point sort settings define the order of the points in the listing. The point filter settings define the points to be viewed in the listing.
- Only points are copied - observation data is not copied.
- When points are copied from one job to another:
  - the point codes and attached attributes are also copied.
  - the **Class** is retained.
  - the **Sub class** is retained.
  - the **Source** is changed to **Copied Point**.
  - the point coordinate quality is retained.
  - the **Date** and **Time** is retained.

## Access

From the job menu select **Export data**, scroll down and select **Between jobs**.

## Copy Data Between Jobs

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To copy a selection of points.   |
| <b>Filter</b> | To define the point sort and/or point filter settings of points from the job. Refer to <a href="#">7.6 Point Sorting and Filters</a> .   |
| <b>Data</b>   | To view, edit and delete points and lines stored with the job. Points and lines are shown on separate pages. Selected sort and filter settings apply. Refer to <a href="#">7 Job Menu - View &amp; edit data</a> . |

### Description of fields

| Field           | Option          | Description                                 |
|-----------------|-----------------|---|
| <b>From job</b> | Selectable list | Describes where the points are copied from. |
| <b>To job</b>   | Selectable list | Describes where the points are copied to.   |





All changes made affect the design job.

### Linked jobs and global data

Linked jobs will overwrite the points and lines from the global design job selected in **Design Data**.

### Access

Select **Leica Captivate - Home: Create pts & lines**.



**Data** displays the data in the design job.

### Create a Point, Coordinates page

For all point fields, the 3D viewer can be used to select the desired point.

| Key  | Description   |
|--|---|
| <b>Store</b>                               | To store the line/arc to the design job.  |
| <b>Next</b>                                | To store the line/arc and to remain in the panel. The line ID increments according to line ID template.                                     |
| <b>Meas app</b>                            | To measure a point manually. Available when a point field is highlighted.   |
| <b>Fn Indiv ID</b><br>and<br><b>Fn Run</b> | To change between entering an individual line ID different to the defined ID template and the running line ID according to the ID template. |

### Description of fields

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Line ID</b>              | Editable field | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of line IDs, type over the line ID.</li> <li>For an individual name independent of the ID template <b>Fn Indiv ID</b>. <b>Fn Run</b> changes back to the next ID from the configured ID template.</li> </ul> |
| <b>Azimuth</b>              | Editable field | The azimuth of the line from the start point.  |
| <b>Difference in height</b> | Editable field | The difference in height from the start point to the end point of the line.  |
| <b>Grade</b>                | Editable field | The gradient of the line from the start point to the end point of the line.  |
| <b>Horizontal distance</b>  | Editable field | The horizontal grid distance from the start point to the end point of the line.  |
| <b>Line length</b>          | Display only   | For lines: The horizontal grid distance between the two points of the line. If the distance cannot be calculated, ----- is displayed.<br><br>For arcs: The horizontal grid distance along the arc between the points. If the distance cannot be calculated, ----- is displayed.  |

| Field               | Option          | Description   |
|---------------------|-----------------|---|
| <b>Radius</b>       | Editable field  | The radius of the arc.  |
| <b>Start point</b>  | Selectable list | The first point forming the line.   |
| <b>Second point</b> | Selectable list | The medium point forming the arc.   |
| <b>End point</b>    | Selectable list | The last point forming the line.  |
| <b>Point ID</b>     | Editable field  | The end point of the defined line. Available for creating a line with <b>Method:Point, brng, dist, height diff</b> or <b>Point, brng, dist, grade</b> . |

## Methods for creating lines, arcs and polylines

### Description of fields

| Field         | Option   | Description   |
|---------------|--|---|
| <b>Method</b> |  | Select one of the following options to create a line/arc/polyline.  |
|               | <b>2 points and Line from 2 points</b>   | For lines/polylines. Uses two known points to define the line.  |
|               | <b>Point, brng, dist, grade and Line from point, bearing, distance &amp; grade</b>                   | For lines/polylines. Defines the line using a known point, a distance, an azimuth and the gradient of the line. A new point is created at the end of the line.  |
|               | <b>Point, brng, dist, height diff and Line from point, bearing, distance &amp; height difference</b> | For lines/polylines. The same as <b>Point, brng, dist, grade/Line from point, bearing, distance &amp; grade</b> but uses the difference in height instead of the gradient. A new point is created at the end of the line. |
|               | <b>3 points and Arc from 3 points</b>  | For arcs/polylines. Defines the arc using three known points.   |
|               | <b>2 points &amp; radius and Arc from 2 pts &amp; a radius</b>                                       | For arcs/polylines. Defines the arc with two known points and a known radius.   |

## Create new line/arc

For all point fields, the 3D viewer can be used to select the desired point.

| Key                             | Description   |
|---------------------------------|---|
| <b>Store</b>                    | To store the line/arc to the design job.  |
| <b>Next</b>                     | To store the line/arc and to remain in the panel. The line ID increments according to line ID template.                                     |
| <b>Meas app</b>                 | To measure a point manually. Available when a point field is highlighted.   |
| <b>Fn Individ ID and Fn Run</b> | To change between entering an individual line ID different to the defined ID template and the running line ID according to the ID template. |

### Description of fields

| Field                       | Option          | Description  |
|-----------------------------|-----------------|--|
| <b>Line ID</b>              | Editable field  | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of line IDs, type over the line ID.</li> <li>For an individual name independent of the ID template <b>Fn Individ ID</b>. <b>Fn Run</b> changes back to the next ID from the configured ID template.</li> </ul> |
| <b>Azimuth</b>              | Editable field  | The azimuth of the line from the start point.  |
| <b>Difference in height</b> | Editable field  | The difference in height from the start point to the end point of the line.  |
| <b>Grade</b>                | Editable field  | The gradient of the line from the start point to the end point of the line.  |
| <b>Horizontal distance</b>  | Editable field  | The horizontal grid distance from the start point to the end point of the line.  |
| <b>Line length</b>          | Display only    | For lines: The horizontal grid distance between the two points of the line. If the distance cannot be calculated, ----- is displayed.<br>For arcs: The horizontal grid distance along the arc between the points. If the distance cannot be calculated, ----- is displayed.  |
| <b>Radius</b>               | Editable field  | The radius of the arc.   |
| <b>Start point</b>          | Selectable list | The first point forming the line.  |
| <b>Second point</b>         | Selectable list | The medium point forming the arc.  |
| <b>End point</b>            | Selectable list | The last point forming the line.   |

| Field           | Option         | Description   |
|-----------------|----------------|---|
| <b>Point ID</b> | Editable field | The end point of the defined line. Available for creating a line with <b>Method:Point, brng, dist, height diff</b> or <b>Point, brng, dist, grade</b> . |

### Create new polyline - Several segments


1. In **Create a Polyline** select **Several segments**.
2. Select the method to use for the first segment. Refer to [Methods for creating lines, arcs and polylines](#) for a description of methods.
3. Type in the values for the first segment. Refer to [Create new line/arc](#) for a description of the fields.
4. **Next** to store the segment.
5. Repeat step 2. to 4. until all segments are entered.
6. **Finish** to store the polyline.


### Create new polyline - Several entered points

In **Create a Polyline** select **Several entered points**.

| Key                                  | Description   |
|--------------------------------------|---|
| <b>Store</b>                         | To store the line to the design job.  |
| <b>Fn Indiv ID</b> and <b>Fn Run</b> | To change between entering an individual line ID different to the defined ID template and the running line ID according to the ID template. |

#### Description of fields

| Field                                | Option         | Description  |
|--------------------------------------|----------------|--|
| <b>Line ID</b>                       | Editable field | The name of the new line. The configured ID template for lines is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>• To start a new sequence of line IDs, type over the line ID.</li> <li>• For an individual name independent of the ID template <b>Fn Indiv ID</b>. <b>Fn Run</b> changes back to the next ID from the configured ID template.</li> </ul>   |
| <b>Create line from these points</b> | Editable field | Enter a list of points from the design job and characters to define the line. <p>.</p> <p>Entering a dot between the points adds point-by-point to the polyline.<br/>Example: Entering 1.3.5 creates a polyline with the points 1, 3 and 5 in that order.</p> <p>-</p> <p>Entering a minus between the points adds all points between the two points to the polyline, according to the point ID ordering.<br/>Example: Entering 1-5 creates a polyline with all points between 1 and 5.</p> <p> This can only be used with numeric point IDs.</p> |

| Field              | Option       | Description   |
|--------------------|--------------|---|
|                    | ()           | Entering () creates an arc between the points which are outside () through the point which is inside ().<br>Example: Entering 1(3)5 creates a 3-point arc from 1 to 5 through 3 as the arc mid point.   |
| <b>Line length</b> | Display only | The calculated 2D line length according to the selected points. Units according to distance in regional settings.<br><br> The line length is shown in the unit configured in <b>Regional, Distance</b> page. |

## Create Offset Line & Points

| Key         | Description                                 |
|-------------|---|
| <b>OK</b>   | To store the line/points to the design job. |
| <b>Page</b> | To change to another page on this panel.    |

### Description of fields

| Field                    | Option                   | Description   |
|--------------------------|--------------------------|---|
| <b>Line ID</b>           | Selectable list          | To select a line. Open the selectable list to access the <b>Line Selection</b> panel showing all selectable lines from the design job.  |
| <b>Objects to create</b> | <b>Line</b>              | To create lines only.   |
|                          | <b>Points</b>            | To create points only.  |
|                          | <b>Line &amp; points</b> | To create lines and points.   |
|                          | <b>Single point</b>      | To create only one point.   |
| <b>Offset</b>            | Editable field           | Perpendicular offset of the line. Left is negative. Right is positive.  |
| <b>Line ID</b>           | Editable field           | The name of the new line. The configured ID template for lines is used. Type over the line ID to change it.   |
| <b>Starting point ID</b> | Editable field           | The point ID of the line start point. The configured ID template for points is used.  |
| <b>Start chainage</b>    | Display only             | The beginning chainage of the line.   |
| <b>Chainage</b>          | Editable field           | Chainage of the current position along the line.  |
| <b>Point ID</b>          | Editable field           | The name of the new point. The configured point ID template is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of point IDs, type over the point ID.</li> </ul> |

| Field | Option | Description  |
|-------|--------|--|
|       |        | <ul style="list-style-type: none"> <li>For an individual name independent of the ID template <b>Fn Tools</b> and then <b>Individual point ID. Fn Tools</b> and then <b>Sequential point ID</b> changes back to the next ID from the configured ID template.</li> </ul> |

### Extend existing polyline

1. In **Choose line to extend** select the line to extend.
2. **OK.**
3. Continue as if creating a new polyline. Refer to [Create new polyline - Several segments](#).

# 13

## Connections - GS connection wizard

### Description

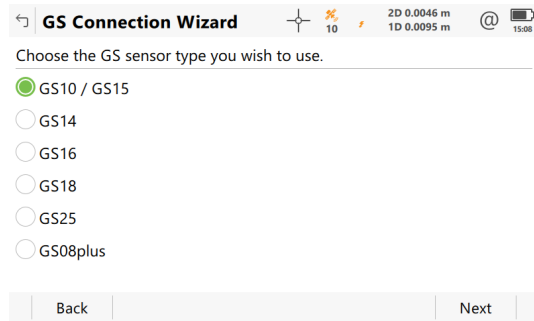
This chapter explains how the field controller can be connected with a GNSS antenna using a wizard.

### Access

Select **Leica Captivate - Home: Settings\Connections\GS connection wizard**.

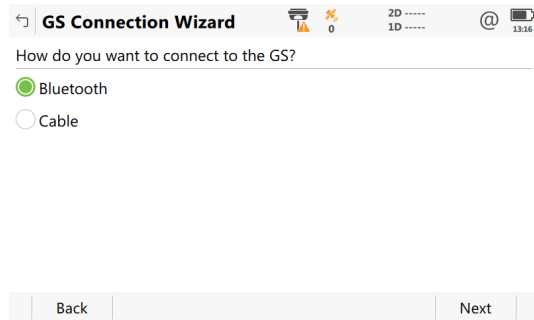
 Unavailable for CS30/CS35.

### GS Connection Wizard - Step 1



| Key  | Description  |
|------|--|
| Back | To return to the previous panel.                           |
| Next | To confirm the settings and to continue to the next panel. |

### GS Connection Wizard - Step 2



| Key  | Description  |
|------|--|
| Back | To return to the previous panel.                           |
| Next | To confirm the settings and to continue to the next panel. |

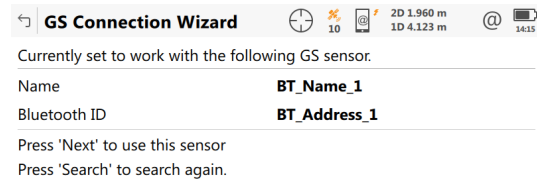
### Next step

**Next** changes to the next panel.

| IF                        | THEN  |
|---------------------------|---|
| connected using cable     | follow the instructions on the panel.   |
| connected using Bluetooth | the panel shown depends on whether a Bluetooth GS connection has previously been configured or not. |

## GS Connection Wizard - Step 3

This panel is displayed if a Bluetooth connection has previously been configured.



| Key    | Description  |
|--------|--|
| Back   | To return to the previous panel.                           |
| Search | To search for a different GS instrument.                   |
| Next   | To confirm the settings and to continue to the next panel. |

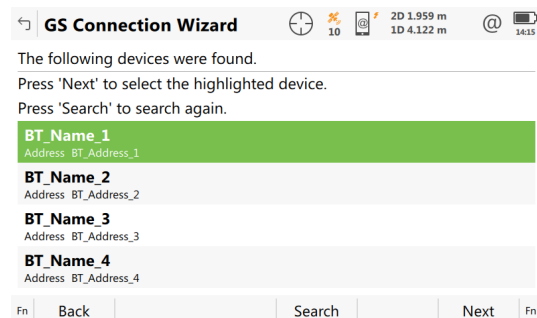
### Next step

Follow the instructions on the panel.

## GS Connection Wizard - Step 4

This panel is displayed if NO Bluetooth connection has previously been configured.

Move the focus using the arrow keys or the stylus to select a Bluetooth device.



| Key    | Description   |
|--------|---|
| Back   | To return to the previous panel.                                  |
| Search | To search again for a GS.   |
| Next   | To connect to the selected device and continue to the next panel. |

### Next step

Follow the instructions on the panel.



# 14

## Connections - TS connection wizard

### 14.1

### Starting the TS Connection Wizard

#### Description

This chapter explains how the field controller can be connected with a total station using a wizard.

#### Access

Select **Leica Captivate - Home: Settings\Connections\TS connection wizard**.



Unavailable for CS30/CS35.

#### TS Connection Wizard - Step 1

Choose the total station you wish to use

Manufacturer: Leica

Model: TPS1200

Connect using: Bluetooth

Back      Next

| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |

#### Description of fields

| Field                | Option   | Description  |
|----------------------|--|--|
| <b>Manufacturer</b>  | Selectable list  | The brand of the instrument.   |
| <b>Model</b>         | Selectable list  | The instrument model.  |
| <b>Connect using</b> | <b>Cable, Bluetooth, Long-range TS or External radio</b> | How the instrument is connected. The options available depend on the selection for <b>Model</b> .  |
|                      | <b>CTR20 expansion pack</b>                              | The CTR20 can only be used on the field controller.<br>To connect a field controller with CTR20 attached to a TS with RH16/RH17/RH18/TCPS29/TCPS30 attached.<br>Offline configuration is possible if a Bluetooth address is known. |
|                      | <b>CTR30 LRBT module</b>                                 | To connect a CS30 with long-range Bluetooth module to a TS with RH16/RH17/RH18/TCPS29/TCPS30 attached.   |

| Field   | Option                  | Description   |
|---|-------------------------|---|
|   | <b>CTR35 LRBT Stick</b> | To connect a CS35 with long-range Bluetooth stick attached to a TS with RH16/ RH17/RH18/TCPS29/TCPS30 attached.   |
| <b>Reduce video streaming rate for long distance connection</b> | Check box               | Available for <b>Connect using: CTR30 LRBT module</b> .<br>When this box is checked and when the connection between field controller and total station is over a long distance, then the sequence of the live videos created from the 3D data taken by the camera of the instrument is reduced. |

### Next step

**Next** changes to the next panel.

## 14.2

### Connection Using Cable

#### Description

The connection settings must be specified.

#### TS Connection Wizard - Step 2

TS Connection Wizard

Ensure the same settings are made on the total station

Baud rate: 115200

Parity: None

Data bits: 8

Stop bit: 1

Flow control: None

Back Default Next

| Key            | Description  |
|----------------|--|
| <b>Back</b>    | To return to the previous panel.                           |
| <b>Default</b> | To return the fields back to their default values.         |
| <b>Next</b>    | To confirm the settings and to continue to the next panel. |

#### Description of fields

| Field            | Option                            | Description  |
|------------------|-----------------------------------|--|
| <b>Baud rate</b> | From <b>1200</b> to <b>115200</b> | Frequency of data transfer from instrument to device in bits per second. |
| <b>Parity</b>    | <b>None, Even</b> or <b>Odd</b>   | Error checksum at the end of a block of digital data.                    |
| <b>Data bits</b> | <b>6, 7</b> or <b>8</b>           | Number of bits in a block of digital data.                               |
| <b>Stop bit</b>  | <b>1</b> or <b>2</b>              | Number of bits at the end of a block of digital data.                    |

| Field        | Option          | Description  |
|--------------|-----------------|--|
| Flow control | None or RTS/CTS | Activates hardware handshake. When the instrument/device is ready for data, it asserts the Ready To Send line indicating it is ready to receive data. This line is read by the sender at the Clear To Send input, indicating it is clear to send the data. |

#### Next step

**Next** and follow the instructions on the panel.

## 14.3

### Connection Using Bluetooth

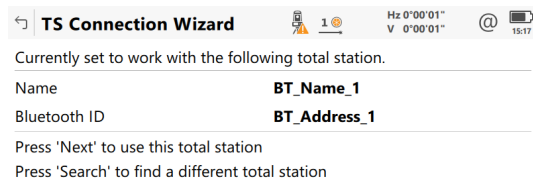
#### Description

The panel shown depends on whether a last used Bluetooth ID is available for the chosen instrument model.

#### TS Connection Wizard - Step 2

This panel is displayed if the chosen instrument model has a previously used Bluetooth ID already stored.

For a CTR20 connection, the last total station with RH17/TCPS30 which was connected is displayed.



| Key           | Description  |
|---------------|--|
| <b>Back</b>   | To return to the previous panel.   |
| <b>Search</b> | To search for a different total station. For a CTR20 connection also: To check if the radio used for the connection was changed. |
| <b>Next</b>   | To confirm the settings and to continue to the next panel.   |

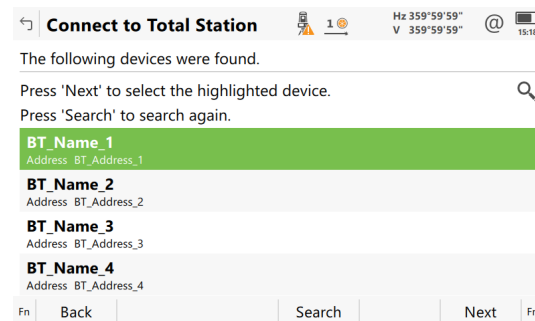
#### Next step

Follow the instructions on the panel.

## Connect to Total Station - Step 2

This panel is displayed if the chosen instrument model has NO previous used Bluetooth ID already stored.

Move the focus using the arrow keys or the stylus to select a Bluetooth device.



| Key    | Description   |
|--------|---|
| Next   | To connect to the selected device and continue to the next panel. |
| Search | To search for a different total station.                          |
| Back   | To return to the previous panel.                                  |

### Next step

Follow the instructions on the panel.

## 14.4

### TS Connection Wizard - Step 2

## Connection Using Internal Radio

### Description of fields

| Field       | Option         | Description  |
|-------------|----------------|--|
| Link number | Editable field | The assigned channel number.   |
| Set as      | Remote or Base | The radio modules inside the field controller and the TS instrument must be set to opposite settings. Set the field controller to <b>Remote</b> and TS instrument to <b>Base</b> . |

### Next step

**Next** and follow the instructions on the panel.

## 14.5



## Connection To Leica Legacy and Third Party Total Stations

Once you begin working with the CS always work on the controller! Do not touch the total station software, excluding turning the laser pointer, laser plummet or guide lights on/off for some models.



Refer to [35.6 Connection to Other Total Stations](#) for supported functions.

### Settings required

Before using any Leica Legacy or third-party total station, ensure that the following values are set on the **TS**:

| Instrument                         | Settings  |
|------------------------------------|---|
| Leica Legacy total station         | <ol style="list-style-type: none"> <li>1. Total station ppm/scale: <ul style="list-style-type: none"> <li>• Atmospheric ppm = 0</li> <li>• Geometric ppm = 0 or scale factor = 1</li> </ul> <p>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.</p> </li> <li>2. Communication settings: <ul style="list-style-type: none"> <li>• The communication settings on the TS must match the default parameters for that particular instrument type as seen on the CS.</li> <li>• For TPS1000 and TPS1100 instruments: <ul style="list-style-type: none"> <li>• set the communication mode to GSI</li> <li>• ensure the TS is in the measurement panel when trying to connect.</li> </ul> </li> </ul> </li> </ol>   |
| Third-party total station - Topcon | <ol style="list-style-type: none"> <li>1. Total station ppm/scale: <ul style="list-style-type: none"> <li>• Atmospheric ppm = 0</li> <li>• Geometric ppm = 0 or scale factor = 1</li> <li>• Prism constant = 0 (non-motorised instruments only)</li> <li>• The vertical angle on the total station must be set to zenith for all Topcon instruments.</li> <li>• The angular unit on both the total station and controller must match</li> </ul> <p>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.</p> </li> <li>2. Communication settings: <ul style="list-style-type: none"> <li>• The communication settings on the TS must match the default parameters for that particular instrument type as seen on the CS.</li> <li>• On motorised Topcon total stations, for example GTS800 and above, set the communication values through <b>Prog\Ext. Link\Setting\RS232</b>.</li> <li>• For non-motorised instruments, ensure that the total station is in the measurement panel when trying to connect.</li> </ul> </li> <li>3. External Link mode <ul style="list-style-type: none"> <li>• To connect to motorised Topcon total stations, for example GTS800 and above, set the external link mode through <b>Prog\Ext. Link\Execute</b>.</li> </ul> </li> </ol> |

| Instrument                         | Settings  |
|------------------------------------|---|
|                                    | 4. Required cable: <ul style="list-style-type: none"> <li>• TDS DB9 Data Cable (148 SCGTSSOKTOP – Topcon/Sokkia)</li> </ul>   |
| Third party total station - Sokkia | <ol style="list-style-type: none"> <li>1. Total station ppm/scale:             <ul style="list-style-type: none"> <li>• Atmospheric ppm = 0</li> <li>• Geometric ppm = 0 or scale factor = 1</li> <li>• Prism constant = 0</li> <li>• The vertical angle display setting must be the same on the CS and the total station</li> </ul> <p>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.</p> </li> <li>2. Units:             <ul style="list-style-type: none"> <li>• For a Sokkia Set030R/220/010 instrument, the angle unit at the total station must be set to degrees, minutes, seconds. The angle setting at the CS does not matter.</li> </ul> </li> <li>3. Communication settings:             <ul style="list-style-type: none"> <li>• The communication settings on the TS must match the default parameters for that particular instrument type as seen on the CS.</li> <li>• For all Sokkia instruments, ensure the TS is in the measurement panel when trying to connect.</li> <li>• On motorised Sokkia total stations, set additional total station communication values: <b>Comms mode: RS232C, Checksum: No</b> and <b>Controller: 2 Way + Remote</b></li> <li>• For the Sokkia SRX set <b>Tilt correction: No</b> to have an uninterrupted connection. On the total station go to <b>Settings\Obs. Condition\Tilt crn: No</b>.</li> </ul> </li> <li>4. Required cable:             <ul style="list-style-type: none"> <li>• TDS DB9 Data Cable (148 SCGTSSOKTOP – Topcon/Sokkia)</li> </ul> </li> </ol> |

| Instrument                        | Settings   |
|-----------------------------------|--|
| Third party total station - Nikon | <ol style="list-style-type: none"> <li>1. Total station ppm/scale: <ul style="list-style-type: none"> <li>• Atmospheric ppm = 0</li> <li>• Geometric ppm = 0 or scale factor = 1</li> <li>• Prism constant = 0</li> <li>• The angular unit on both the total station and controller must match</li> </ul> <p>These settings ensure that the correct coordinates are calculated at the CS. It is still possible to apply the relevant atmospheric and geometric ppm/scale factor values. These values must then be set on the CS.</p> </li> <li>2. Communication settings: <ul style="list-style-type: none"> <li>• The communication settings on the TS must match the default parameters for that particular instrument type as seen on the CS.</li> <li>• For all Nikon instruments, ensure the TS is in the measurement panel when trying to connect.</li> </ul> </li> <li>3. Required cable: <ul style="list-style-type: none"> <li>• TDS DB9 Data Cable (148 CNTG Nikon)</li> </ul> </li> </ol> |

# 15

# Connections - CS connection wizard

## 15.1

## Starting the CS Connection Wizard



### Description

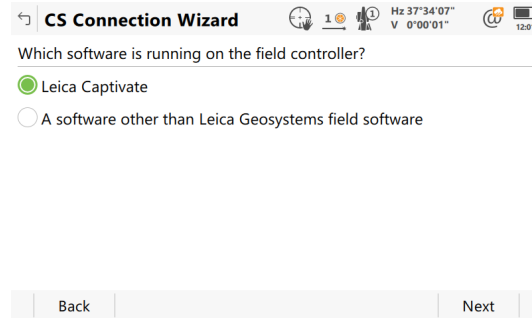
This chapter explains how to configure a TS to be remotely controlled from the CS.

### Access

Select **Leica Captivate - Home: Settings\Connections\CS connection wizard**.

### CS Connection Wizard, Which software is running on the field controller?

-  A CS running Leica SmartWorx Viva cannot remote control a TS running Leica Captivate.
-  **Leica iCON Field** is unavailable for TS10 and TS13.

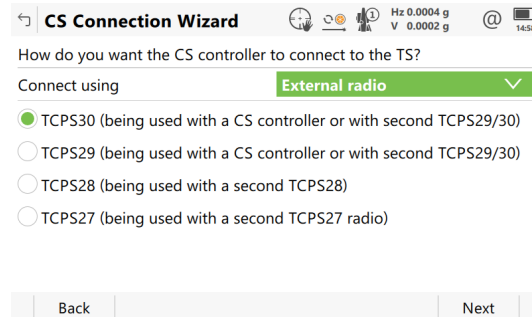


| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |

### Next step

Independent of the selection made, **Next** changes to a panel where the connection type must be selected.


### CS Connection Wizard, How do you want the CS controller to connect to the TS?



| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |



## Description of fields

| Field                | Option   | Description   |
|----------------------|--|---|
| <b>Connect using</b> |  | How the instrument is connected. The options available depend on the type of instrument in use and on the selection of the software type made in wizard step 1.<br> For CS30/CS35, only Bluetooth connections can be configured. |
|                      | <b>Radio handle, Bluetooth, External radio</b> | When <b>External radio</b> is selected, choose the type of <b>External radio</b> in use.  |
|                      | <b>Cable</b>                                   | For TS13/TS16: Serial cable connection. No TCP/IP.<br>For TS60/MS60/TM60: USB cable connection. Select <b>Cable</b> for a USB cable connection. Use the cables GEV234 (LEMO - USB), GEV237 (LEMO - LEMO) or GEV261 (combined RS232/USB cable). No TCP/IP.   |
|                      | <b>Cable RS232</b>                             | Available when <b>A software other than Leica Geosystems field software</b> is checked in the previous panel. Available on TS60/MS60/TM60 to configure serial connection.   |
|                      | <b>WLAN</b>                                    | Available when <b>A software other than Leica Geosystems field software</b> is checked in the previous panel. Requires settings in WinCE.   |

## Next step

**Next** changes to the next panel.

| IF   | THEN   |
|--|--|
| connected using Radio-Handle   | <b>Next</b> changes to the next panel.<br><br>The RadioHandle is detected automatically, if it is plugged into the TS. The name of the RadioHandle is then displayed.<br><br>If the RadioHandle is not plugged onto the TS, then select the RadioHandle which is used. Press <b>Next</b> . |
| connected using TCPS29/TCPS30  | Select the TCPS connected and press <b>Next</b> . Refer to <a href="#">15.2 Connection Using TCPS</a> .  |
| connected using cable  | refer to <a href="#">15.3 Connection Using Cable</a> .   |
| a TS60/MS60/TM60 is connected using cable and Leica Captivate is running on the field controller | the system sets all the parameters to be able to connect to a CS using USB interface from port 1.  |

| IF   | THEN   |
|--|--|
| a TS60/MS60/TM60 is connected using cable and a software other than Leica Captivate is running on the field controller | <ul style="list-style-type: none"> <li>for a serial connection refer to <a href="#">15.3 Connection Using Cable</a>.</li> <li>for a USB connection, the system sets all the parameters to be able to connect to a CS using USB interface from port 1.</li> </ul> |
| connected using Bluetooth  | <b>Next</b> changes to the next panel. The Bluetooth connection is established automatically. Press <b>Finish</b> .  |
| connected using WLAN   | enable and configure WLAN within WinCE. <b>Next</b> changes to the next panel. Press <b>Finish</b> .   |

## 15.2

### Connection Using TCPS

#### TS Connection Wizard



This panel is valid for TCPS28/TCPS29.

The channel on which the TCPS broadcasts can be changed. Changing channels changes the frequency at which the TCPS operates. This may be necessary to enable multiple pairs of TCPS to work simultaneously in the same area without interfering with each other.

Fn Back Next Fn

| Key               | Description  |
|-------------------|--|
| <b>Back</b>       | To return to the previous panel.                           |
| <b>Next</b>       | To confirm the settings and to continue to the next panel. |
| <b>Fn Default</b> | To return the fields back to their default values.         |
| <b>Fn Save</b>    | To save the settings.                                      |

#### Description of fields

| Field              | Option                       | Description   |
|--------------------|------------------------------|---|
| <b>Radio type</b>  | Display only                 | The type of protocol.   |
| <b>Link number</b> | Editable field               | The assigned channel number.  |
| <b>Set as</b>      | <b>Remote</b> or <b>Base</b> | The TCPS inside the field controller and the TS13/TS16/TS60/MS60/TM60 must be set to opposite settings. Set the field controller to <b>Remote</b> and TS13/TS16/TS60/MS60/TM60 to <b>Base</b> . |

### Next step

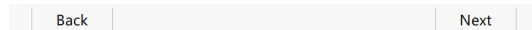
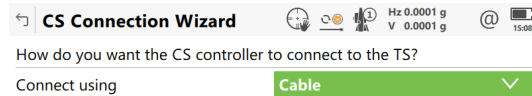
**Next** and follow the instructions on the panel.

## 15.3

**CS Connection Wizard**  
- Ensure the same settings are made on the CS.

### Connection Using Cable

Valid for TS13/TS16/TS60/MS60/TM60.



| Key               | Description  |
|-------------------|--|
| <b>Back</b>       | To return to the previous panel.                           |
| <b>Next</b>       | To confirm the settings and to continue to the next panel. |
| <b>Fn Default</b> | To return the fields back to their default values.         |

#### Description of fields

| Field               | Option                            | Description  |
|---------------------|-----------------------------------|--|
| <b>Baud rate</b>    | From <b>1200</b> to <b>115200</b> | Frequency of data transfer from instrument to device in bits per second.   |
| <b>Parity</b>       | <b>None, Even</b> or <b>Odd</b>   | Error checksum at the end of a block of digital data.  |
| <b>Data bits</b>    | <b>6, 7</b> or <b>8</b>           | Number of bits in a block of digital data.   |
| <b>Stop bit</b>     | <b>1</b> or <b>2</b>              | Number of bits at the end of a block of digital data.  |
| <b>Flow control</b> | <b>None</b> or <b>RTS/CTS</b>     | Activates hardware handshake. When the instrument/device is ready for data, it asserts the Ready To Send line indicating it is ready to receive data. This line is read by the sender at the Clear To Send input, indicating it is clear to send the data. |

### Next step

**Next** and follow the instructions on the panel.

## 16

## Connections - AP connection wizard

### 16.1

### Starting the AP Connection Wizard on a TS

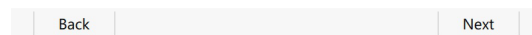
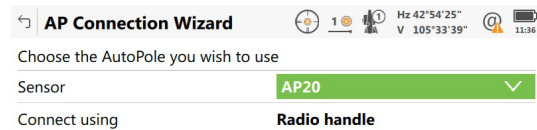
#### Description

This chapter explains how an AP20 AutoPole can be connected with a total station using a wizard.

#### Access

Select **Leica Captivate - Home: Settings\Connections\AP connection wizard**.

#### AP Connection Wizard, Choose the AutoPole you wish to use



| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |

#### Description of fields

| Field                | Option          | Description  |
|----------------------|-----------------|--|
| <b>Sensor</b>        | Selectable list | The instrument model.  |
| <b>Connect using</b> | Selectable list | How the instrument is connected. The options available depend on the selection for <b>Sensor</b> . |

#### Next step

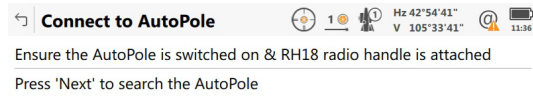
**Next** changes to the next panel.

#### AP Connection Wizard, Ensure the AutoPole is switched on

This panel informs about the types of connections that can be used for the selected AP20.

| Instrument        | Supported connection type          |
|-------------------|------------------------------------|
| AP20 H<br>AP20 ID | RH16, RH17, RH18, TCPS29 or TCPS30 |
| AP20 T<br>AP20    | RH18                               |

The last configured AP20 is remembered until a new search is performed.



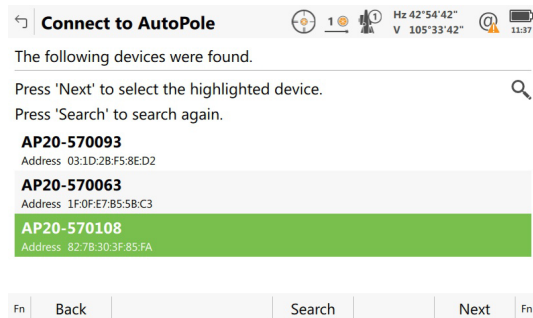
| Key  | Description   |
|------|---|
| Back | To return to the previous panel.  |
| Next | To confirm the settings, continue to the next panel and perform a search. |

### Next step

Follow the instructions on the panel.

## AP Connection Wizard, Connect to AutoPole

Move the focus using the arrow keys or the stylus to select a Bluetooth device.



| Key    | Description   |
|--------|---|
| Back   | To return to the previous panel.                                  |
| Search | To search for a different AP20 AutoPole.                          |
| Next   | To connect to the selected device and continue to the next panel. |

### Next step

Follow the instructions on the panel.

## AP Connection Wizard, Successfully connected to AutoPole

This panel shows the available AP20 AutoPole functionalities which can be enabled or disabled.

When available, PoleHeight functionality is always enabled.

**AP Connection Wizard** Hz 42°54'44" V 105°33'41" 11:38

Connected to AutoPole

Successfully connected to AutoPole

Select which AutoPole functionality should be used

Press 'Finish' to complete the wizard

Use TargetID

Choose ID

TargetID ensures the total station to only detect the target with the defined ID

AP tilt compensation

| Key           | Description   |
|---------------|---|
| <b>Finish</b> | To confirm the settings and return to <b>Leica Captivate - Home</b> . |

### Description of fields


| Field                       | Option                     | Description  |
|-----------------------------|----------------------------|--|
| <b>Use TargetID</b>         | Check box                  | If checked, target searches are performed using TargetID.  |
| <b>Choose ID</b>            | From <b>1</b> to <b>16</b> | Available when <b>Use TargetID</b> is checked. The number for TargetID can be selected. Up to 16 different IDs can be defined. |
| <b>AP tilt compensation</b> | <b>Off</b>                 | The tilt compensation for AP20 is disabled.  |
|                             | <b>On - to pole tip</b>    | The tilt compensation for AP20 is enabled. Tilt compensated point coordinates are calculated to the tip of the pole.           |



- a GLS51
- c GRZ122

### On - reversed

The tilt compensation for AP20 is enabled. Tilt compensated point coordinates are calculated to the opposite of the tip of pole. PoleHeight is not supported in this mode, target height needs to be entered manually.

| Field | Option | Description  |
|-------|--------|--|
|       |        |  |
|       | a      | GLS51  |
|       | b      | MPR122   |
|       | c      | GRZ122   |
|       | d      | CRP10 with optional CRP13*   |

## 16.2

### Starting the AP Connection Wizard on a CS

#### Description

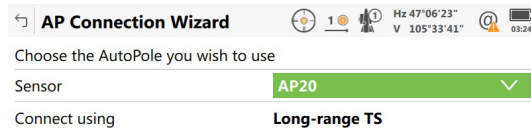
This chapter explains how an AP20 AutoPole can be connected with a CS using a wizard.

The field controller should already be connected to a total station.

#### Access

Select **Leica Captivate - Home: Settings\Connections\AP connection wizard**.

#### AP Connection Wizard, Choose the AutoPole you wish to use



| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |

#### Description of fields

| Field                | Option          | Description  |
|----------------------|-----------------|--|
| <b>Sensor</b>        | Selectable list | The instrument model.  |
| <b>Connect using</b> | Selectable list | How the instrument is connected. The options available depend on the selection for <b>Sensor</b> . |

#### Next step

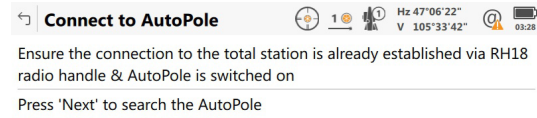
**Next** changes to the next panel.

## AP Connection Wizard, Ensure the AutoPole is switched on

This panel informs about the types of connections that can be used for the selected AP20.

| Instrument        | Supported connection type                  |
|-------------------|--|
| AP20 H<br>AP20 ID | Internal Bluetooth of the CS is supported. |
| AP20 T<br>AP20    | Total station with RH18                    |

The last configured AP20 is remembered until a new search is performed.



|      |      |
|------|------|
| Back | Next |
|------|------|

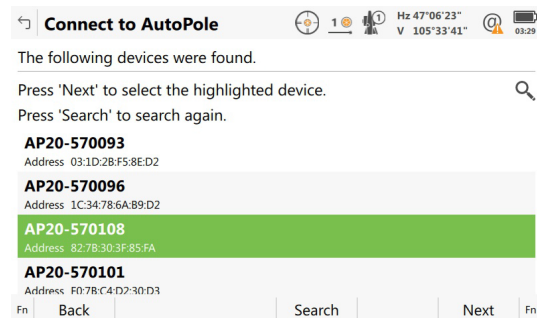
| Key  | Description   |
|------|---|
| Back | To return to the previous panel.  |
| Next | To confirm the settings, continue to the next panel and perform a search. |

### Next step

Follow the instructions on the panel.

## AP Connection Wizard, Connect to AutoPole

Move the focus using the arrow keys or the stylus to select a Bluetooth device.



| Key    | Description   |
|--------|---|
| Back   | To return to the previous panel.                                  |
| Search | To search for a different AP20 AutoPole.                          |
| Next   | To connect to the selected device and continue to the next panel. |

### Next step

Follow the instructions on the panel.



## AP Connection Wizard, Successfully connected to AutoPole

This panel shows the available AP20 AutoPole functionalities which can be enabled or disabled.

When available, PoleHeight functionality is always enabled.

| Key           | Description   |
|---------------|---|
| <b>Finish</b> | To confirm the settings and return to <b>Leica Captivate - Home</b> . |

### Description of fields

| Field                       | Option                     | Description  |
|-----------------------------|----------------------------|--|
| <b>Use TargetID</b>         | Check box                  | If checked, target searches are performed using TargetID.  |
| <b>Choose ID</b>            | From <b>1</b> to <b>16</b> | Available when <b>Use TargetID</b> is checked. The number for TargetID can be selected. Up to 16 different IDs can be defined. |
| <b>AP tilt compensation</b> | <b>Off</b>                 | The tilt compensation for AP20 is disabled.  |
|                             | <b>On - to pole tip</b>    | The tilt compensation for AP20 is enabled. Tilt compensated point coordinates are calculated to the tip of the pole.           |



a GLS51  
c GRZ122

**On - reversed**

The tilt compensation for AP20 is enabled. Tilt compensated point coordinates are calculated to the opposite of the tip of pole. PoleHeight is not supported in this mode, target height needs to be entered manually.

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



- a GLS51
- b MPR122
- c GRZ122
- d CRP10 with optional CRP13\*

# 17

# RTK rover wizard

## 17.1

## Overview

### Description

Using this wizard, the settings for a real-time rover behaviour are defined at one glance. These settings are stored in an RTK profile.

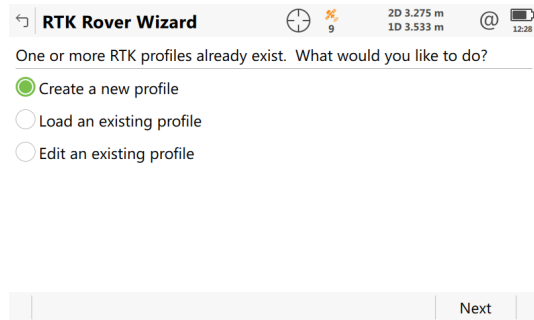
### Access

Select **Leica Captivate - Home: Settings\Connections\RTK rover wizard**.



If RTK profiles exist, the wizard starts with the panel shown in this section. Otherwise, the wizard starts the process of creating a RTK profile. In this case, refer to [17.2 Creating a New RTK Profile](#).

### RTK Rover Wizard



| Key         | Description  |
|-------------|--|
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard. |

### Next step

| IF you want to                     | THEN  |
|------------------------------------|---|
| create a set of settings           | select <b>Create a new profile</b> , press <b>Next</b> and continue with <a href="#">17.2 Creating a New RTK Profile</a> .          |
| select a different set of settings | select <b>Load an existing profile</b> , press <b>Next</b> and continue with <a href="#">17.3 Loading an Existing RTK Profile</a> . |
| edit an existing set of settings   | select <b>Edit an existing profile</b> , press <b>Next</b> and continue with <a href="#">17.4 Editing an Existing RTK Profile</a> . |

## 17.2

### RTK Rover Wizard, Enter a name for the new RTK profile

## Creating a New RTK Profile

Type in the name and a description for the new set of settings.

RTK Rover Wizard

Enter a name for the new RTK profile

Name: 123

Description: -----

Back Next

| Key  | Description  |
|------|--|
| Back | To return to the previous panel.   |
| Next | To accept changes and to continue with the subsequent panel within the wizard. |

## 17.3

### RTK Rover Wizard, Choose an RTK profile

## Loading an Existing RTK Profile

Select an existing RTK profile from the selectable list. Listed are profiles that match the instrument in use.

RTK Rover Wizard

Choose an RTK profile

RTK profile: 123

Connection type: Radio

Back Delete Finish

| Key    | Description   |
|--------|---|
| Back   | To return to the previous panel.  |
| Delete | Pressing this key deletes the RTK profile currently shown in the selectable list. |
| Finish | To accept changes and to return to <b>Leica Captivate - Home</b> .                |

## 17.4

## Editing an Existing RTK Profile

### RTK Rover Wizard, Choose an RTK profile

Select the RTK profile to be edited from the selectable list. Listed are profiles that match the instrument in use.

RTK Rover Wizard 9 2D 3.280 m 1D 3.539 m 12:28

Choose an RTK profile

RTK profile 123

Connection type Radio

Create a copy

Back Delete Next

| Key           | Description   |
|---------------|---|
| <b>Back</b>   | To return to the previous panel.  |
| <b>Delete</b> | Pressing this key deletes the RTK profile currently shown in the selectable list. |
| <b>Next</b>   | To accept changes and to continue with the subsequent panel within the wizard.    |

### Description of fields

| Field                | Option    | Description                                       |
|----------------------|-----------|---|
| <b>Create a copy</b> | Check box | Creates a copy before the editing process starts. |



**Description**

This chapter explains how the instrument or field controller can be connected to the Internet using a wizard and without using RTK.

**Access**

Select **Leica Captivate - Home: Settings\Connections\Internet wizard**.

The panel displayed varies.

| IF  | AND                                | THEN   |
|---|------------------------------------|--|
| the Internet wizard is started for the first time | a CS is used                       | the Internet device can be connected to the <ul style="list-style-type: none"> <li>• CS modem</li> <li>• Bluetooth mobile phone</li> <li>• WLAN</li> </ul>  Depending on the installed hardware key of the CS20, the device is automatically set.<br><br> If the installed modem is a PXS8 modem, select either the CDMA or the UMTS device. |
|   | a TS10 is used                     | the Internet device can be connected to the <ul style="list-style-type: none"> <li>• 4G modem port</li> <li>• Bluetooth mobile phone</li> <li>• WLAN</li> </ul>  |
|   | a TS13/TS16/TS60/MS60/TM60 is used | the Internet device can be connected to a Bluetooth phone of type <ul style="list-style-type: none"> <li>• GSM/UMTS/LTE device</li> <li>• CDMA device</li> <li>• WLAN</li> </ul>   |
| the Internet connection is configured             | not connected                      | <ul style="list-style-type: none"> <li>• the Internet connection can be edited.</li> <li>• the connection can be started.</li> </ul>   |

| IF                                    | AND       | THEN  |
|---------------------------------------|-----------|---|
| the Internet connection is configured | connected | <ul style="list-style-type: none"><li>the Internet connection can be edited.</li><li>the connection can be stopped.</li></ul> |

---

**Next step**

Make a selection, press **Next** and follow the instructions on the panel.

---

**Description**

The instrument has various connections which can be configured to be used with different ports and devices.

**Access**

Select **Leica Captivate - Home: Settings\Connections\All other connections**.

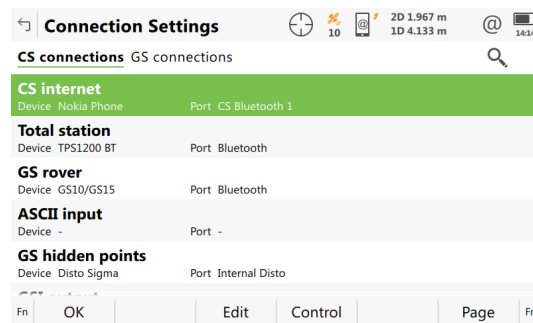
**Connection Settings**



The panel gives an overview of all connections with the currently assigned port and device.

For an RTK rover, this panel consists of the **CS connections** and the **GS connections** page.

For a GS07, this panel consists of only one page.

 For CS30/CS35, **CS internet**, **GS rover** and **Total station** connections can be configured.



| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To return to the panel from where this panel was accessed.   |
| <b>Edit</b>        | To configure the parameters related to the highlighted connection. Refer to the sections on each individual connection in this chapter.  |
| <b>Control</b>     | Available for certain devices connected to certain connections. To configure more parameters related to the highlighted device.<br><br>For TS60/MS60/TM60: Available when the <b>GeoCOM</b> connection is set to <b>Cable</b> (USB) and <b>WLAN</b> . To show the IP and the port for Third-party connections.   |
| <b>Fn Wireless</b> | Available for TS instruments.<br>To enable or disable Bluetooth and/or WLAN.<br>Check the box to enable internal Bluetooth and/or WLAN.<br><br> When disabling the use of internal Bluetooth and/or WLAN, the TS cannot connect to wireless networks and/or Bluetooth devices<br><br> After changing a setting, the instrument must be turned off and on again to apply the changes. |



| Key  | Description  |
|--|--|
| <b>Fn Connect</b><br>and<br><b>Fn Disconnect</b> | Available for a real-time connection configured to use an Internet connection. To connect/disconnect from the GNSS reference data. |

## 19.2

## CS internet / GS internet / TS Internet

### 19.2.1

### Leica Captivate

#### Description

The Internet connection

- allows accessing the Internet using the field controller (CS internal phone modem) or the instrument plus a phone modem device.
- can be used together with the real-time connection to receive real-time data from, for example, a Ntrip Caster using Internet communication.

Refer to [36 NTRIP via Internet](#) for information about Ntrip.

The settings on this panel define the port and parameters required for accessing the Internet.

#### Access

For CS:

- In **Connection Settings, CS connections** page, highlight **CS internet. Edit.**

For CS - GS rover:

- In **Connection Settings, GS connections** page, highlight **GS internet. Edit.**

For TS:

- In **Connection Settings**, highlight **TS Internet. Edit.**

For TS with GS:

- In **Connection Settings, TS connections** page, highlight **TS Internet. Edit.**
- In **Connection Settings, GS connections** page, highlight **GS internet. Edit.**

#### Internet Connection, Internet page

For the CS20 in rover mode, this is only a page without separate tab.

**Internet Connection**

Use Internet connection on CS

Connect using **CS Bluetooth 1**

Device **Nokia Phone**

Bluetooth ID -----

Connect to internet using **Mobile data**



Use user ID & password





OK Search Device


| Key       | Description   |
|-----------|---|
| <b>OK</b> | To accept changes and return to the panel from where this panel was accessed. |

| Key           | Description  |
|---------------|--|
| <b>Search</b> | <p>For <b>Connect using: CS Bluetooth 1</b> or <b>Connect using: CS Bluetooth 2</b>:<br/>To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided.</p> <p>For <b>Connect using: WLAN</b>:<br/>To search for a WLAN network and to access the <b>Found Networks panel</b>. WinEC WLAN is activated. Refer to <a href="#">Found Networks</a>.</p> |
| <b>Device</b> | <p>To create, select, edit or delete a device. Refer to <a href="#">19.1 Accessing Configuration Connections</a>. Available if <b>Use Internet connection on CS/Use Internet connection on GS/Use Internet connection on TS</b> is checked.</p> <p>For the CS20: Only available, if the CS modem hardware key for PXS8 is installed. Use <b>Device</b> to select between PXS8 UMTS and PXS8 CDMA.</p>                    |

#### Description of fields

| Field  | Option                                   | Description  |
|--|--|--|
| <b>Use Internet connection on CS, Use Internet connection on GS or Use Internet connection on TS</b> | Check box                                | Activates the Internet connection.   |
| <b>Connect using</b>   |  | The ports available for connection to the Internet.  |
|  | <b>CS RS232 port</b>                     | The RS232 port on the field controller. Unavailable for CS30/CS35.   |
|  | <b>CS Bluetooth 1 and CS Bluetooth 2</b> | The Bluetooth ports on the field controller which are used for the connection functionality. Unavailable for CS30/CS35.  |
|  | <b>CS modem</b>                          | The internal modem of the CS Win32 tablets.<br> The internal modem cannot be used when the airplane mode in Windows is activated.   |
|  | <b>CS modem</b>                          | The internal GSM modem of the field controller.<br>For the CS20: Only available, if the CS modem hardware key for PXS8 is installed. Use <b>Device</b> to select between PXS8 UMTS and PXS8 CDMA.<br> A simultaneous connection to the Internet through a SIM card and a WLAN network is not allowed. |

| Field                             | Option                                   | Description   |
|-----------------------------------|--|---|
|                                   | <b>GS modem</b>                          | The internal GSM modem of the GS.<br> A simultaneous connection to the Internet through a SIM card and a WLAN network is not allowed.  |
|                                   | <b>GS Port 1</b>                         | For GS10/GS25: The physical port P1 on the box.   |
|                                   | <b>GS Port 2</b>                         | For GS10/GS25: The physical port P2 on the box.   |
|                                   | <b>GS Port 3</b>                         | For GS10: The physical port P3 on the box.<br>For GS25: The port for the slot devices.  |
|                                   | <b>GS Port 4</b>                         | For GS25: The physical port P4 on the box.  |
|                                   | <b>TS Bluetooth 1 and TS Bluetooth 2</b> | The Bluetooth ports on the TS13/TS16 which are used for the connection functionality.   |
|                                   | <b>WLAN</b>                              | The WLAN connection.<br>If a WLAN network is already configured in Windows/WinEC, the corresponding Service Set Identifier (SSID, WLAN network) is displayed in <b>Network name</b> and an Internet connection is established.<br> If two WLAN networks are already configured and both are within the device range, then Windows decides to which network a connection is established.<br> A simultaneous connection to the Internet through a SIM card and a WLAN network is not allowed.<br> To ensure a right synchronization, when some manual changes are done in the Windows interface, Captivate must be first switched off. |
|                                   | <b>TS modem</b>                          | For TS10: The internal GSM modem.   |
| <b>Device</b>                     | Display only                             | The name of the selected device.<br>Unavailable for <b>Connect using: WLAN</b> .  |
| <b>Use user ID &amp; password</b> | Check box                                | If checked, a user ID and a password can be typed in.<br>Unavailable for <b>Connect using: WLAN</b> .   |
| <b>Connect to internet using</b>  | Display only:<br><b>Mobile data</b>      | On the base with a CS20 with LTE phone (PLAS9-W, PLAS9-X) built-in.<br>Unavailable for <b>Connect using: WLAN</b> .   |
| <b>User ID</b>                    | Editable field                           | Some providers ask for a user ID to allow connecting to the Internet using GPRS. Contact your provider if a user ID must be used.<br>It is possible to show/hide the User ID.<br>Unavailable for <b>Connect using: WLAN</b> .   |



| Field  | Option         | Description  |
|--|----------------|--|
| <b>Password</b><br>or<br><b>Network password</b> | Editable field | Some providers ask for a password to allow connecting to the Internet using GPRS. Contact your provider if a password is required. For WLAN: Only displayed as long as a secured network is configured but no connection is established yet. If a network is already configured, even if it is a secured network, the connection is possible without entering the password again.                    |
| <b>Display password</b>                          | Check box      | When this box is checked, the password is displayed in the <b>Password</b> field.<br>When this box is not checked, dots are displayed in the <b>Password</b> field<br> For WLAN: The configured WLAN networks are stored in the Windows profile manager. Captivate cannot display the WLAN password but only -----. |
| <b>Network name</b>                              | Display only   | Available for <b>Connect using: WLAN</b> .<br>If no WLAN network is configured, then ---- is displayed.<br>If a WLAN network is selected but not connected, then ---- is displayed.<br>If a WLAN network is selected and connected, then the Service Set Identifier (SSID) of that WLAN network is displayed.  |

## Internet Connection, Advanced page

This page is unavailable for CS20 in rover mode.

### Description of fields

| Field             | Option    | Description   |
|-------------------|-----------|---|
| <b>Use DynDNS</b> | Check box | Available for <b>GS internet</b> connection on the base.<br>To configure a dynamic DNS service. This setting provides access to the RTK data stream of a GS base server while it is using a dynamic IP address. The setting allows TCP/IP clients to use an Internet domain name to address a GS with a dynamic IP address.<br>Use case: A GS is set up in base mode with an Internet connection using GPRS. The GS has a different IP address every time the Internet connection is established or after running for a certain time. The GS checks every 12 min if its IP address has changed. If so, the GS updates the DynDNS settings.<br>Refer to <a href="#">19.2.2 DynDNS</a> for more information about DynDNS. |

| Field                   | Option          | Description   |
|-------------------------|-----------------|---|
| <b>Service provider</b> | Selectable list | Available when <b>Use DynDNS</b> is checked. Select the DNS service to use.<br> Register at the selected DynDNS service to receive a user name and password and to create a host name.   |
| <b>Host name</b>        | Editable field  | Available when <b>Use DynDNS</b> is checked. Type in the host name that you created at the DynDNS service where you registered.<br> Rovers can resolve host names. Using DynDNS is an easy way to provide RTK data from an instrument without having to know the current IP address. |
| <b>Username</b>         | Editable field  | Available when <b>Use DynDNS</b> is checked. Type in the user name provided by the DynDNS service where you registered.   |
| <b>Password</b>         | Editable field  | Available when <b>Use DynDNS</b> is checked. Type in the password provided by the DynDNS service where you registered.  |
| <b>Display password</b> | Check box       | When this box is checked, the password is displayed in the <b>Password</b> field. When this box is not checked, dots are displayed in the <b>Password</b> field.  |

#### Next step

**OK** returns to the panel from where **Internet Connection** was accessed.

#### Found Networks

Listed are all detected WLAN networks sorted according to the signal strength. The network with the highest strength is shown on the top of the list.

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To accept changes and return to the panel from where this panel was accessed.   |
| <b>Info</b>         | Available when known networks are available. To provide information about the highlighted WLAN network, such as security, signal strength, encryption and authentication. |
| <b>Search</b>       | To search for all available WLAN networks.  |
| <b>Forget</b>       | Available when a known and available WLAN network is highlighted. To delete an already configured WLAN profile that is within the range of the device.                    |
| <b>FnDelete all</b> | To delete all stored WLAN profiles, even those which are not within the device's range.   |

## Description of metadata

| Metadata             | Description   |
|----------------------|---|
| <b>Secured</b>       | <b>Yes:</b> The network requires a password to be connected.<br><b>No:</b> The network does not require a password to be connected. |
| <b>Security type</b> | Information sent by the WLAN network.   |
| <b>Signal</b>        | Based on the absolute dBm of each WLAN network found.<br>From <b>No signal</b> to <b>Excellent</b> .                                |
| <b>Known network</b> | Indicates known and available networks.   |

## 19.2.2

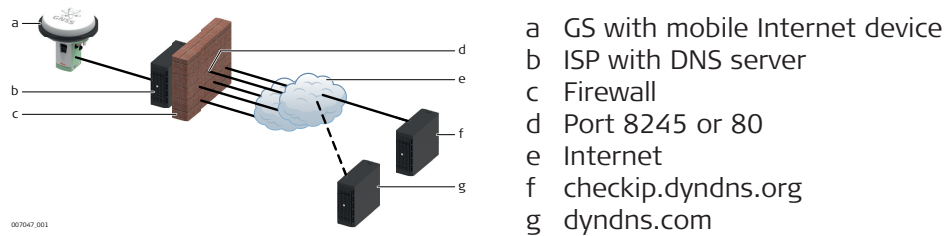
### Usage with dynamic IP address

## DynDNS

### Goal

To access a GS with a dynamic IP address using a host name.

### Basic concept of dynamic DNS (DynDNS)



- When using a mobile Internet connection, be aware of two types of restrictions:
  1. The first restriction is on the outgoing ports. When the GS is trying to access checkip.dyndns.org it uses port 8245. For using two-dns.de, an alternative to DynDNS.com, port 80 is needed additionally. It is important that ports 8245 and possibly 80 are open for outgoing connections, depending on which service you use.
  2. The second restriction is for incoming connections. If you managed to connect to DynDNS.com and associate your IP address with your hostname, you could theoretically connect to it using the hostname. In practise, you can run into the problem of ports not being open.
- Most likely your ISP has closed the standard ports - port 80 for web interface access or port 21 for FTP access.  
In order to access the Internet with a mobile device/SIM card, you need an **Access Point Name**, a user name and a password and a list of open incoming ports.  
Imagine this APN like a subnet for your phone that your ISP can configure, for example what external networks, services, open ports are available. Usually when you use mobile devices/SIM cards from the same ISP, the APN is the same for all these devices.  
The open ports you can use when providing RTK data from your GS are defined by this APN profile. This means besides the APN, user name and password, you must also ask your ISP for a list of open ports. These open ports can then be configured on the GS for the **Base RTK 1** and **Base RTK 2** interface. All other ports on the GS cannot be configured/changed.



Ask for a list of open ports for the APN you want to use before configuring your DynDNS setup.

### Configuring mobile Internet and DynDNS step-by-step

1. Contact your Internet service provider and ask for the APN profile for your mobile device/SIM card. You receive a document listing all open ports for your APN.
2. Register at the DynDNS service of your choice.  
Create:
  - A user name and password for your DynDNS account.
  - A host name for the GS.
3. Select **Leica Captivate - Base\Settings\Connections\All other connections**.
4. Highlight **GS internet** and press **Edit**.
5. On the **Internet** page, check **Use Internet connection on GS**. Select the mobile device to use.
6. On the **Advanced** page, check **Use DynDNS**. Select the **Service provider**. Enter **Host name**, **Username** and **Password**.
7. To see the details about your mobile Internet connection: Tap on @ in the icon bar. Select **Internet status**. The last updated IP address is displayed.
8. Select **Leica Captivate - Base\Settings\Connections\All other connections**.
9. Highlight **Base RTK 1** and press **Edit**.
10. Configure the transmission of RTK correction data and press **OK**.
11. Press **Control**.
12. Configure **User type: Server**. Make sure the TCP/IP port is set to a port listed as open in your APN profile. Configure, how many clients can connect to this port simultaneously to allow up to ten rovers to connect to a base RTK port.
13. You can now receive RTK correction data from your base using the host name and the configured RTK port.

### Troubleshooting

- Tap on @ in the icon bar. Select **Internet status**. Check that DynDNS status is shown as **On**. Check that the currently registered IP address is correct.
- Everything is fine, but you do not get data from the port that you configured for your data stream? Use the DynDNS tool <http://www.dyndns.com/support/tools/openport.html> and enter the IP address of your GS. You can find the IP address as described above. Enter the port you are trying to connect to. The tool tells you if this port is open. If not, change your data stream setting to a different port.

## 19.3

### GS rover / GS base

#### Description

To connect the field controller to the sensor (antenna) either on the base or on the rover side.

#### Access

For RTK rover:

- In **Connection Settings, CS connections** page, highlight **GS rover**. **Edit**.

For RTK base:

- In **Base Connection Settings**, select **GS base. Edit**.


## Connect to GS Rover / Connect to GS Base



OK

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.<br>When you change the sensor type, shut down Leica Captivate. Restart Leica Captivate before using the sensor. |
| <b>Search</b> | To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available for GS with <b>Connect using: Bluetooth</b> .    |

### Description of fields

| Field                  | Option                           | Description  |
|------------------------|----------------------------------|--|
| <b>Sensor</b>          | Selectable list                  | Select the attached model.   |
| <b>Connect using</b>   | <b>Cable</b> or <b>Bluetooth</b> | How the instrument is connected. The options available depend on the selection for <b>Sensor</b> . The availability of the other fields depends on the selection made here.<br> For CS30/CS35:<br>With GS10/GS14/GS15/GS16/GS25, only Bluetooth connections can be used.<br>With GS18, Bluetooth or WLAN connections can be used. |
| <b>Last used rover</b> | Display only                     | Available for RTK rover.<br>The name of the selected Bluetooth device.   |
| <b>Last used base</b>  | Display only                     | Available for RTK base.<br>The name of the selected Bluetooth device.  |
| <b>Bluetooth ID</b>    | Display only                     | The ID of the selected Bluetooth device.   |

## 19.4

### ASCII input

### 19.4.1

#### Configuration of an ASCII Input Connection

#### Description

The ASCII Input connection receives ASCII messages from third-party devices such as depth sounders, barometers, digital cameras, pipe detectors, Geiger



counters. The ASCII messages are stored as annotations together with the next manually measured point and/or auto point.

The settings on this panel define the port and the device to be used and the type of ASCII messages to be written to individual annotations.

## Access

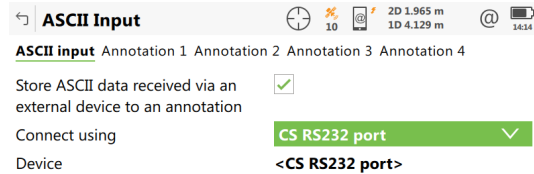
For RTK rover:

- In **Connection Settings, CS connections** page, highlight **ASCII input. Edit.**

For CS30/CS35:

- Unavailable. Use Windows to configure a connection.

## ASCII Input, ASCII input page



Fn OK Device Page Fn

| Key        | Description   |
|------------|---|
| OK         | To accept changes and return to the panel from where this panel was accessed.   |
| Device     | Available when <b>Store ASCII data received via an external device to an annotation</b> is checked. To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> . |
| Page       | To change to another page on this panel.  |
| Fn Command | To configure a message to be sent through the configured port to the device.  |

### Description of fields

| Field   | Option                            | Description  |
|---|-----------------------------------|--|
| Store ASCII data received via an external device to an annotation | Check box                         | Activates the ASCII input connection.  |
| Connect using   | CS Bluetooth 1 and CS Bluetooth 2 | The Bluetooth ports on the field controller which are used for the connection functionality. |
|   | CS RS232 port                     | The RS232 port on the field controller.  |
| Device  | Display only                      | The name of the device selected for ASCII input.   |

### Next step

**Page** changes to the **Annotation 1/Annotation 2/Annotation 3/Annotation 4** page.

ASCII Input,  
Annotation 1/  
Annotation 2/  
Annotation 3/  
Annotation 4page

### Description of fields

| Field                                       | Option         | Description  |
|---|----------------|--|
| <b>Store ASCII data to this annotation</b>  | Check box      | If checked, ASCII messages are recorded with the selected annotation.  |
| <b>Message desc</b>                         | Editable field | The description for the ASCII message being received. This description is then displayed in other panels.  |
| <b>Message ID</b>                           | Display only   | The message ID to identify a particular ASCII message coming from the device. The message is then saved to the annotation. The following characters can be used as filter:<br>^ To accept strings starting with the subsequent characters. For example, ^1 accepts 12 but not 21.<br>\$ To accept strings ending with the preceding characters. For example, 1\$ accepts 21 but not 12.<br>. To accept any character except newline.<br>[ ] To accept a set of characters. For example, [0-9] accepts all numbers.<br>Any characters to accept strings that include the characters at any position. For example 1 accepts 1234, 4321 or 2134 but not 2345. |
| <b>Prefix '@&lt;Desc&gt;@' when writing</b> | Check box      | Stores the description in <b>Message desc</b> as prefix to the ASCII message. This prefix helps to more easily identify the annotations registered with a point.   |

### Next step

**Page** changes to another page on this panel.

## 19.4.2

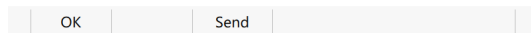
### Configuration of a Command to the Device

#### Access

For RTK rover:

- In **ASCII Input, ASCII input** page, **Fn Command**.

## Send Command to Device



| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Send | To send the command to the device.  |

### Description of fields

| Field   | Option         | Description  |
|---------|----------------|--|
| Command | Editable field | A message to be sent to the device through the configured port when the Measure or stake app is accessed. This functionality, for example, allows the device to be started remotely. The last used command that was entered is remembered as part of the active working style. |

## 19.5

### Disto

#### Description

#### For hidden point measurement

All Distos can be used as hidden point measurement device.

Hidden point measurement devices are used for measuring to points which cannot be directly measured with GNSS, for example house corners or trees. The measurements made with a hidden point measurement device are directly transferred to the instrument for the calculation of the coordinates of the hidden point. They can also be entered manually.

The settings on this panel define the port, the device and estimated qualities to be used for the hidden point connection.

#### For distance measurements

The CS20 with integrated Disto can be used to measure a distance which then populates an highlighted input field within the Captivate software.

Use a hot key or the favourites menu to measure a distance. In a Disto camera view, the laser point is visualised to aid aiming and measuring the point.

#### Access

For RTK rover:

- In **Connection Settings, CS connections** page, highlight **Disto. Edit**.

For CS30/CS35:

- Unavailable. Use Windows to configure a connection.

## Disto Connection

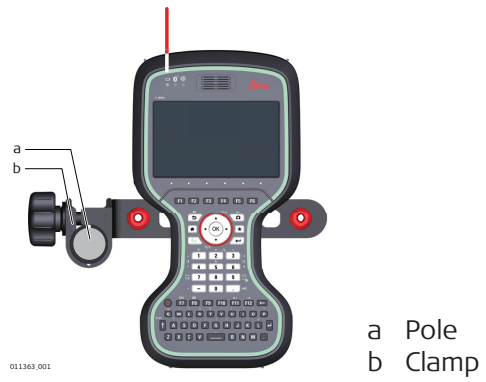
|    |        |
|----|--------|
| OK | Device |
|----|--------|

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Search</b> | Available when a Bluetooth port and device is selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| <b>Device</b> | To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> .  |

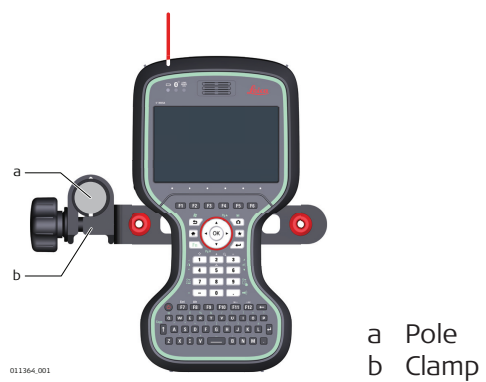
### Description of fields

| Field  | Option  | Description   |
|--|---|---|
| <b>Use a device to measure hidden points</b> | Check box   | To compute a hidden point with height. Activates the hidden point connection. If not checked, the measured values must be entered manually. Or when the CS20 with integrated Disto is used, to measure a distance for an highlighted input field. |
| <b>Connect using</b>                         | <b>CS Bluetooth 1</b><br>and <b>CS Bluetooth 2</b><br><b>CS RS232 port</b><br><b>Internal Disto</b> | The Bluetooth ports on the field controller which are used for the connection functionality.<br><br>The RS232 port on the field controller.<br><br>The DISTO in the CS20.   |
| <b>Device</b>                                | Display only  | The name of the selected hidden point device.   |
| <b>Bluetooth ID</b>                          | Display only  | Available if <b>CS Bluetooth 1</b> or <b>CS Bluetooth 2</b> are selected. The Bluetooth ID of the hidden point device.  |
| <b>Measure distance from</b>                 | <b>Front of CS20</b>  | Right-handed setup<br>The offset of the reference point inside the CS20 turning around the axis of the clamp is taken in account.   |

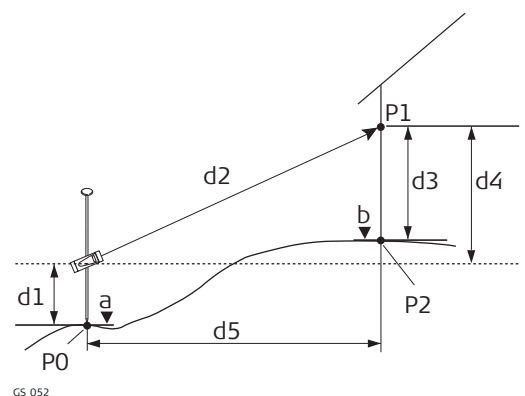
| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



**Back of pole** Right-handed setup  
The offset of the reference point inside the CS20 turning the axis of the clamp is taken in account.



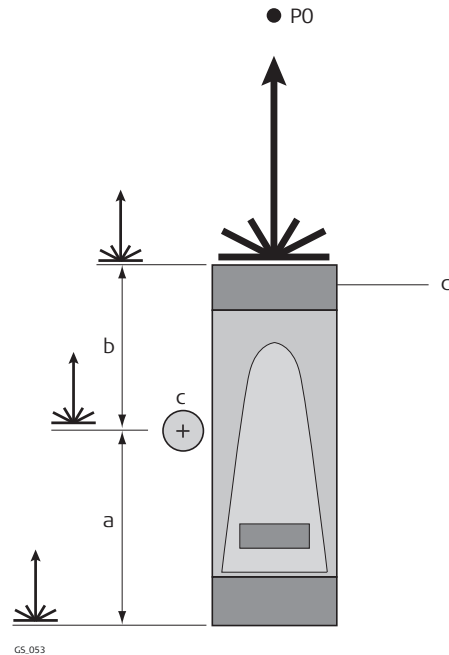
**Diagram**



- P0 Known point
- P1 Target point
- P2 Hidden point
- a Height of P0
- b Height of P2 =  $a + d1 + d4 - d3$
- d1 Device height: height of hidden point measurement device above P0
- d2 Slope distance
- d3 Device height: height of P1 above P2
- d4 Height difference between hidden point measurement device and P1
- d5 Horizontal distance

## Distance offsets at hidden point measurement devices

A Leica DISTO is shown as an example



- a) Negative **Distance offset**
- b) Positive **Distance offset**
- c) Pole
- d) DISTO
- PO Hidden point

## 19.6

### Export job

#### Description

The Export Job connection allows data from a job to be exported from the instrument to another instrument.

The settings on this panel define the port and the device to which the data is exported.

#### Access

For RTK rover:

- In **Connection Settings, CS connections** page, highlight **Export job. Edit.**

For TS:

- In **Connection Settings** highlight **Export job. Edit.**

For CS30/CS35:

- Unavailable. Use Windows to configure a connection.

#### Export Job Connection

**Export Job Connection**

2D 1.967 m  
1D 4.135 m

Export job to external device

Connect using CS RS232 port

Device <CS RS232 port>

OK
Device

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Search</b> | Available when <b>CS Bluetooth 1</b> or <b>CS Bluetooth 2</b> are selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| <b>Device</b> | To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> .  |

#### Description of fields

| Field                                | Option   | Description   |
|--------------------------------------|--|---|
| <b>Export job to external device</b> | Check box  | Activates the connection.   |
| <b>Connect using</b>                 | <b>CS Bluetooth 1 / CS Bluetooth 2</b><br>or<br><b>TS Bluetooth 1 / TS Bluetooth 2</b><br><b>CS RS232 port</b> or<br><b>Cable</b><br><b>Radio handle</b> | The Bluetooth ports on the field controller or the TS which are used for the connection functionality.<br><br>The RS232 port on the field controller or the TS.<br><br>Hotshoe connection for RadioHandle. This port is on top of Communication side cover. |
| <b>Device</b>                        | Display only   | The device currently assigned to the selected port within the active working style. The device which is selected determines the availability of the next fields.  |

## 19.7

### RTK rover

#### 19.7.1

#### Configuration of a Rover Real-Time Connection

##### Description

The real-time connection allows real-time related parameters to be configured. These parameters include defining the real-time messages and the base to be used.

##### Access

For RTK rover:

- In **Connection Settings, GS connections** page, highlight **RTK rover. Edit.**

## RTK Rover Settings, General page

The available fields and keys on this panel depend on the selected settings.

**RTK Rover Settings** 📶 📶 📶 2D 1.965 m 1D 4.131 m @ 14:15

**RTK data** RTK base RTK network Advanced

Receive RTK data

Connect using **CS RS232 port** ▼


RTK device <CS RS232 port>

RTK data format **Leica 4G** ▼


Use auto coordinate system

Receive RTK network information


OK Device Page

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.   |
| <b>Search</b> | Available when connecting using Bluetooth. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided.   |
| <b>Device</b> | To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> .<br> For CS30/CS35: Configure Bluetooth mobile phones and short range Bluetooth for TS applications in Windows. |
| <b>Page</b>   | To change to another page on this panel.  |

### Description of fields

| Field                   | Option  | Description   |
|-------------------------|---|---|
| <b>Receive RTK data</b> | Check box   | If checked, the rover real-time connection is activated.  |
| <b>Connect using</b>    | <b>CS Bluetooth 1</b> and <b>CS Bluetooth 2</b>       | The Bluetooth ports on the field controller used for the connection.<br> For CS30/CS35, only Bluetooth connections are configurable. |
|                         | <b>CS CGR radio</b>                                   | The CGR20 that can be attached to the CS20.   |
|                         | <b>CS Internal radio</b>                              | The internal GSM modem of the field controller.   |
|                         | <b>CS Internet 1, CS Internet 2 and CS Internet 3</b> | The Internet ports on the field controller. If these ports are not assigned to a specific connection, then these ports are extra remote ports.  |
|                         | <b>CS RS232 port</b>                                  | The RS232 port on the field controller. Unavailable for GS07.   |
|                         | <b>CTR20 expansion pack</b>                           | External long-range TS communication radio.   |



| Field                  | Option  | Description  |
|------------------------|---|--|
|                        | <b>GS Internet 1, GS Internet 2 and GS Internet 3</b> | The Internet ports on the GS. If these ports are not assigned to a specific connection, then these ports are extra remote ports.   |
|                        | <b>GS Port 1</b>                                      | For GS10: The physical port P1 on the box.<br>For GS14/GS16/GS18: The red LEMO port.<br>For GS25: The physical LEMO port P1 on the box.  |
|                        | <b>GS modem</b>                                       | Available for GS14/GS16.   |
|                        | <b>GS radio</b>                                       | Available for GS14/GS16/GS18.  |
|                        | <b>GS Port 2</b>                                      | For GS10: The physical port P2 on the box.<br>For GS25: The physical LEMO port P2 on the box.  |
|                        | <b>GS Port 3</b>                                      | For GS10: The physical port P3 on the box.   |
|                        | <b>GS Port 4</b>                                      | For GS25: The physical LEMO port P4 on the box.  |
|                        | <b>TS Bluetooth 1 and TS Bluetooth 2</b>              | The Bluetooth ports on the TS which are used for the connection functionality.   |
|                        | <b>TS Internet 1, TS Internet 2 and TS Internet 3</b> | The Internet ports on the TS. If these ports are not assigned to a specific connection, then these ports are extra remote ports.   |
| <b>RTK device</b>      | Display only  | The device currently assigned to the selected port within the active working style. The device which is selected determines the availability of the next fields.   |
| <b>RTK data format</b> |   |  If a mountpoint was selected from a downloaded source table during the use of the RTK connection wizard, then the RTK format which is used with the NTRIP mountpoint is displayed. |
|                        | <b>Leica 4G</b>                                       | The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2/B3. This format is recommended when working exclusively with Leica instruments.  |
|                        | <b>Leica</b>  | The proprietary Leica real-time GNSS data format supporting GPS L1/L2 and GLONASS L1/L2. This format is recommended when working exclusively with Leica instruments.   |

| Field | Option               | Description  |
|-------|----------------------|--|
|       | <b>CMR/CMR+</b>      | CMR and CMR+ are compacted formats used to broadcast data for third-party instruments.   |
|       | <b>RTCM 18,19 v2</b> | Message according to RTCM version 2.x. Uncorrected carrier phase and pseudorange. Message 3 is also generated. Use for real-time operations where the ambiguities are resolved at the rover. Accuracy at the rover: 1 - 5 cm rms after a successful ambiguity resolution.  |
|       | <b>RTCM v3</b>       | <p>Use RTCM when rover units from a different manufacturer are used.</p> <p>Use to decode the standard <b>RTCM v3</b> and the <b>RTCM v3 (MSM)</b> messages from the base.</p> <p>Message according to RTCM version 3. A new standard format for transmission of <b>Global Navigation Satellite System</b> correction information. Higher efficiency than RTCM v2.x. Supports real-time services with reduced bandwidth.</p> <p><b>Message types for real-time GNSS operation:</b></p> <ul style="list-style-type: none"> <li>• 1001: L1-only GPS real-time observables</li> <li>• 1002: Extended L1-only GPS real-time observables</li> <li>• 1003: L1 &amp; L2 GPS real-time observables</li> <li>• 1004: Extended L1 &amp; L2 GPS real-time observables</li> <li>• 1005: Stationary real-time base station <b>Antenna Reference Point</b></li> <li>• 1006: Stationary real-time base station ARP with antenna height</li> <li>• 1007: Antenna descriptor</li> <li>• 1008: Antenna descriptor and serial number</li> <li>• 1009: L1-only GLONASS real-time observables</li> <li>• 1010: Extended L1-only GLONASS real-time observables</li> <li>• 1011: L1 &amp; L2 GLONASS real-time observables</li> <li>• 1012: Extended L1 &amp; L2 GLONASS real-time observables</li> </ul> <p><b>Network RTK Messages according to Master-Auxiliary Concept:</b></p> |

| Field | Option | Description  |
|-------|--------|--|
|       |        | <ul style="list-style-type: none"> <li>1014: Network Auxiliary Station Data message.</li> </ul> <p>This message contains details of the base stations in the network. For example, the master station and its coordinates, and the coordinate differences between the master and its auxiliaries.</p>  |
|       |        | <ul style="list-style-type: none"> <li>1015: Ionospheric Correction Differences message</li> <li>1016: Geometric Correction Differences message</li> <li>1021: Helmert/Abridged Molodensky transformation</li> <li>1022: Molodensky-Badekas transformation</li> <li>1023: Transformation Residual Message, ellipsoidal grid representation; CSCS/position &amp; geoid/height residuals are supported</li> <li>1024: Transformation Residual Message, plane grid representation; CSCS/position &amp; geoid/height residuals are supported</li> <li>1025: Projection types except LCC2SP, OM</li> <li>1026: Projection type Lambert Conic Conformal (LCC2SP)</li> <li>1027: Projection type Oblique Mercator (OM)</li> <li>1029: Unicode Text String message</li> <li>1032: Physical Reference Station Position message</li> <li>1033: Receiver and Antenna Descriptor message</li> <li>1037: GLONASS Ionospheric Correction Differences message (phase).</li> <li>1038: GLONASS Geometric Correction Differences message (phase).</li> <li>1039: GLONASS Combined Geometric and Ionospheric Correction Differences message (phase).</li> <li>1068: GLONASS Ionospheric Correction Differences message (code).</li> <li>1069: GLONASS Geometric Correction Differences message (code).</li> <li>1070: GLONASS Combined Geometric and Ionospheric Correction Differences message (code).</li> <li>1230: GLONASS biases</li> </ul> |

| Field | Option | Description   |
|-------|--------|---|
|       |        | <p>Pseudorange and phase range values for L1 and L2. Depending on the type of instrument, the data for L1-only or for L1 and L2 are sent out.</p> <p><b>Message types for universal real-time GNSS operation, decoding from : RTCM v3 (MSM)</b></p> <p>The receiver can decode <b>RTCM v3 (MSM)</b>.</p> <ul style="list-style-type: none"> <li>• 1071: Compact GPS pseudo ranges (MSM1)</li> <li>• 1072: Compact GPS phase ranges (MSM2)</li> <li>• 1073: Compact GPS pseudo ranges and phase ranges (MSM3)</li> <li>• 1074: Full GPS pseudo ranges and phase ranges plus <b>Carrier-to-Noise Ratio</b> (MSM4)</li> <li>• 1075: Full GPS pseudo ranges, phase range, phase range rate and CNR (MSM5)</li> <li>• 1076: Full GPS pseudo ranges and phase ranges plus CNR, high resolution (MSM6)</li> <li>• 1077: Full GPS pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)</li> <li>• 1081: Compact GLONASS pseudo ranges (MSM1)</li> <li>• 1082: Compact GLONASS phase ranges (MSM2)</li> <li>• 1083: Compact GLONASS pseudo ranges and phase ranges (MSM3)</li> <li>• 1084: Full GLONASS pseudo ranges and phase ranges plus CNR (MSM4)</li> <li>• 1085: Full GLONASS pseudo ranges, phase ranges, phase range rates and CNR (MSM5)</li> <li>• 1086: Full GLONASS pseudo ranges and phase ranges plus CNR, high resolution (MSM6)</li> <li>• 1087: Full GLONASS pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)</li> <li>• 1091: Compact Galileo pseudo ranges (MSM1)</li> <li>• 1092: Compact Galileo phase ranges (MSM2)</li> <li>• 1093: Compact Galileo pseudo ranges and phase ranges (MSM3)</li> </ul> |

| Field | Option               | Description   |
|-------|----------------------|---|
|       |                      | <ul style="list-style-type: none"> <li>• 1094: Full Galileo pseudo ranges and phase ranges plus CNR (MSM4)</li> <li>• 1095: Full Galileo pseudo ranges, phase ranges, phase range rates and CNR (MSM5)</li> <li>• 1096: Full Galileo pseudo ranges and phase ranges plus CNR, high resolution (MSM6)</li> <li>• 1097: Full Galileo pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)</li> <li>• 1121: Compact BeiDou pseudo ranges (MSM1)</li> <li>• 1122: Compact BeiDou phase ranges (MSM2)</li> <li>• 1123: Compact BeiDou pseudo ranges and phase ranges (MSM3)</li> <li>• 1124: Full BeiDou pseudo ranges and phase ranges plus CNR (MSM4)</li> <li>• 1125: Full BeiDou pseudo ranges, phase ranges, phase range rates and CNR (MSM5)</li> <li>• 1126: Full BeiDou pseudo ranges and phase ranges plus CNR, high resolution (MSM6)</li> <li>• 1127: Full BeiDou pseudo ranges, phase ranges, phase range rates and CNR, high resolution (MSM7)</li> </ul> |
|       |                      | <p><b>Accuracy at the rover:</b></p> <ul style="list-style-type: none"> <li>• For L1-only: 0.25-1m rms.</li> <li>• For L1 and L2: 1-5cm rms after a successful ambiguity resolution.</li> </ul>   |
|       | <b>RTCM 1,2 v2</b>   | Message according to RTCM version 2.x. Differential and delta differential GPS corrections. Message 3 is also generated. Use for DGPS. Accuracy at the rover: 0.25-1m rms.  |
|       | <b>RTCM 9,2 v2</b>   | Message according to RTCM version 2.x. GPS partial correction set and delta differential GPS corrections. Message 3 is also generated. Use for DGPS with a slow data channel in the presence of interference. Accuracy at the rover: 0.25-1m rms.   |
|       | <b>RTCM 20,21 v2</b> | Message according to RTCM version 2.x. Real-time carrier phase corrections and high accuracy pseudorange corrections. Message 3 is also generated. Use for real-time operations. Accuracy at the rover: 1-5cm rms after a successful ambiguity resolution.  |

| Field                                  | Option   | Description   |
|--|--|---|
|  | <b>RTCM 1,2,18,19 v2</b>   | Available for RTK base. Message according to RTCM version 2.x. Combination of <b>RTCM 1,2 v2</b> and <b>RTCM 18,19 v2</b> .   |
|  | <b>RTCM 1,2,20,21 v2</b>   | Available for RTK base. Message according to RTCM version 2.x. Combination of <b>RTCM 1,2 v2</b> and <b>RTCM 20,21 v2</b> .   |
|  | The availability of the following options, depends on the selection made for <b>SBAS tracking</b> on the <b>Advanced</b> page. |   |
|  | <b>Automatic SBAS</b>  | SBAS satellites are tracked and the SBAS service used is automatically selected.  |
|  | <b>WAAS</b>  | <b>Wide Area Augmentation System</b> satellites are tracked.  |
|  | <b>EGNOS</b>   | <b>European Geostationary Navigation Overlay System</b> satellites are tracked.   |
|  | <b>MSAS</b>  | <b>MTSAT Satellite-based Augmentation System</b> where MTSAT stands for <b>Multi-functional Transport SATellite</b>   |
|  | <b>GAGAN</b>   | <b>GPS Aided Geo Augmentation Navigation</b> satellites are tracked.  |
| <b>RTCM version</b>                    | <b>1.x, 2.1, 2.2 or 2.3</b>  | Available when the selected <b>RTK data format</b> is an RTCM version 2 format. The same version must be used at the reference and the rover.   |
| <b>Bits per byte</b>                   | <b>6 or 8</b>  | Defines the number of bits/byte in the RTCM message being received.   |
| <b>Use auto coordinate system</b>      | Check box  | Available for <b>RTK data format: RTCM v3</b> or <b>Leica 4G</b> . To set an RTCM coordinate system received by a reference network as active coordinate system.  |
| <b>Receive RTK network information</b> | Check box  | Available for <b>RTK data format: RTCM v3</b> or <b>Leica 4G</b> . Activates an info message (RTCM message 1029).   |
| <b>Behaviour</b>                       | Selectable list  | Available when <b>Receive RTK network information</b> is checked.   |
|  | <b>Log only</b>  | The info message is logged to a text file.  |
|  | <b>Show only</b>   | The info message is shown by the instrument.  |
|  | <b>Show &amp; log</b>  | The info message is shown by the instrument and logged to a text file.  |
| <b>Automatic-ly connect</b>            | Check box  | Available for <b>Connect using: GS Internet 1, GS Internet 2, GS Internet 3, CS Internet 1, CS Internet 2 or CS Internet 3</b> . When this box is checked, define when the system should automatically connect in <b>Connect when</b> . |
| <b>Connect when</b>                    | Selectable list  | Available when <b>Automatically connect</b> is checked.   |


| Field | Option                    | Description  |
|-------|---------------------------|--|
|       | <b>Measure is pressed</b> | The system connects to the Ntrip caster when <b>Measure</b> was pressed in any app.  |
|       | <b>Turned on</b>          | The system connects to the Ntrip caster after the GS has been started up. The connection to the Ntrip caster will be established no matter if a controller is connected to the GS or not.<br>Only available for <b>Connect using: GS Internet 1, GS Internet 2, GS Internet 3.</b> |

### Next step

**Page** changes to the **RTK base** page.

## RTK Rover Settings, RTK base page

### Description of fields

| Field                                | Option          | Description   |
|--------------------------------------|-----------------|---|
| <b>Sensor at base</b>                | Selectable list | The instrument type used at the base. If the real-time data format contains information of the instrument type, certain corrections based on this information are applied in order to provide correct results. The real-time data formats <b>Leica, Leica 4G, CMR/CMR+</b> and <b>RTCM v3</b> contain this information. These corrections are important when third-party instruments are used as reference.   |
| <b>Antenna at base</b>               | Selectable list | The antenna used at the base. If the real-time data format contains information of the antenna, certain corrections based on this information are applied in order to provide correct results. The real-time data formats <b>Leica, Leica 4G, CMR/CMR+</b> and <b>RTCM v3</b> contain this information.<br><br> If the reference data is corrected by absolute antenna calibration values and a Leica standard antenna is being used on the rover, select <b>ADVNULLANTENNA</b> as base antenna. |
| <b>RTK base is sending unique ID</b> | Check box       | If checked, an ID can be typed in.  |
| <b>RTK base ID</b>                   | Editabile field | The special ID of the base station from which real-time data is received. The allowed minimum and maximum values vary.<br><br>From <b>0</b> to <b>31</b> For <b>RTK data format: Leica</b> and <b>RTK data format: CMR/CMR+</b> .<br><br>From <b>0</b> to <b>1023</b> For <b>RTCM version: 2.x.</b>   |

| Field | Option                       | Description  |
|-------|------------------------------|--|
|       | From <b>0</b> to <b>4095</b> | For <b>RTK data format: Leica 4G</b> and <b>RTK data format: RTCM v3</b> . |

### Next step

**Page** changes to the **RTK network** page.

## RTK Rover Settings, RTK network page

OK GGA Page

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Fn GGA</b> | To activate the sending of a GGA message for RTK networks. Refer to <a href="#">19.7.3 Configuration of GGA Message Sending for Reference Network Applications</a> . |
| <b>Page</b>   | To change to another page on this panel.   |

### Description of fields

| Field                  | Option         | Description  |
|------------------------|----------------|--|
| <b>Use RTK network</b> | Check box      | If checked, an RTK network can be used.  |
| <b>Network type</b>    | <b>Nearest</b> | Defines the type of reference network to be used. Refer to SmartNet documentation for more detailed descriptions.<br><br>The rover sends its position using NMEA GGA message to SmartNet. From this position, SmartNet determines the reference in a reference network that is closest to the rover. The corrections from that reference are sent to the rover. Supported for all real-time data formats.<br><br>If this option is selected, an NMEA GGA message must be activated using <b>Fn GGA</b> . |
|                        | <b>i-MAX</b>   | individualised <b>Master-AuXiliary</b> corrections. The rover sends its position using NMEA GGA message to SmartNet where the Master-Auxiliary corrections are calculated. SmartNet individualises the corrections, which means it determines the best suitable corrections for that rover.  |




| Field                                       | Option         | Description  |
|---|----------------|--|
|   | <b>MAX</b>     | If this option is selected, an NMEA GGA message can be activated using <b>Fn GGA</b> .<br><b>Master-AuXiliary</b> corrections<br>The rover typically does not send its position to SmartNet. SmartNet calculates and sends Master-Auxiliary corrections to the rover. The rover individualises the corrections for its position, which means it determines the best suitable corrections. The corrections are sent in <b>RTCM v3</b> with message types 1015/1016. |
|   | <b>VRS</b>     | If this option is selected, an NMEA GGA message can be activated using <b>Fn GGA</b> .<br><b>Virtual Reference Station</b> . If this option is selected, an NMEA GGA message must be activated using <b>Fn GGA</b> . Refer to <a href="#">19.7.3 Configuration of GGA Message Sending for Reference Network Applications</a> .   |
|   | <b>FKP</b>     | Area correction parameters. Derived from German: <b>FlächenKorrektur Parameter</b>   |
| <b>Send user ID</b>                         | Check box      | Activates the sending of a Leica proprietary NMEA message defining the user.   |
| <b>User ID 1</b><br>and<br><b>User ID 2</b> | Editable field | The specific user IDs to be sent as part of the Leica proprietary NMEA message. By default the serial number of the instrument is displayed.   |

#### Next step

Page changes to the **Advanced** page.

#### RTK Rover Settings, Advanced page

#### Description of fields

| Field                         | Option    | Description  |
|-------------------------------|-----------|--|
| <b>Compute xRTK positions</b> | Check box | To activate or deactivate a slightly less accurate RTK position type, typically 5 - 10 cm, automatically providing more availability for phase fixed positions with a reliability of 99%. Recommended when working in heavy canopy environments.<br><br> For NMEA messages, positions measured with the xRTK mode are flagged as fixed. |

| Field                | Option                | Description  |
|----------------------|-----------------------|--|
| <b>SBAS tracking</b> |                       | Allows the <b>Space-Based Augmentation System</b> to be configured to provide extra corrections in conjunction with GPS signals. Also commonly referred to as <b>Satellite-Based Augmentation System</b> , SBAS provides corrected time and distance measurements calculated by a network of ground relay stations and geostatic satellites. An SBAS can correct for problems such as atmospheric delays, poor satellite geometry and incorrect satellite positioning. |
|                      | <b>Automatic SBAS</b> | SBAS satellites are tracked and the SBAS service used is automatically selected.   |
|                      | <b>WAAS</b>           | <b>Wide Area Augmentation System</b> satellites are tracked.   |
|                      | <b>EGNOS</b>          | <b>European Geostationary Navigation Overlay System</b> satellites are tracked.  |
|                      | <b>MSAS</b>           | <b>MTSAT Satellite-based Augmentation System</b> where MTSAT stands for <b>Multi-functional Transport SATellite</b>  |
|                      | <b>GAGAN</b>          | <b>GPS Aided Geo Augmentation Navigation</b> satellites are tracked.   |

#### Next step

**Page** changes to another page on this panel.

### 19.7.2

#### Configuration with Digital Cellular Phone and Radio

##### Description

An ideal real-time setup is to combine a radio and a digital cellular phone to get the best of both technologies. The radio can be used where the radio signals can be received. The advantage is that the radio data transmission is free. If the radio channel is broken, when the rover goes out of range or due to an obstruction, change to the digital cellular phone to complete the measurements. This switch allows maximum productivity and minimal costs with real-time applications.

##### Field procedure step-by-step

1. Set up a base.
2. On the base, attach a digital cellular phone to one port and a radio to another port.
3. Configure both connections on the base.
4. Start the base. Real-time data is transmitted on two ports simultaneously - using different devices.
5. Set up a rover.
6. On the rover, attach a digital cellular phone to one port and a radio to another port.
7. Use two working styles to configure both connections on the rover.
8. Start the rover using either the digital cellular phone connection or the radio connection.

- On the rover, change the working style in use in order to change between using digital cellular phone and radio. There is no need to return to the base.

### 19.7.3

## Configuration of GGA Message Sending for Reference Network Applications

### Description

Most reference networks require an approximate position of the rover. For reference network applications, a rover dials into the reference network and submits its approximate position in form of an NMEA GGA message.

By default, the instrument sends GGA messages with updated current positions automatically when a reference network is selected.

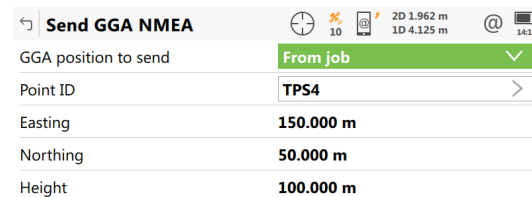
Surveying regulations in some countries require that one certain position can be selected. This position is then sent to the reference network as GGA message through the real-time connection every five seconds.

Refer to [E.3 GGA - Global Positioning System Fix Data](#) for information on GGA message format.

### Access

In **RTK Rover Settings**, **RTK network** page, press **Fn GGA**.

### Send GGA NMEA



Fn OK Fn

| Key                            | Description   |
|--------------------------------|---|
| <b>OK</b>                      | To accept changes and return to the panel from where this panel was accessed.   |
| <b>Last</b>                    | Available for <b>GGA position to send: Last or current position</b> . To use the same coordinates in the GGA message as when the instrument was last used in a reference network application. This functionality is possible when position coordinates from a previous reference network application are still stored in the internal memory. |
| <b>Here</b>                    | Available for <b>GGA position to send: Last or current position</b> . To use the coordinates of the current navigation position in the GGA message.   |
| <b>Fn Coord</b>                | Available for <b>GGA position to send: From job</b> . To view other coordinate types. Local coordinates are available when a local coordinate system is active.   |
| <b>Fn Ell Ht and Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates.  |

## Description of fields

| Field                       | Option                          | Description  |
|-----------------------------|---------------------------------|--|
| <b>GGA position to send</b> | <b>Automatic</b>                | The current rover position is sent to the reference network. The position is updated and sent every 5 seconds.   |
|                             | <b>From job</b>                 | A point from the job can be selected in <b>Point ID</b> . The position of this point is sent to the reference network every 5 seconds.   |
|                             | <b>Last or current position</b> | The position last used in a reference network application or the current navigation position can be selected using <b>Last</b> or <b>Here</b> . The selected position is sent every 5 seconds. |
|                             | <b>None</b>                     | No GGA message is sent to the reference network.   |
| <b>Point ID</b>             | Selectable list                 | Available for <b>GGA position to send: From job</b> . The coordinates of this point are sent out in the GGA message.   |

## 19.8

### Base RTK 1 / Base RTK 2



Unavailable for GS07.

### Description

The real-time connection allows real-time related parameters to be configured. These parameters include defining the real-time messages, data rates and time slicing. Up to two real-time connections can be configured on the instrument.

### Access

For RTK base:

- In **Base Connection Settings** highlight **Base RTK 1. Edit**.



Two real-time devices can be attached to two different ports, for example a radio and a digital cellular phone. On the reference, the two devices can operate simultaneously. Highlight **Base RTK 2** and press **Edit** to configure a second real-time connection.

### RTK Base Settings (RTK 1)/ RTK Base Settings (RTK 2), General page

The available fields and pages on this page depend on the selected settings.

OK Device Page

| Key       | Description   |
|-----------|---|
| <b>OK</b> | To accept changes and return to the panel from where this panel was accessed. |

| Key           | Description   |
|---------------|---|
| <b>Device</b> | Available for <b>Connect using: GS Port 1/GS Port 2/GS Port 3/GS Port 4/GS radio/GS modem</b> . To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> . |
| <b>Page</b>   | To change to another page on this panel.  |

#### Description of fields

| Field                    | Option   | Description   |
|--------------------------|--|---|
| <b>Transmit RTK data</b> | Check box  | Activates the base real-time connection.  |
| <b>Connect using</b>     | <b>GS Port 1</b>   | For GS10: The physical port P1 on the box.<br>For GS14/GS16/GS18: The red LEMO port.<br>For GS25: The physical LEMO port P1 on the box. |
|                          | <b>GS Port 2</b>   | For GS10: The physical port P2 on the box.<br>For GS25: The physical LEMO port P2 on the box.   |
|                          | <b>GS Port 3</b>   | For GS10: The physical port P3 on the box.<br>For GS25: The slot for a device.  |
|                          | <b>GS Port 4</b>   | For GS25: The physical LEMO port P4 on the box.   |
|                          | <b>GS Internet 1, GS Internet 2 and GS Internet 3</b>  | The Internet ports on the GS. If these ports are not assigned to a specific connection, then these ports are extra remote ports.        |
|                          | <b>GS radio</b><br><b>GS modem</b>   | Available for GS14/GS16/GS18.<br>Available for GS14/GS16.   |
| <b>Device</b>            | Display only   | The device currently assigned to the selected port within the active working style.   |
| <b>RTK data format</b>   | <b>Leica, Leica 4G, CMR/CMR+, RTCM v3, RTCM 18,19 v2, RTCM 1,2 v2, RTCM 9,2 v2, RTCM 20,21 v2, RTCM 1,2,18,19 v2</b> | Refer to <a href="#">19.7.1 Configuration of a Rover Real-Time Connection</a> for information about these real-time data formats.       |

| Field  | Option                      | Description   |
|--|-----------------------------|---|
|  | <b>RTCM v3 (MSM)</b>        | Refer to <a href="#">19.7.1 Configuration of a Rover Real-Time Connection</a> for information about this real-time data format.<br><b>RTCM v3 (MSM)</b> generates GNSS receiver observables in a universal manner to meet the coming reality when more GNSS and their signals become available. Encodes the raw observations of all tracked GNSS signals and delivers them as RTK corrections.<br><b>RTCM v3 (MSM)</b> and <b>RTCM v3</b> are treated separately.                       |
| <b>RTCM version</b>                                | <b>1.x, 2.1, 2.2 or 2.3</b> | Available when the selected <b>RTK data format</b> is an RTCM version 2 format. The same version must be used at the reference and the rover.   |
| <b>Apply antenna correction to RTK data stream</b> | Check box                   | Available when <b>RTK data format: RTCM v3</b> is selected.<br>When this box is checked, the RTCM v3 stream sends out ADVNULLANTENNA and normalises the corrections. ADVNULLANTENNA indicates a "null antenna" antenna type used (often by Trimble GNSS devices) to denote that the end user (the rover device) does not have to deal with additional antenna offset corrections.<br>When this box is not checked, the RTCM stream includes the correct IGS antenna name in the stream. |

#### Next step

Page changes to the **Data rates** page.

RTK Base Settings (RTK 1)/  
RTK Base Settings (RTK 2),  
Data rates page

#### Description

For all real-time data formats, parts of the message can be output at different rates.

The settings on this panel define the output rates for the various parts of the selected real-time data format. The available fields on this panel depend on the selected setting for **RTK data format** in **RTK Base Settings (RTK 1)/RTK Base Settings (RTK 2)**.

#### Description of fields

| Field                  | Option                           | Description   |
|------------------------|----------------------------------|---|
| <b>RTK data format</b> | Display only                     | The selected data format.   |
| <b>Data</b>            | From <b>0.1s</b> to <b>60.0s</b> | Rates for the transmission of raw observations. The default settings are suitable for standard applications. They can be changed for special applications. A check is performed for permissible combinations. |

| Field  | Option                         | Description  |
|--|--------------------------------|--|
| <b>Message type</b>  |                                | The message type of <b>RTCM v3</b> and <b>Leica 4G</b> .   |
|  | <b>Compact</b>                 | Suitable for standard applications. For <b>RTK data format: RTCM v3 (MSM)</b> , encoding according to MSM3. Refer to <a href="#">RTK Rover Settings, General page</a> .  |
|  | <b>Extended</b>                | For <b>RTK data format: RTCM v3 (MSM)</b> , encoding according to MSM5. Refer to <a href="#">RTK Rover Settings, General page</a> .  |
| <b>Coordinates</b>   | From <b>10s</b> to <b>120s</b> | Rate for the transmission of reference coordinates.  |
| <b>Information</b>   | From <b>10s</b> to <b>120s</b> | Rate for the transmission of base station information such as point ID.  |
|  | <b>Off</b>                     | Available for <b>RTCM v3 (MSM)</b> . No receiver and antenna descriptors information message is sent out. Default for <b>Message type: Compact</b> .   |
| <b>End of message</b>  | <b>Nothing</b> or <b>CR</b>    | To add a <b>Carriage Return</b> at the end of the real-time message.   |
| <b>Messages to be streamed (local coordinates will be computed using the coordinate system on the GS sensor)</b> | Selectable list                | Available for <b>RTCM version: 2.3</b> . The messages sent within the coordinate message.  |
| <b>RTK base ID</b>   | Editable field                 | An identification for a base station. It is converted into a compact format and sent out with real-time data in all real-time data formats. It is different from the point ID of the base station.<br><br>If working with several base stations in time slicing mode on the same frequency, an ID of the base station is required. In this case, the ID of the base station from which data is accepted must be typed in at the rover.<br><br>The allowed minimum and maximum values vary. |
|  | From <b>0</b> to <b>31</b>     | For <b>Leica</b> and <b>CMR/CMR+</b> .   |
|  | From <b>0</b> to <b>1023</b>   | For any RTCM version 2 format.   |
|  | From <b>0</b> to <b>4095</b>   | For <b>Leica 4G</b> , <b>RTCM v3</b> and <b>RTCM v3 (MSM)</b> .  |

### Next step

**Page** changes to the **Time slicing** page.

RTK Base Settings (RTK 1)/  
RTK Base Settings (RTK 2),  
Time slicing page

### Description of fields

| Field                                 | Option  | Description  |
|---------------------------------------|---|--|
| <b>Use time slicing</b>               | Check box   | The possibility to send delayed real-time messages. This functionality is required when real-time messages from different base stations are sent on the same radio channel. Time slicing works for all device types.   |
| <b>Total base stations being used</b> | 2, 3 or 4   | The number of base stations in use from where real-time messages are sent.   |
| <b>Time slot for this base</b>        | 2, 3 or 4<br>The contents of the selectable list depend on the settings for <b>Total base stations being used</b> . | The time slot represents the current time delay. The number of possible time slots is the number of base stations in use. The time delay equals 1s divided by the total number of base stations. If two base stations are used, the time delay is 0.50s. Therefore, the time slots are at 0.00s and at 0.50s. With three base stations, the time delay is 0.33s. The time slots are at 0.00s, 0.33s and 0.66s. |

### Next step

**Page** changes to another page on this panel.

## 19.9



### NMEA 1 / NMEA 2

Unavailable for GS07.



For GS07, streaming of GGA messages is supported for RTK network operations.

### Description

National **M**arine **E**lectronics **A**ssociation has developed a message standard related to the marine electronics industry. NMEA messages have been accepted as the standard for sharing specific data information between companies since the late 1970s. Refer to [E NMEA Message Formats](#) for a comprehensive description of each NMEA message.

The settings on this panel define the port, the device and the type of NMEA message to be used for the NMEA Out connection.

Up to two NMEA Out connections can be configured. Each NMEA Out connection can output different messages at different rates with different talker IDs. The output of NMEA messages on both ports is simultaneous.

The panels for the settings of both NMEA connections are identical except for the title - **NMEA Output 1** and **NMEA Output 2**. For simplicity, the title **NMEA Output 1** is used in the following.



## Access

For RTK rover:

- In **Connection Settings, GS connections** page, highlight **NMEA 1** or **NMEA 2. Edit.**

For CS30/CS35:

- Unavailable. Use Windows to configure a connection.

## NMEA Output 1

| Key             | Description  |
|-----------------|--|
| <b>OK</b>       | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Messages</b> | To configure what NMEA messages are output, the rates and the output timing method. Refer to paragraph <a href="#">NMEA Messages</a> . |
| <b>Device</b>   | To create, select, edit or delete a device.  |

### Description of fields

| Field  | Option   | Description  |
|--|--|--|
| <b>Stream NMEA messages from the GS sensor</b> | Check box  | Activates the output of NMEA.  |
| <b>Connect using</b>                           | <b>GS Port 1</b>                                   | For GS10/GS25: The physical port P1 on the box.<br>For GS14/GS16/GS18: The red LEMO port.  |
|  | <b>GS Port 2</b>                                   | For GS10/GS25: The physical port P2 on the box.  |
|  | <b>GS Port 3</b>                                   | For GS10: The physical port P3 on the box.<br>For GS25: The slot for a device.   |
|  | <b>GS Port 4</b>                                   | For GS25: The physical port P4 on the box.   |
|  | <b>GS BT 1</b>                                     | The Bluetooth port on the GS.  |
|  | <b>GS Internet 1, GS Internet 2, GS Internet 3</b> | The Internet ports on the GS. If these ports are not assigned to a specific connection, then these ports are extra remote ports. |
|  | <b>GS radio</b>                                    | Available for GS14/GS16.   |
|  | <b>GS modem</b>                                    | Available for GS14/GS16/GS18.  |

| Field  | Option                | Description   |
|--|-----------------------|---|
| <b>Device</b>  | Display only          | Usually, <b>RS232</b> is used to transfer NMEA messages.  |
| <b>NMEA Version</b>  | <b>4.0 (extended)</b> | Backwards compatible to NMEA in Leica Captivate version 5.0 plus BeiDou support.  |
|  | <b>4.1 (compact)</b>  | More compact message output than in Leica Captivate version 5.0 plus BeiDou support.  |
| <b>Use a defined talker ID</b>   | Check box             | When this box is checked, a user-defined talker ID can be typed in. Otherwise, the standard NMEA Talker ID is used:<br><br>GN = <b>G</b> lobal <b>N</b> avigation <b>S</b> atellite <b>S</b> ystem<br>= GPS with GLONASS/Galileo/BeiDou in any combination<br><br>GP = GPS only<br>GL = GLONASS<br>GA = Galileo<br>GB = BeiDou<br>GQ = QZSS |
| <b>Talker ID</b>   | Editable field        | Available when <b>Use a defined talker ID</b> is checked. Appears at the beginning of each NMEA message.  |
| <b>Messages to be streamed (local coordinates will be computed using the coordinate system on the GS sensor)</b> | Display only          | The NMEA messages currently selected for output.  |

#### Overview of NMEA messages sent depending on settings

| Message | GPS        | GNSS  | GPS        | GNSS       |
|---------|------------|---|------------|------------|
|         | NMEA v4.0  |   | NMEA v4.1  |            |
| GGA     | \$GPGGA    | \$GNGGA   | \$GPGGA    | \$GNGGA    |
| GGK     | \$GPGGK    | \$GNGGK   | \$GPGGK    | \$GNGGK    |
| GGK_PT  | \$PTNL,GGK | \$PTNL,GGK  | \$PTNL,GGK | \$PTNL,GGK |
| GGQ     | \$GPGGQ    | \$GNGGQ<br>\$GPGGQ<br>\$GLGGQ<br>\$GAGGQ<br>\$BDGGQ | \$GPGGQ    | \$GNGGQ    |
| GLL     | \$GPGLL    | \$GNGLL   | \$GPGLL    | \$GNGLL    |
| GNS     | \$GPGNS    | \$GNGNS   | \$GPGNS    | \$GNGNS    |
| GSA     | \$GNGSA    | \$GPGSA   | \$GPGSA    | \$GNGSA    |

| Message | GPS       | GNSS  | GPS       | GNSS                                     |
|---------|-----------|---|-----------|--|
|         | NMEA v4.0 |   | NMEA v4.1 |  |
| GSV     | \$GPGSV   | \$GPGSV<br>\$GLGSV<br>\$GAGSV<br>\$BDGSV            | \$GPGSV   | \$GPGSV<br>\$GLGSV<br>\$GAGSV<br>\$BDGSV |
| LLK     | \$GPLLK   | \$GNLLK<br>\$GPLLK<br>\$GLLLK<br>\$GALLK<br>\$BDLLK | \$GPLLK   | \$GNLLK                                  |
| LLQ     | \$GPLLQ   | \$GNLLQ<br>\$GPLLQ<br>\$GLLLQ<br>\$GALLQ<br>\$BDLLQ | \$GPLLQ   | \$GNLLQ                                  |
| RMC     | \$GNRMC   | \$GNRMC   | \$GNRMC   | \$GNRMC                                  |
| VTG     | \$GPVTG   | \$GNVTG   | \$GPVTG   | \$GNVTG                                  |
| ZDA     | \$GPZDA   | \$GPZDA   | \$GPZDA   | \$GPZDA                                  |

## NMEA Messages

This panel shows the messages that can be output, which messages are currently output, the output rates and the output timing method.

| NMEA Messages                       |    |      |        |
|-------------------------------------|----|------|--------|
| Use                                 | No | Rate | Output |
| <input checked="" type="checkbox"/> |    | ---- | ----   |
| <input type="checkbox"/>            |    | ---- | ----   |
| <input type="checkbox"/>            |    | ---- | ----   |
| <input type="checkbox"/>            |    | ---- | ----   |
| <input type="checkbox"/>            |    | ---- | ----   |
| <input type="checkbox"/>            |    | ---- | ----   |

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To accept changes and return to the panel from where this panel was accessed.   |
| <b>Edit</b>         | To configure how the currently highlighted message is output. Refer to paragraph <a href="#">NMEA Message to Send</a> . |
| <b>All and None</b> | To activate and deactivate the output for all messages.   |
| <b>Use</b>          | To activate and deactivate the output for the highlighted message.  |

### Next step

| IF an NMEA message      | THEN                                    |
|-------------------------|---|
| is not to be configured | <b>OK</b> closes the panel.             |
| is to be configured     | highlight the message and <b>Edit</b> . |

## NMEA Message to Send

**NMEA Message to Send** 2D 1.960 m 1D 4.121 m 14:15

Send the GGA message

Send message **Immediately**


Rate **1.0 sec**

Don't send message if quality limit is exceeded

OK

| Key | Description   |
|-----|---|
| OK  | To accept changes and return to the panel from where this panel was accessed. |

### Description of fields

| Field  | Option                              | Description   |
|--|-------------------------------------|---|
| <b>Stream the NMEA message</b>                         | Check box                           | When this box is checked, the selected NMEA message is output.  |
| <b>Send message</b>                                    | <b>Immediately</b>                  | The NMEA message is created as soon as the information is available. It is sent out in the time interval as defined in <b>Rate</b> .  |
|  | <b>On point stored</b>              | The NMEA message is sent on point storage.<br><br> If the time interval defined in <b>Rate</b> is shorter than the epochs of the panel update, then the internal computation of positions is changed to allow the specified rate of NMEA positions. The panel update remains unchanged. |
| <b>Point type</b>                                      |                                     | Available for <b>Send message: On point stored</b> .<br>Defines the type of points for which the NMEA message is sent.  |
|  | <b>All points</b>                   | The NMEA message is sent when any type of point is stored.  |
|  | <b>Occupied pts only</b>            | The NMEA message is sent when a manually measured point is stored.  |
|  | <b>Auto pts only</b>                | The NMEA message is sent when auto points are stored.   |
| <b>Rate</b>  | From <b>0.05s</b> to <b>3600.0s</b> | Available unless <b>Send message: On point stored</b> .<br>Defines the time intervals at which the NMEA messages are created.   |
| <b>Don't send message if quality limit is exceeded</b> | Check box                           | When this box is checked the CQ control can be defined.   |

| Field            | Option  | Description  |
|------------------|---|--|
| Check quality of | Position only, Height only or Position & height | Available when <b>Don't send message if quality limit is exceeded</b> is checked. Activates a control over the coordinate quality. If the coordinate quality of the position and/or height component exceeds the limit as defined in <b>Quality limit</b> , then NMEA messages are not output. |
| Quality limit    | Editable field                                  | Available when <b>Don't send message if quality limit is exceeded</b> is checked. The limit for the coordinate quality up to which NMEA messages are output.   |

#### Next step

1. **OK** returns to **NMEA Messages**.
2. **OK** returns to the panel from where **NMEA Messages** was accessed.

## 19.10

### Remote (OWI)



Unavailable for GS07.

#### Description

The remote connection allows:

- the instrument to be controlled using a device other than the field controller, for example a computer. **Outside World Interface** or **Leica Binary 2** commands can be used to control the instrument through the remote port. Documentation for OWI and LB2 is available on request from the Leica Geosystems representative.
- a message log to be requested from a remote client via an OWI message. A message log contains a history of warning messages and message lines.
- the downloading of data directly from the instrument's memory device to Infinity through a serial port on the computer. The CS does not need to be removed from the instrument.

The settings on this panel define the port and the device to be used for the remote control.



A port configured as a remote port can be used to output event input, meteo or tilt notification messages.



The OWI commands listed here are protected by a licence key. Refer to [30.3 Entitlements & licences](#) for information on licence keys. The corresponding LB2 commands are also protected. If these OWI commands have been activated by a licence key, it is indicated in **About Leica Captivate**.

- |       |           |       |       |       |
|-------|-----------|-------|-------|-------|
| • AHT | • DPM     | • GLL | • POB | • RTK |
| • ANT | • GGA     | • GNS | • POE | • TPV |
| • CNF | • GGK     | • LLK | • POQ | • USR |
| • DCF | • GGK(PT) | • LLQ | • POS |       |
| • DCT | • GGQ     | • NET | • RMC |       |

## Access

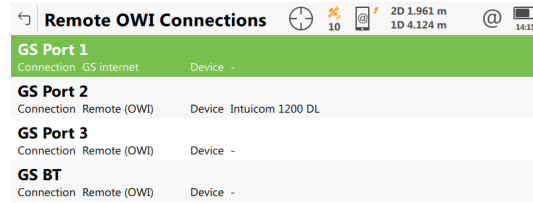
For RTK rover:

- In **Connection Settings, GS connections** page, highlight **Remote (OWI). Edit.**

For CS30/CS35:

- Unavailable. Use Windows to configure a connection.

## Remote OWI Connections



Fn OK Use Fn

| Key     | Description  |
|---------|--|
| OK      | To accept changes and return to the panel from where this panel was accessed.  |
| Control | To configure more parameters.  |
| Device  | Available unless an Internet connection is used. To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> . |

### Description of metadata

| Metadata   | Description  |
|------------|--|
| Connection | The connection configured for the ports. Any port which is not configured is automatically assigned the remote connection. |
| Device     | The hardware connected to the chosen port.   |

## 19.11

### PPS output



The PPS output is an optional interface requiring a special port.

### Description

PPS stands for **P**ulse **P**er **S**econd. It is a pulse that is output at a specified interval time. The pulse can be used to activate another device. Additionally, a notification message can be output through the GS25 ports P1, P2, P3, P4 or BT when a PPS output occurs.

For example, in aerial photography, an aerial camera can be configured to take a photo each time it receives a pulse from the instrument.

The settings on this panel define the output port and parameters for the PPS option. This panel is available if the instrument is fitted with a PPS output port.



This option is only available on GS25.

## Access

For RTK rover:

- In **Connection Settings, GS connections** page, highlight **PPS output. Edit.**

## PPS Output, PPS Output page

PPS Output Notification

Output a Pulse Per Second from the  GS

Rate

Polarity

OK Page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Page | To change to another page on this panel.                                      |

### Description of fields

| Field                                 | Option                          | Description   |
|---------------------------------------|---------------------------------|---|
| Output a Pulse Per Second from the GS | Check box                       | When this box is checked, the output of PPS is activated and relevant settings can be configured. |
| Rate                                  | From 1.0 sec to 20.0 sec        | The rate at which pulses are output.  |
| Polarity                              | Negative edge and Positive edge | Measure the time from the negative edge or the positive edge of the pulse.                        |

### Next step

**Page** changes to the **Notification** page.

## PPS Output, Notification page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Page | To change to another page on this panel.                                      |

### Description of fields

| Field                                | Option    | Description  |
|--------------------------------------|-----------|--|
| Send notification on each PPS output | Check box | When this box is checked, the output of a notification message with each PPS output is activated. Refer to <a href="#">H PPS Output Notify Message Format</a> for information on the message format. |

| Field                | Option  | Description  |
|----------------------|---|--|
| <b>Connect using</b> | <b>GS Port 1,</b><br><b>GS Port 2,</b><br><b>GS Port 3</b> or<br><b>GS Port 4</b> | The ports on the GS25 used for the connection.           |
|                      | <b>GS BT 1</b>  | The Bluetooth ports on the GS25 used for the connection. |
| <b>Device</b>        | Display only  | The hardware connected to the chosen port.               |
| <b>Notification</b>  | Selectable list   | The message can be in ASCII or in binary format.         |

### Next step

**Page** changes to another page on this panel.

## 19.12

### Event input 1/ Event input 2



The event input is an optional interface requiring a special port.

#### Description

The event input interface allows pulses which are sent from devices connected to the instrument to be recorded. These records can later be superimposed on the processed kinematic data and the positions where the events took place can be interpolated in Infinity. Events logged during real-time operations can also be exported to an ASCII file using an appropriate format file. Additionally, a notification message can be output through the GS25 ports P1, P2, P3, P4 or BT providing information about when the event occurred. A port configured as a remote port can be used to output the notification message.

For example, in aerial photography, an aerial camera can be connected through the event input port. When the shutter opens, the position at which the event occurred is recorded.

The settings on this panel define the input port and parameters for the event input option. This panel is available if the instrument is fitted with an event input port.



This option is only available on GS25.

#### Event Input 1/ Event Input 2, Event input page

| Key       | Description   |
|-----------|---|
| <b>OK</b> | To accept changes and return to the panel from where this panel was accessed. |



| Key                          | Description   |  |
|------------------------------|---|--|
| Page                         | To change to another page on this panel.              |  |
| <b>Description of fields</b> |   |  |
| Field                        | Option  | Description  |
| Receive event input pulses   | Check box   | When this box is checked, the detection and logging of events being sent to the event ports is activated and relevant settings can be configured.                              |
| Information to log           | Time, pos, vel, CQ, Time, pos, vel, Time, pos or Time | Time, position, velocity and coordinate quality can be recorded in various combinations.   |
| Polarity                     | Negative edge or Positive edge                        | The polarity according to the device in use.   |
| Accuracy limit               | Editable field  | If two or more events take place during the time defined in s, the first event is recorded. Enter 0 to accept all events. The shortest recording time is 0.05 s.               |
| Description                  | Editable field  | Records up to four lines of data with the event record. Use the description to differentiate between the two event records if two event input ports are used at the same time. |

#### Next step

Page changes to the **Bias values** page.

Event Input 1/  
Event Input 2,  
Bias values page

| Key                              | Description   |  |
|----------------------------------|---|--|
| OK                               | To accept changes and return to the panel from where this panel was accessed. |  |
| Page                             | To change to another page on this panel.                                      |  |
| <b>Description of fields</b>     |   |  |
| Field                            | Option  | Description  |
| External bias                    | Editable field  | Sets a calibration value in ns according to the external event device and cable being used.  |
| Enter user defined internal bias | Check box   | When this box is checked, personal calibration values for the particular instrument can be configured.<br>When this box is not checked, default calibration values for the particular instrument are used. |
| Internal bias                    | Editable field  | Available when <b>Enter user defined internal bias</b> is checked. Sets the particular calibration value in ns for the instrument.   |

### Next step

**Page** changes to the **Notification** page.

Event Input 1/  
Event Input 2,  
Notification page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Page | To change to another page on this panel.                                      |

### Description of fields

| Field                                 | Option  | Description  |
|---------------------------------------|---|--|
| Send notification on each Event Input | Check box   | When this box is checked, the output of a notification message with each event input is activated. Refer to <a href="#">G Event Input Notify Message Format</a> for information on the message format. |
| Connect using                         | GS Port 1,<br>GS Port 2,<br>GS Port 3 or<br>GS BT 1 | The ports on the GS25 which are used for the connection.<br><br>The Bluetooth ports on the GS25 used for the connection.   |
| Device                                | Display only  | The hardware connected to the chosen port.   |
| Notification                          | Selectable list                                     | The message can be in ASCII or in binary format.   |

### Next step

**Page** changes to another page on this panel.

## 19.13

### Total station

#### Description

The settings on this panel define the communication of the field controller with Leica TS and third-party instruments.

#### Access

For a connection from CS to Total station:

- In **Connection Settings** highlight **Total station. Edit.**

#### Connect to Total Station

Connect to Total Station

Manufacturer: Leica

Model: TPS1200

Connect using: Bluetooth

Name: BT\_Name\_1

Bluetooth ID: BT\_Address\_1

OK Search

| Key            | Description  |
|----------------|--|
| <b>OK</b>      | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Search</b>  | To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available if <b>Connect using: Bluetooth</b> is selected. |
| <b>Control</b> | Available for certain devices connected to certain connections. To configure more parameters, for example changing the radio channel.  |
| <b>Default</b> | To return the fields back to their default values.   |

#### Description of fields

| Field                        | Option   | Description  |
|------------------------------|--|--|
| <b>Manufacturer</b>          | Selectable list  | The brand of the instrument.   |
| <b>Model</b>                 | Selectable list  | The instrument model.  |
| <b>Connect using</b>         | <b>Cable, Bluetooth, Long-range TS, External radio</b><br><b>CTR20 expansion pack</b><br><b>CTR30 LRBT module</b><br><b>CTR35 LRBT Stick</b> | How the instrument is connected. The options available depend on the selection for <b>Model</b> . The availability of the other fields depends on the selection made here.<br>To configure a connection between a CS20 with robotic module and a TS with RH17.<br>To connect a CS30 with long-range Bluetooth module to a TS with RH17/TCPS30 attached.<br>To connect a CS35 with long-range Bluetooth stick attached to a TS with RH17/TCPS30 attached. |
| <b>Baud rate</b>             | From <b>1200</b> to <b>115200</b>  | Frequency of data transfer from instrument to device in bits per second.   |
| <b>Parity</b>                | <b>None, Even</b> or <b>Odd</b>  | Error checksum at the end of a block of digital data.  |
| <b>Data bits</b>             | <b>6, 7</b> or <b>8</b>  | Number of bits in a block of digital data.   |
| <b>Stop bit</b>              | <b>1</b> or <b>2</b>   | Number of bits at the end of a block of digital data.  |
| <b>Flow control</b>          | <b>None</b> or <b>RTS/CTS</b>  | Activates hardware handshake. When the instrument/device is ready for data, it asserts the Ready To Send line indicating it is ready to receive data. This line is read by the sender at the Clear To Send input, indicating it is clear to send the data.   |
| <b>Name and Bluetooth ID</b> | Display only   | The last connected total station using Bluetooth or CTR20 expansion pack. If no information of a last total station is available, then ---- is displayed.  |

| Field   | Option    | Description   |
|---|-----------|---|
| <b>Reduce video streaming rate for long distance connection</b> | Check box | Available for <b>Connect using: CTR30 LRBT module</b> .<br>When this box is checked and when the connection between field controller and total station is over a long distance, then the sequence of the live videos created from the 3D data taken by the camera of the instrument is reduced. |

## 19.14

### AutoPole

#### Description

The settings on this panel define the communication of the total station or field controller with the AutoPole.

#### Access

For a connection to AutoPole:

- In **Connection Settings** highlight **AutoPole. Edit**.

#### AP20 Connection Settings

AP20 Connection Settings

Use AutoPole

Sensor **AP20**

Connect using **Radio handle**

Last used AutoPole -----

Bluetooth ID -----

OK Search

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Search</b> | To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |

#### Description of fields

| Field                                      | Option  | Description  |
|--|---|--|
| Sensor                                     | Selectable list                               | The instrument model.  |
| <b>Connect using</b>                       | <b>Radio handle, Bluetooth, Long-range TS</b> | How the instrument is connected. The options available depend on the selection for <b>Radio handle</b> and where the search is triggered from (total station or field controller). |
| <b>Last used AutoPole and Bluetooth ID</b> | Display only                                  | The last connected AutoPole using <b>Radio handle, Bluetooth</b> or <b>Long-range TS</b> . If no information of a last AutoPole is available, then ----- is displayed.             |

## 19.15

## GSI output

### Description

Each time a measured point is stored to the job, GSI data is streamed through the configured port of the field controller.

### Access

In **Connection Settings** highlight **GSI output. Edit.**



Unavailable for CS30/CS35. Use Windows to configure a connection.

### GSI Output Connection

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Search</b> | Available when <b>CS Bluetooth 1</b> or <b>CS Bluetooth 2</b> are selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| <b>Device</b> | To create, select, edit or delete a device.  |

### Description of fields

| Field                            | Option  | Description   |
|----------------------------------|---|---|
| <b>Output GSI data to device</b> | Check box                                       | Activates the connection.   |
| <b>Connect using</b>             | <b>CS RS232 port</b>                            | The RS232 port on the field controller.   |
|                                  | <b>CS Bluetooth 1</b> and <b>CS Bluetooth 2</b> | The Bluetooth ports on the field controller which are used.   |
|                                  | <b>TS Bluetooth 1</b> and <b>TS Bluetooth 2</b> | The Bluetooth ports on the TS13/TS16 which can be used.   |
|                                  | <b>Cable</b> and <b>Radio handle</b>            | The RS232 port on the TS13/TS16. Hotshoe connection for RadioHandle. This port is on top of Communication side cover. |
| <b>Device</b>                    | Display only                                    | The device currently assigned to the selected port.   |

| Field             | Option                            | Description  |
|-------------------|-----------------------------------|--|
| <b>GSI Format</b> | <b>GSI8 polar &amp; cartesian</b> | GSI Polar and Cartesian (8 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM, E, N, Elev.)  |
|                   | <b>GSI16 polar</b>                | GSI Polar (16 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM, reflector height)  |
|                   | <b>GSI16 cartesian</b>            | GSI Cartesian (16 data characters) (E, N, Elev, Reflector Height)  |
|                   | <b>Pt, N, E, Ht, date</b>         | Coordinate data (Northing BEFORE Easting)  |
|                   | <b>Pt, E, N, Ht, date</b>         | Coordinate data<br>(Easting BEFORE Northing)   |
|                   | <b>Pseudo NMEA GGA</b>            | Based on NMEA ( <b>N</b> ational <b>M</b> arine <b>E</b> lectronics <b>A</b> ssociation), which is a standard for interfacing marine electronic devices. |
|                   | <b>GSI8 polar</b>                 | GSI Polar (8 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM)   |
|                   | <b>GSI16 polar 2</b>              | GSI Polar (16 data characters)<br>(Point ID, Hz, V, SlopeDist, PPM)  |

#### Output format - GSI Format

GSI data is transmitted in blocks. Every block consists of several data words, refer to the examples in the following table. Every data word begins with a two character Word Index, the WI code, specifying the data type within this block. Each GSI8 word has in total 16 characters, consisting of 7 information characters followed by 8 data characters and finally the blank character ASCII code 32. The GSI16 block is like the GSI8 block, but begins with \* and the data word contains 16 characters for large values such as UTM coordinates, alphanumeric codes, attributes or point IDs.

Example 1 shows a GSI8 block sequence with the words for point ID (11), Easting coordinate (81) and Northing coordinate (82). Example 2 shows a GSI16 block sequence with the words for point ID (11), horizontal (21) and vertical angle (22).

| Type  | GSI8 Polar&Cart | GSI16 Polar  | GSI16 Cartesian |
|-------|-----------------|--------------|-----------------|
| WI 11 | Point ID        | Point ID     | Point ID        |
| WI 21 | Hz              | Hz           | -               |
| WI 22 | V               | V            | -               |
| WI 31 | SlopeDist       | SlopeDist    | -               |
| WI 51 | PPM Total/mm    | PPM Total/mm | -               |
| WI 81 | East            | -            | East            |
| WI 82 | North           | -            | North           |
| WI 83 | Elev.           | -            | Elev.           |
| WI 87 | Refl. Ht        | -            | Refl. Ht        |

### Example 1: GSI8

Each word has 16 characters of which 8 characters are used for the data block.

| Word 1          | Word 2          | Word 3          |
|-----------------|-----------------|-----------------|
| 110001+0000A110 | 81..00+00005387 | 82..00-00000992 |
| 110002+0000A111 | 81..00+00007586 | 82..00-00003031 |
| 110003+0000A112 | 81..00+00007536 | 82..00-00003080 |
| 110004+0000A113 | 81..00+00003839 | 82..00-00003080 |
| 110005+0000A114 | 81..00+00001241 | 82..00-00001344 |


### Example 2: GSI16

Each word has 24 characters of which 16 characters are used for the data block.

| Word 1                   | Word 2                  | Word 3                  |
|--------------------------|-------------------------|-------------------------|
| *110001+000000000PNC0055 | 21.002+0000000013384650 | 22.002+0000000005371500 |
| *110002+000000000PNC0056 | 21.002+0000000012802530 | 22.002+0000000005255000 |
| *110003+000000000PNC0057 | 21.002+0000000011222360 | 22.002+0000000005433800 |
| *110004+000000000PNC0058 | 21.002+0000000010573550 | 22.002+0000000005817600 |
| *110005+000000000PNC0059 | 21.002+0000000009983610 | 22.002+0000000005171400 |

### GSI Word information

| Pos. | Name                        | Description of values   | Applicable for                                       |
|------|-----------------------------|---|--|
| 1-2  | Word Index (WI)             |   |  |
| 3    | No significance             | .: No information.  | WI11, WI21, WI22, WI31, WI51, WI81, WI82, WI83, WI87 |
| 4    | Automatic index information | .: No information.<br>0: <b>Tilt compensator:Off</b><br>3: <b>Tilt compensator:On</b>   | WI21, WI22   |
| 5    | Input mode                  | .: No information.<br>0: Measured values transferred from instrument<br>1: Manual input from keyboard<br>2: Measured value, <b>Hz correction:On.</b><br>3: Measured value, <b>Hz correction:Off.</b><br>4: Result calculated from functions | WI21, WI22, WI31, WI51, WI81, WI82, WI83, WI87       |

| Pos.         | Name                    | Description of values   | Applicable for   |
|--------------|-------------------------|---|--|
| 6            | Units                   | .: No information.<br>0: <b>Distance:Metre (m)</b> ,<br>last digit 1 / 1000 m<br>1: <b>Distance:US ft (ft)</b><br>last digit 1 / 1000 ft<br>2: <b>Angle:400 gon</b><br>3: <b>Angle:360° dec</b><br>4: <b>Angle:360°"</b><br>5: <b>Angle:6400 mil</b><br>6: <b>Distance:Metre (m)</b> ,<br>last digit 1 / 10000 m<br>7: <b>Distance:US ft (ft)</b><br>last digit 1 / 10000 ft          | WI21, WI22, WI31,<br>WI81, WI82, WI83, WI87                |
| 7            | Sign                    | +: Positive value<br>-: Negative value  | WI21, WI22, WI31,<br>WI51, WI81, WI82,<br>WI83, WI87       |
| 8-15<br>8-23 | Data                    | Data includes a sequence<br>of 8 (16) numerical or<br>alphanumeric characters.<br> Certain data<br>blocks are<br>allowed to carry<br>more than one<br>value for<br>example<br>ppm/mm. This<br>data is auto-<br>matically trans-<br>ferred with the<br>according sign<br>before each<br>single value. | WI11, WI21, WI22,<br>WI31, WI51, WI81,<br>WI82, WI83, WI87 |
| 1624         | Separating<br>character | : Blank   | WI11, WI21, WI22,<br>WI31, WI51, WI81,<br>WI82, WI83, WI87 |

### Output format - Pt, N, E, Ht, date

#### Format

Point ID, Northing, Easting, Elevation, Date, Time <CR/LF>

#### Description of fields

The format settings are defined in **Regional**.

| Field     | Description                              |
|-----------|--|
| Point ID  | Text describing the point identification |
| Northing  | The Northing coordinate.                 |
| Easting   | The Easting coordinate.                  |
| Elevation | The height coordinate.                   |
| Date      | The measurement/origination date.        |
| Time      | The measurement/origination time.        |



| Field   | Description               |
|---------|---------------------------|
| <CR/LF> | Carriage Return Line Feed |

### Example

2004,4997.635,6010.784,393.173,09/10/2001,16:34:12.2  
 2005,4997.647,6010.765,393.167,09/10/2001,16:34:12.4  
 2006,4997.657,6010.755,393.165,09/10/2001,16:34:12.7

### Output format - Pt, E, N, Ht, date

#### Format

This output format is identical to the Pt,N,E,Ht,Date format except the order of the Easting and Northing variables are reversed.

### Output format - Pseudo NMEA GGA

#### Description

This output format is based on NMEA (National Marine Electronics Association), which is a standard for interfacing marine electronic devices.

#### Format

\$GPGGA,Time,Northing,N,Easting,E,1,05,1.0,Elevation,M,0.0,M,0.0,0001\*99  
 <CR/LF>

#### Description of Fields

| Field                       | Description  |
|-----------------------------|--|
| \$GPGGA                     | Sentence identification (header including talker identification). A Talker ID appears at the beginning of the header of each NMEA message. |
| Time                        | UTC time of position (hhmmss.ss)   |
| Northing                    | The Northing coordinate (always output with 2 decimal places)  |
| N                           | Fixed text (N)   |
| Easting                     | The Easting coordinate (always output with 2 decimal places)   |
| E                           | Fixed text (E)   |
| GPS Quality Indicator       | Fixed number (1=no real-time position, navigation fix)   |
| Number of satellites        | Number of satellites in use (00 to 12)   |
| HDOP                        | Fixed number (1.0)   |
| Elevation                   | The height coordinate (always output with 2 decimal places)  |
| Elevation units             | Elevation units (F or M). The format settings are defined in <b>Regional</b> .   |
| Height Geoid                | Fixed number (0.0)   |
| Height units                | Fixed text (M)   |
| Time since last DGPS update | Fixed number (0.0)   |

| Field                      | Description                      |
|----------------------------|----------------------------------|
| DGPS<br>Base station<br>ID | Fixed number (0.0001)            |
| Checksum                   | Fixed number (*99)               |
| <CR/LF>                    | <b>Carriage Return Line Feed</b> |

### Example

\$GPGGA,171933.97,7290747.02,N,3645372.06,E,1,05,1.0,1093609.54,F,0.0,  
M,0.0,0001\*99

\$GPGGA,171934.20,7290747.02,N,3645372.06,E,1,05,1.0,1093609.54,F,0.0,  
M,0.0,0001\*99

\$GPGGA,171934.45,7290747.03,N,3645372.06,E,1,05,1.0,1093609.54,F,0.0,  
M,0.0,0001\*99



Fields are always separated by a comma. A comma is never placed before the Checksum field. When information for a field is not available, the position in the data string is empty.

## 19.16

### CS Connection

#### Description

The Remote connection allows the TS instrument to be steered remotely from a field controller where Leica Captivate is running.

The settings on this panel define the port and the device used for the remote connection.

#### CS Connection

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Device</b> | Available unless <b>Connect using: Cable</b> is selected on TS60/TM60. To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> . |

## Description of fields

| Field  | Option  | Description   |
|--|---|---|
| <b>Allow CS controller to connect to this instrument</b> | Check box   | When this box is checked, the remote connection is activated.   |
| <b>Connect using</b>                                     | <b>Cable</b><br><b>Radio handle</b><br><b>Bluetooth</b><br><b>Cable RS232</b> | For TS13/TS16: The RS232 port.<br>For TS60/MS60/TM60: The cable USB port.<br>Hotshoe connection for RadioHandle. This port is on top of Communication side cover.<br>The Bluetooth port on the TS13/TS16 or CS30/CS35 which is used.<br>The RS232 port on the TS60/MS60/TM60. |
| <b>Device</b>  | Display only  | The device currently assigned to the selected port.   |

## Next step

When the connection is established, most keys are locked. Available are:

- **Measure, Distance** and **Store**.
- **Distance** and **Store** have the same functionality as on the CS or as on the TS13/TS16/TS60/MS60/TM60 when it is independently controlled.
- **Level** goes to **Level & Compensator**. Check the level bubble, laser plummet intensity, tilt compensator and horizontal correction.

## 19.17

## GeoCOM Connection

### Description

The GeoCOM Mode permits communication of the TS with a 3<sup>rd</sup> party device.

### GeoCOM Connection

GeoCOM Connection

Allow GeoCOM communication with this instrument

Connect using **Cable**


Device **RS232**

Allow GeoCOM communication while locked by mySecurity

OK Device

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Search</b> | Available when <b>CS Bluetooth 1</b> or <b>CS Bluetooth 2</b> are selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| <b>Device</b> | Available unless <b>Connect using: Cable</b> is selected on TS60/TM60. To create, select, edit or delete a device. Refer to <a href="#">21.2 Accessing Devices</a> .   |

## Description of fields

| Field   | Option                                   | Description  |
|---|--|--|
| <b>Allow Geo-COM communication with this instrument</b>       | Check box                                | When this box is checked, the GeoCOM mode is activated.  |
| <b>Connect using</b>  | <b>Cable</b>                             | For TS13/TS16: The RS232 port.<br>For TS60/MS60/TM60: The cable USB port.  |
|   | <b>Radio handle</b>                      | Hotshoe connection for RadioHandle. This port is on top of Communication side cover.   |
|   | <b>TS Bluetooth 1 and TS Bluetooth 2</b> | The Bluetooth ports on the TS13/TS16 which can be used.  |
|   | <b>Cable RS232</b>                       | The RS232 port on the TS60/MS60/TM60.  |
|   | <b>WLAN</b>                              | The WLAN port on the TS60/MS60/TM60.   |
| <b>Device</b>   | Display only                             | The device currently assigned to the selected port.  |
| <b>Allow Geo-COM communication while locked by mySecurity</b> | Check box                                | When this box is checked, the use of the instrument from the display is blocked. Geo-Com can be used instead.<br> In this case, the PIN protection does not work because at the time when the software requests the PIN code to be entered, the system is not fully started. Use <a href="https://myworld.leica-geosystems.com">https://myworld.leica-geosystems.com</a> instead. |
| <b>Use TCP/IP</b>   | Check box                                | Available for TS instruments unless <b>Connect using: WLAN</b> .<br>When this box is checked, the instrument is identified by the IP number.   |

### 20.1 Digital Cellular Phones

---

#### 20.1.1 Overview

---

##### Description

For digital cellular phones, information such as

- the base stations that can be contacted
- the phone numbers of the base stations and
- the type of protocol to be used

can be defined.

Changing the base station to be dialed is of interest in two cases.

- Case 1: Two real-time base stations, each equipped with a digital cellular phone, are set up at two locations belonging to different network providers. When leaving the area of one base, the station can be changed and the other base can be called.
- Case 2: Set up as in case 1. Two separate fixes from each base for each point can be obtained, providing redundancy for future least squares adjustment operations.

##### Technologies

| Technology | Description  |
|------------|--|
| CDMA       | Code Division Multiple Access is a high speed data transmission for effective and flexible use of available resources such as bandwidth. Users of a cellular phone network occupy the same frequency band. The signal is especially coded for each user. |
| GSM        | <b>Global System for Mobile Communications</b> is a more efficient version of CDMA technology that uses smaller time slots but faster data transfer rates. It is the world's most commonly used digital network.   |

#### 20.1.2 Configuring a GSM Connection

---

##### Access

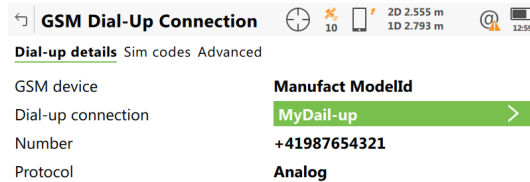
For RTK rover and TS:

- In **Connection Settings**, highlight a connection which has a digital cellular phone of GSM technology attached. **Control.**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a digital cellular phone of GSM technology attached. **Control.**
-

GSM Dial-Up Connection/Internet Connection, Dial-up details page or APN page



Fn OK Near Page Fn

| Key        | Description   |
|------------|---|
| OK         | To accept changes and return to the panel from where this panel was accessed.   |
| Near       | To find the nearest base station with a digital cellular phone of GSM technology. Available when base stations to dial are already created in <b>Dial-up Connection List</b> . Coordinates of these stations must be known. |
| Page       | To change to another page on this panel.  |
| Fn Command | To send AT commands to the digital cellular phone. Unavailable for CS Win32 tablets.  |

Description of fields

| Field                | Option          | Description  |
|----------------------|-----------------|--|
| GSM device or Device | Display only    | Available for RTK rover and TS. The type of digital cellular phone highlighted when this panel was accessed.   |
| Dial-up connection   | Selectable list | Available for RTK rover and TS. The digital cellular phone base station to be dialled. Open the selectable list to access <b>Dial-up Connection List</b> where new base stations can be created and existing base stations can be selected or edited. Refer to <a href="#">20.6 Configuring the Stations to Dial</a> . |
| Number               | Display only    | Available for RTK rover and TS. The number of the digital cellular phone at the selected <b>Dial-up connection</b> as configured in <b>Dial-up Connection List</b> .   |
| Protocol             | Display only    | Available for RTK rover and TS. The configured protocol of the digital cellular phone at the selected <b>Dial-up connection</b> as configured in <b>Dial-up Connection List</b> .  |
| APN                  | Editable field  | The Access Point Name of a server from the network provider. Contact your provider to get the correct APN.   |

Next step

Page changes to the **Sim codes** page.

GSM Dial-Up Connection,  
Sim codes page

| Key      | Description   |
|----------|---|
| OK       | To accept changes and return to the panel from where this panel was accessed. |
| Page     | To change to another page on this panel.                                      |
| Fn Clear | To set the additional editable fields to ----.                                |

Description of fields

| Field                                     | Option         | Description   |
|---|----------------|---|
| Enter active PIN code to edit the setting | Editable field | To enter the <b>Personal Identification Number</b> of the SIM card.   |
| Display PIN code                          | Check box      | When this box is checked, the PIN is displayed in the <b>Enter active PIN code to edit the setting</b> field.<br>When this box is not checked, dots are displayed in the <b>Enter active PIN code to edit the setting</b> field |
| PUK code                                  | Editable field | If the PIN is locked for any reason, for example the wrong PIN was entered, input the <b>Personal UnbloCking</b> code for access to the PIN.  |
| Display PUK code                          | Check box      | When this box is checked, the PIN is displayed in the <b>Display PUK code</b> field.<br>When this box is not checked, dots are displayed in the <b>Display PUK code</b> field   |

Next step

Page changes to the **Advanced** page.

GSM Dial-Up Connection,  
Advanced page

Description of fields

| Field  | Option    | Description  |
|--|-----------|--|
| Preferred network type<br>or<br>Manually select cell-phone network | Automatic | Available for LTE capable phones.  |
|  | Check box | Uses any available network type from the GSM to the LTE network.<br>Other options force the LTE phone modem to use only the specified network type.<br>Available for digital cellular phone devices unless they are in data mode. When this box is checked, the currently selected network provider is displayed and the <b>Search</b> key is available. |

| Field | Option | Description  |
|-------|--------|--|
|       |        | Press <b>Search</b> for a list of all available networks and to select a specific network. |

### Next step

**Page** changes to another page on this panel.

## 20.1.3

### Configuring a CDMA Connection

#### Access

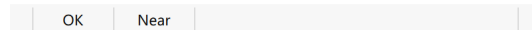
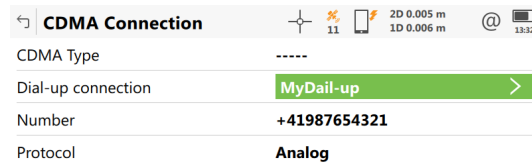
For RTK rover and TS:

- In **Connection Settings**, highlight a connection which has a digital cellular phone of CDMA technology attached. **Control**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a digital cellular phone of CDMA technology attached. **Control**.

#### CDMA Connection



| Key               | Description  |
|-------------------|--|
| <b>OK</b>         | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Near</b>       | To find the nearest base station with a digital cellular phone of CDMA technology. Available when base stations to dial are already created in <b>Dial-up Connection List</b> . Coordinates of these stations must be known. |
| <b>Fn Info</b>    | To provide information about the CDMA device being used, such as the manufacturer, the model and the electronic serial number.   |
| <b>Fn Reg</b>     | To register the settings of the CDMA digital cellular phone over the air. For US and Canada only. Available when the registration process must be done manually.   |
| <b>Fn Command</b> | To send AT commands to the digital cellular phone.   |

#### Description of fields

| Field            | Option       | Description  |
|------------------|--------------|--|
| <b>CDMA Type</b> | Display only | The type of digital cellular phone highlighted when this panel was accessed. |



| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Dial-up connection</b> | Selectable list | The digital cellular phone base station to be dialed. Open the selectable list to access <b>Dial-up Connection List</b> where new base stations can be created and existing base stations can be selected or edited. Refer to <a href="#">20.6 Configuring the Stations to Dial</a> . |
| <b>Number</b>             | Display only    | The number of the digital cellular phone at the selected <b>Dial-up connection</b> as configured in <b>Dial-up Connection List</b> .  |
| <b>Protocol</b>           | Display only    | The configured protocol of the digital cellular phone at the selected <b>Dial-up connection</b> as configured in <b>Dial-up Connection List</b> .   |

#### Next step

**Fn Info** changes to **CDMA Information**.

## CDMA Information

#### Description of fields

| Field               | Option       | Description   |
|---------------------|--------------|---|
| <b>Manufacturer</b> | Display only | The manufacturer of the CDMA device being used.   |
| <b>Model</b>        | Display only | The model of the CDMA device being used.  |
| <b>ESN No.</b>      | Display only | <b>Electronic Serial Number</b><br>For registration purposes, send the electronic serial number to the network provider in order to receive the service programming code and the mobile directory number. These numbers must be typed in <b>CDMA Registration</b> . |

#### Next step

1. Press **Print** to print all information to a file CDMA Info.log in the \DATA directory on the data storage device.
2. Press **OK** to return to **CDMA Connection**.
3. For US and Canada only: Press **Reg** to access **CDMA Registration**.

## CDMA Registration

The settings allow the CDMA digital cellular phone to be registered over the air.

#### Description of fields

| Field          | Option       | Description   |
|----------------|--------------|---|
| <b>MSL/SPC</b> | Display only | The <b>Service Program Code</b> provided by the network provider.   |
| <b>MDN</b>     | Display only | The <b>Mobile Directory Number</b> provided by the network provider |

| Field           | Option       | Description  |
|-----------------|--------------|--|
| <b>MSID/MIN</b> | Display only | <b>M</b> obile <b>S</b> tation <b>I</b> dentity Number and <b>M</b> obile <b>I</b> dentification <b>N</b> umber. Another 10-digit number to identify the mobile phone. Sometimes identical with the MDN. |

**Next step**

**OK** to return to **CDMA Connection**.

**20.2**

**Modems**

**Description**

For modems, information such as

- the base stations that can be contacted and
- the phone numbers of the base stations

can be controlled.

Changing the base station to be dialled is of interest in two cases.

Case 1: Two real-time base stations, each equipped with a digital cellular phone, are set up at two locations belonging to different network providers. When leaving the area of one base, the station can be changed and the other base can be called.

Case 2: Set up as in case 1. Two separate fixes from each base for each point can be obtained, providing redundancy for future least squares adjustment operations.

**Access**

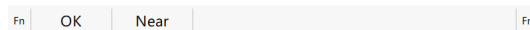
For RTK rover and TS:

- In **Connection Settings**, highlight a connection which has a modem attached. **Control**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a modem attached. **Control**.

**Dial-Up Connection**



| Key       | Description   |
|-----------|---|
| <b>OK</b> | To accept changes and return to the panel from where this panel was accessed. |

| Key               | Description  |
|-------------------|--|
| <b>Near</b>       | To find the nearest base station with a modem. Available when base stations to dial are already created in <b>Dial-up Connection List</b> . Coordinates of these stations must be known. |
| <b>Fn Command</b> | To send AT commands to the modem.  |

#### Description of fields

| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Modem</b>              | Display only    | The type of modem highlighted when this panel was accessed.   |
| <b>Dial-up connection</b> | Selectable list | The modem base station to be dialled. Open the selectable list to access <b>Dial-up Connection List</b> where new base stations can be created and existing base stations can be selected or edited. Refer to <a href="#">20.6 Configuring the Stations to Dial</a> . |
| <b>Number</b>             | Display only    | The number of the modem at the selected <b>Dial-up connection</b> as configured in <b>Dial-up Connection List</b> .   |
| <b>Protocol</b>           | Display only    | The configured protocol of the modem at the selected <b>Dial-up connection</b> as configured in <b>Dial-up Connection List</b> .  |

## 20.3

### Radios for GPS Real-Time

#### Description

For radios the channels on which the radio broadcasts can be changed. Changing channels changes the frequency at which the radio operates. Not all radios support channel changing.

Changing radio channels is of interest in three cases.

- Case 1: Two real-time base stations are set up at two locations, each broadcasting on a different channel. If the signal from one base station is jammed, the channel can be changed and the other base can be used.
- Case 2: Set up as in case 1. Two separate fixes for each point can be obtained, providing redundancy for future least squares adjustment operations.
- Case 3: One real-time base and one real-time rover are being used. If the signal is blocked due to radio interference, the channel at the base and the rover can be changed in order to work on a different frequency.

#### Requirements for channel changing

| Type                | Requirement  |
|---------------------|--|
| Pacific Crest radio | Contact a Pacific Crest dealer for the activation of channel changing.<br>A special licence might be required. |
| Satellite radio     | Channel switch works with all Satel radios.  |



Channel changing may contravene radio broadcasting regulations in certain countries. Before operating with radios, check the regulations in force in the working area.



The number of channels available and the frequency spacing between channels depends on the radio used.

For some Satel radios the configuration can be done within Leica Captivate.



If you want to use channel changing, set **RTK base ID** in **RTK Base Settings (RTK 1)/RTK Base Settings (RTK 2), Data rates** page to a different ID for each base site when configuring the base real-time connection. By doing so, the rover can recognise if the incoming real-time data after channel changing is being received from a different base station or if the original base station is using a new frequency. In the first case, the ambiguities are recomputed.

## Access

For RTK rover and TS:

- In **Connection Settings**, highlight a connection which has a radio attached. **Control**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a radio attached. **Control**.

## Radio Channel

| Key             | Description   |
|-----------------|---|
| <b>OK</b>       | To accept changes and return to the panel from where this panel was accessed.   |
| <b>Scan</b>     | To provide information such as the station ID, latency and the data format of incoming signals from base stations broadcasting on the same radio channel. This information can be used to select appropriate base stations to dial. |
| <b>Settings</b> | To edit the channel list of the active radio. In base mode, a password is required for changing the radio settings.   |

### Description of fields

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| <b>Radio type</b>       | Display only   | The type of radio highlighted when this panel was accessed.   |
| <b>Channel</b>          | Editable field | The radio channel. The channel used must be within minimum and maximum allowed input values. The minimum and maximum allowed input values for a radio depend on the number of channels supported by the radio and the spacing between the channels. |
| <b>Actual frequency</b> | Display only   | Available for all Satel radios. Displays the current frequency of the radio.  |

| Field                                 | Option   | Description   |
|---------------------------------------|--|---|
| <b>Radio protocol</b>                 |  | Available when a Sateline radio is selected as <b>Radio type</b> .<br>Different protocols are selectable. Example: Pacific Crest or TrimTalk compatibility. The radio must be active to accept the settings. The radio need not be connected to a computer and no configuration software is needed. |
|                                       | <b>Satel 4-FSK,</b><br><b>Satel 8-FSK,</b><br><b>Satel 16-FSK,</b><br><b>PacCrest 4-FSK,</b><br><b>PacCrest GMSK,</b><br><b>PacCrest FST,</b><br><b>TrimTalk(P) GMSK</b><br>and<br><b>TrimTalk(T) GMSK</b> | Defines the settings for the used modulation type. Shows the compatibility to Pacific Crest/TrimTalk. The available options depend on the used radio hardware and firmware.   |
| <b>Forward error correction (FEC)</b> | Check box  | Available for <b>Radio protocol: Satel 4-FSK</b> . When this box is checked, <b>Forward Error Correction</b> can be set on or off. <b>Satel 4-FSK</b> is the only protocol, where FEC can be defined separately.  |

#### Settings depending on protocol

| Protocol         | Baud rate 12.5 kHz | Baud rate 25 kHz                   | Modulation | Use Forward Error Correction |
|------------------|--------------------|------------------------------------|------------|------------------------------|
| Satel 4FSK       | 9600               | 19200                              | 4FSK       | ON                           |
| Satel 8FSK       | 14400              | 28800                              | 8FSK       | OFF                          |
| Satel 16FSK      | 14400              | 28800                              | 16FSK      | ON                           |
| Satellite 3AS    | 9600               | 19200                              | 4FSK       | OFF                          |
| PCC-4FSK         | 9600               | 19200                              | 4FSK       | ON                           |
| PCC-GMSK         | 4800               | 9600 <sup>1</sup> /NA <sup>2</sup> | GMSK       | ON                           |
| TrimTalk450s (P) | 4800               | 9600 <sup>1</sup> /NA <sup>2</sup> | GMSK       | OFF                          |
| TrimTalk450s (T) | 4800               | 9600 <sup>1</sup> /NA <sup>2</sup> | GMSK       | OFF                          |
| PCC-FST          | 9600               | 19200                              | 4FSK       | ON                           |

<sup>1</sup> For countries without narrow banding regulations

<sup>2</sup> For countries with narrow banding regulations, for example the USA

## Next step

**Scan** to access **Scan for Base Station**.

## Scan for Base Station

This panel provides information about the base stations, with specific types of devices attached, for example a radio, from which real-time corrections are being received. This information can also be useful for finding out if anyone else in the area is using a particular radio channel.

| Key   | Description   |
|---|---|
| <b>OK</b>                                   | To select the highlighted base station and to continue with the subsequent panel.   |
| <b>Channel-1</b><br>and<br><b>Channel+1</b> | Available for scanning base stations with radios attached. To switch the radio to one channel lower/higher than the current channel. The base stations displayed change to broadcasting on the new channel. |

## Description of metadata


| Metadata          | Description  |
|-------------------|--|
| -                 | ID of available base stations from which a signal is being received.<br>For radios, the base station radios transmitting on the same channel are listed.         |
| <b>Latency(s)</b> | Time delay, in seconds and configured on the base, from when the base collects the data to when the data is transmitted.   |
| <b>RTK format</b> | Format of the data from the base station. Refer to <a href="#">19.7.1 Configuration of a Rover Real-Time Connection</a> for more information about data formats. |



## Channel Settings

Minimum Satel firmware version required:

| Satel Radio Model | Firmware Version   |
|-------------------|--------------------|
| M3-TR3            | 2.0.4.2 or higher  |
| M3-TR4            | 2.1.0.3 or higher  |
| M3-R3             | 1.0.9.3 or higher  |
| M3-TR1            | 3.63 or higher     |
| TR4+              | 2.5.1.14 or higher |

The information displayed is queried from the Satel radio. The current status is displayed. The information is not stored in Leica Captivate.

| Key          | Description   |
|--------------|---|
| <b>Store</b> | To apply and send the new settings to the Satel radio and to return to the panel from where this panel was accessed.  |
| <b>New</b>   | To create a channel.<br> Changes are only applied and sent to the Satel radio when pressing <b>Store</b> . |

| Key           | Description   |
|---------------|---|
| <b>Edit</b>   | To edit the highlighted channel.<br> Changes are only applied and sent to the Satel radio when pressing <b>Store</b> .   |
| <b>Delete</b> | To delete the highlighted channel.<br> Changes are only applied and sent to the Satel radio when pressing <b>Store</b> . |
| <b>More</b>   | To change between <b>Spacing (kHz)</b> and <b>Rx Freq. (MHz)</b> on a rover respectively <b>Tx Freq. (MHz)</b> and also <b>Tx Power(mW)</b> on a base.  |

#### Description of metadata

| Metadata              | Description   |
|-----------------------|---|
| <b>Channel</b>        | Name/number to the channel. Any integer number between -32767 and 32767 is allowed. |
| <b>Rx Freq. (MHz)</b> | Available on the rover.<br>Receive frequency assigned to the channel in MHz.        |
| <b>Tx Freq. (MHz)</b> | Available on the base.<br>Transmit frequency assigned to the channel in MHz.        |
| <b>Spacing (kHz)</b>  | Channel spacing assigned to the channel in kHz.                                     |
| <b>Tx Power(mW)</b>   | Available on the base.<br>Output power assigned to the channel in mW                |

## 20.4

### RS232

#### Description

RS232 is a standard serial communication method that is able to transfer data without the need for predefined time slots.

#### Access

For RTK rover and TS:

- In **Connection Settings**, highlight a connection which has an RS232 device attached. **Control**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has an RS232 device attached. **Control**.

#### RS232 Connection

Displayed is the type of device highlighted when this panel was accessed.

## 20.5

### Internet

#### Description

#### Internet

The Internet connection allows connection to the Internet to receive real-time data. A GPRS / Internet device must be attached to the instrument.

## Requirements

### For Internet

- Check **Use Internet connection on GS** or **Use Internet connection on CS** in **Internet Connection**.
- An Internet port must be selected in **RTK Base Settings (RTK 1)/RTK Base Settings (RTK 2)** or **RTK Rover Settings**.

## Access

For RTK rover:

- In **Connection Settings**, highlight a connection which has an Internet device attached. **Control**.

For RTK base:

- In **Base Connection Settings**, highlight a connection which has an Internet device attached. **Control**.

## Internet Port Connection

Internet port **GS Internet 1**

Server to use **MyServer**

NTRIP mountpoint -----

Press 'Source' to get a list of mountpoints

|    |        |
|----|--------|
| OK | Source |
|----|--------|

| Key    | Description   |
|--------|---|
| OK     | To accept changes and return to the panel from where this panel was accessed. |
| Source | Available in rover mode. To access the NTRIP source table.                    |

### Description of fields

| Field                                 | Option         | Description  |
|---------------------------------------|----------------|--|
| <b>Internet port</b>                  | Display only   | The name of the Internet port attached to the connection that was highlighted when this page was accessed.   |
| <b>User type</b>                      | <b>Client</b>  | How the instrument operates in the Internet. Available on the base. Must be selected when connecting to a server, for example Ntrip caster or TCP/IP server. |
|                                       | <b>Server</b>  | Available on the base. Must be selected to allow connections from TCP/IP clients, for example GNSS rovers.   |
| <b>IP address</b>                     | Display only   | Available for <b>User type: Server</b> . Current IP address of the GS instrument.  |
| <b>TCP/IP port</b>                    | Editable field | Available for <b>User type: Server</b> . The port number to which the TCP/IP clients connect for receiving the RTK data stream.                              |
| <b>Allow simultaneous connections</b> | <b>1 to 10</b> | Available on the base for <b>User type: Server</b> . Select the number of clients which are allowed to connect to the port.                                  |



| Field                   | Option          | Description   |
|-------------------------|-----------------|---|
| <b>Server to use</b>    | Selectable list | Available on the rover, also on the base for <b>User type: Client</b> . The server to be accessed in the Internet. Open the selectable list to access <b>Server to Connect</b> where new servers can be created and existing servers can be selected or edited. |
| <b>NTRIP mountpoint</b> | Editable field  | Mountpoints are the Ntrip servers sending out real-time data.   |

### Next step

Select **Source** to access **NTRIP Source Table**.

Highlight a mountpoint about which more information is required. This information helps to configure the instrument to use the selected mountpoint as a base. Press **Info** to access **Mountpoint**.

### Mountpoint, General page

#### Description of fields

| Field                        | Option        | Description   |
|------------------------------|---------------|---|
| <b>Identifier</b>            | Display only  | The name of the selected mountpoint.  |
| <b>Format</b>                | Display only  | The real-time data format sent out by the mountpoint.   |
| <b>Format details</b>        | Display only  | Details about <b>Format</b> , for example the RTCM message types including update rates in seconds displayed in brackets. |
| <b>Authentication method</b> | <b>None</b>   | The type of password protection required for the authorisation to the Ntrip server.<br>If no password is required.        |
|                              | <b>Basic</b>  | If the password does not require encryption.  |
|                              | <b>Digest</b> | If the password must be encrypted.  |
| <b>NMEA</b>                  | Display only  | Indicates if the mountpoint must receive GGA NMEA data from the rover in order to compute VRS information.                |
| <b>Charges</b>               | Display only  | Indicates if charges are currently made for the connection.   |
| <b>Carrier</b>               | Display only  | The type of carrier message sent out.   |
| <b>System</b>                | Display only  | The type of satellite system supported by the mountpoint.   |

### Next step

**Page** changes to the **Location** page.

### Mountpoint, Location page

Detailed information about the location of the Mountpoint is displayed.

### Next step

**Page** changes to the **Miscellaneous** page.

**Description of fields**

| Field              | Option       | Description                                       |
|--------------------|--------------|---|
| <b>Generator</b>   | Display only | The hard- or software generating the data stream. |
| <b>Compress</b>    | Display only | The name of the compression/encryption algorithm. |
| <b>Bitrate</b>     | Display only | The data speed in bits per second.                |
| <b>Information</b> | Display only | Miscellaneous information if available.           |

**Next step**

**OK** to return to the previous panel.

**20.6**

**Configuring the Stations to Dial**

**20.6.1**

**Accessing Dial-up Connection List**

**Description**

**Dial-up Connection List** allows new stations to be created, provides a list of base stations that can be dialled and allows existing stations to be edited. For digital cellular phones of any technology and for modems, the phone numbers of the device at the base station must be known. For a base station to be dialled, a name, the phone number and, if available, the coordinates can be configured.

**Access step-by-step**

1. In **Connection Settings**, highlight a connection which has a digital cellular phone of any technology or modem attached.
2. **Control**.
3. Open the selectable list for **Dial-up connection**.

**Dial-up Connection List**

The screenshot shows a form titled "New Dial-Up Connection" with the following fields and values:

- Name: My new Dail-up
- Number: +41978564321
- Protocol: Analog
- Use coordinates:
- WGS84 X: 100.0000 m
- WGS84 Y: 100.0000 m
- WGS84 Z: 100.0000 m

At the bottom, there are "Fn" buttons and a "Store" button.

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To select the highlighted station and to return to the panel from where this panel was accessed. |
| <b>New</b>    | To create a station. Refer to <a href="#">20.6.2 Creating / Editing a Station to Dial</a> .      |
| <b>Edit</b>   | To edit a station. Refer to <a href="#">20.6.2 Creating / Editing a Station to Dial</a> .        |
| <b>Delete</b> | To delete the highlighted station.   |

## Description of metadata

| Metadata      | Description                             |
|---------------|---|
| -             | Listed are all available base stations. |
| <b>Number</b> | Phone number of the station to dial.    |

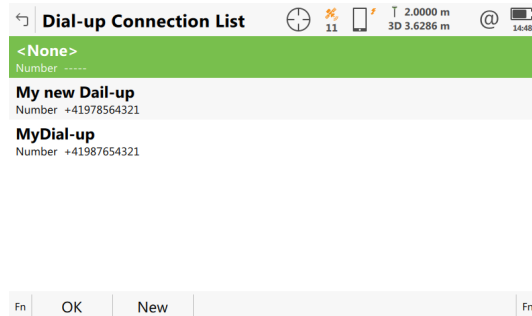
## 20.6.2

## Creating / Editing a Station to Dial

### Access

In **Dial-up Connection List** press **New** or **Edit**.

### New Dial-Up Connection



| Key             | Description  |
|-----------------|--|
| <b>Store</b>    | To return to the panel from where this panel was accessed.                           |
| <b>Fn Coord</b> | Available when <b>Use coordinates</b> is checked.<br>To view other coordinate types. |

### Description of fields

| Field                  | Option  | Description   |
|------------------------|---|---|
| <b>Name</b>            | Editable field  | A unique name for the new base station to be dialled. The name can be up to 16 characters long and include spaces.  |
| <b>Number</b>          | Editable field  | The number of the base station to dial. If the survey is taken across country borders it is necessary to input the phone number using standard international dialling codes. For example, + 41123456789. Otherwise it can be input as a standard digital cellular phone number. |
| <b>Protocol</b>        | <b>Analog</b><br><b>ISDN v.110</b><br>or<br><b>ISDN v.120</b> | Available for digital cellular phones of GSM technology. The configured protocol of the digital cellular phone of GSM technology.<br>For conventional phone networks.<br>For GSM networks.  |
| <b>Use coordinates</b> | Check box   | Check this box to type in the approximate coordinates of the base station.  |

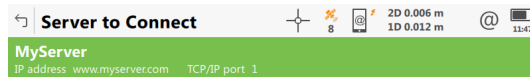
## 20.7 Configuring the Server to Connect

### 20.7.1 Accessing Server to Connect

**Description** **Server to Connect** allows new servers to be created, provides a list of servers that can be accessed in the Internet and allows existing servers to be edited.

- Access step-by-step**
1. In **Connection Settings**, highlight a connection which has an Internet connection attached.
  2. **Control**.
  3. Open the selectable list for **Server to use**.

#### Server to Connect



Fn OK New Edit Delete Fn

| Key    | Description   |
|--------|---|
| OK     | To select the highlighted server and to return to the panel from where this panel was accessed. |
| New    | To create a server. Refer to <a href="#">20.7.2 Creating / Editing a Server</a> .               |
| Edit   | To edit a server. Refer to <a href="#">20.7.2 Creating / Editing a Server</a> .                 |
| Delete | To delete the highlighted server.   |

#### Description of metadata

| Column      | Description                                   |
|-------------|---|
| -           | Listed are all available servers.             |
| IP address  | IP addresses of all available servers.        |
| TCP/IP port | TCP/IP Port numbers of all available servers. |

### 20.7.2 Creating / Editing a Server

**Access** In **Server to Connect** press **New** or **Edit**.

## New Server, General page

**New Server**

General NTRIP

Server name: MyServer

Address: www.myserver.com

Port: 1000

Store Page

| Key          | Description  |
|--------------|--|
| <b>Store</b> | To return to the panel from where this panel was accessed. |
| <b>Page</b>  | To change to another page on this panel.                   |

### Description of fields

| Field              | Option         | Description   |
|--------------------|----------------|---|
| <b>Server name</b> | Editable field | A unique name for the new server to be accessed.  |
| <b>Address</b>     | Editable field | Type in the host name or the IP address of the server to be accessed in the Internet.                                   |
| <b>Port</b>        | Editable field | The port of the Internet server through which the data is provided. Each server has several ports for various services. |

### Next step

**Page** changes to the **NTRIP** page.

## New Server, NTRIP page

### Description of fields

| Field                             | Option                   | Description   |
|-----------------------------------|--------------------------|---|
| <b>Use NTRIP with this server</b> | <b>No</b>                | Ntrip is not being used with this server.   |
|                                   | <b>With sensor ID</b>    | Ntrip is being used with this server. The login is managed automatically. Available for connecting registered GS sensors with active HxGN SmartNet subscription only.                           |
|                                   | <b>With user account</b> | Ntrip is being used with this server. Enter a username and a password.  |
| <b>NTRIP user ID</b>              | Editable field           | A user ID is required to receive data from to the Ntrip Caster. Contact the Ntrip administrator for information.<br><b>For Use NTRIP with this server: With sensor ID, entries are ignored.</b> |
| <b>NTRIP password</b>             | Editable field           | A password is required to receive data from the Ntrip Caster. Contact the Ntrip administrator for information.<br><b>For Use NTRIP with this server: With sensor ID, entries are ignored.</b>   |

| Field                   | Option    | Description  |
|-------------------------|-----------|--|
| <b>Display password</b> | Check box | When this box is checked, the password is displayed in the <b>NTRIP password</b> field.<br>When this box is not checked, dots are displayed in the <b>NTRIP password</b> field |

---

**Next step**

**Store** to store the settings.

---

## 21 Configuration of Devices

### 21.1 Devices

#### 21.1.1 Overview

##### Description

Before using any device, it is necessary to configure the interface with which it is used. Refer to [19.1 Accessing Configuration Connections](#) for information on how to configure the interfaces.

Some devices can be used with different interfaces for different applications. For example:

- For GS: A radio can be used to receive real-time base data but a second radio could also be used to output simultaneous NMEA messages.
- For TS: A radio can be used for remote control with a TS but also to send GeoCOM commands from a computer to a TS.

#### 21.1.2 Digital Cellular Phones

##### Description

Digital cellular phones comprise of the technologies CDMA and GSM/UMTS.

##### Typical uses

- To transmit real-time data.
- To receive real-time data.

##### Example use

1. Base and rover must both be equipped with a digital cellular phone.
2. Ensure that the digital cellular phone at the base is on.
3. The rover digital cellular phone contacts the selected base of which the phone number was pre-defined. Refer to [21.3 Creating/Editing a Device](#).
4. One rover can dial in to the base digital cellular phone at a time.
5. As soon as the base digital cellular phone is contacted, real-time data is sent to the rover digital cellular phone that has called.



Several digital cellular phone numbers can be pre-defined on the rover. Dialling a different number dials that particular base station.

##### Requirements for using digital cellular phones

| Required           | Description  |
|--------------------|--|
| Always required    | <ul style="list-style-type: none"><li>• AT command language must be supported by the digital cellular phone.</li><li>• Working area must be covered by a digital cellular phone network.</li><li>• The network operator must support data transmission.</li></ul>                                      |
| Sometimes required | <ul style="list-style-type: none"><li>• SIM card. This SIM card is the same as is normally used in mobile phones. The SIM card must be enabled to transmit data. Contact the service provider to enable the SIM card.</li><li>• <b>Personal Identification Number</b></li><li>• Registration</li></ul> |

## Supported digital cellular phones

Some digital cellular phones are predefined.

Other digital cellular phones can be used. Their settings must be defined by creating a new digital cellular phone configuration. Refer to [21.3 Creating/Editing a Device](#). These digital cellular phones must be connected with a cable or Bluetooth. Refer to [D Cables](#) for information on cables. Please contact the local selling unit or dealer for further information.

## Advantages

- Unlimited range of the data channel between base and rover.
- Free of jamming from other users.
- Cheaper in price in the initial costs of buying.

## Disadvantages

Fees are charged for the time that the digital cellular phone network is being used.



Base and rover can both be equipped with a digital cellular phone and a radio. On the base, they operate simultaneously. On the rover, use the radio when within radio range of the base and the digital cellular phone when radio reception is not possible.

The internal devices of the GS14/GS16 cannot be used simultaneously.

## 21.1.3

### Modems

## Typical uses

- To transmit NMEA messages.
- To transmit real-time data.

### Example of use

1. The base is equipped with a modem.
2. The rover is equipped with a digital cellular phone.
3. Ensure that the modem is switched on.
4. The rover digital cellular phone contacts the selected base of which the phone number was pre-defined. Refer to [21.3 Creating/Editing a Device](#).
5. One rover can dial in to the base modem at a time.
6. As soon as the base modem is contacted, it sends its data to the rover digital cellular phone that has called.



Several modem numbers can be pre-defined on the rover. Dialling a different number changes the base station.

## Requirements for using modem

AT command language must be supported by the modem.

## Supported modems

Some modems are predefined. Modems must be connected with a cable. Other modems can be used. Their settings must be defined by creating a new modem configuration. Refer to [21.3 Creating/Editing a Device](#).

## 21.1.4

### Radios for Real-Time

## Typical uses

- To transmit real-time data.
- To receive real-time data.



### Example of use

- Base and rover must both be equipped with radios using the same frequency range and the same data format.
- The base radio continuously sends out real-time data until the instrument is turned off, the settings are changed or the radio is detached.
- The rover radio continuously receives real-time data until the instrument is turned off, the settings are changed or the radio is detached.
- Several rovers can receive data from the same base at the same time.
- Several base radios can transmit real-time data simultaneously using different radio channels. Changing to a different radio channel on the rover changes the base from which real-time data is received.

### Supported radios

Some radios are predefined.

Other radios can be used. Their settings must be defined by creating a new radio configuration. Refer to [21.3 Creating/Editing a Device](#). These radios must be connected with a cable.



Base and rover can both be equipped with a digital cellular phone and a radio. On the base, they operate simultaneously. On the rover, use the radio when within radio range of the base and the digital cellular phone when radio reception is not possible.

The internal devices of the GS14/GS16 cannot be used simultaneously.

### 21.1.5

#### Radios for Remote Control

### Typical uses

- To remote control the TS.
- To transmit data between a TS and computer.

### Supported radios

- The default radios used with TS for remote control are the internal radio, the RadioHandle and the external radios TCPS. Set the TS to the correct communication mode to send and receive data and commands using the radio.
- A Communication side cover must be fitted to the TS when operating with the RadioHandle.

### User defined radios

Other radios than the default radios can be used. Their settings must be defined by creating a new radio configuration. Refer to [21.3 Creating/Editing a Device](#). These radios must be connected with a cable. Refer to [D Cables](#) for information on cables.

### 21.1.6

#### RS232

### Standard RS232

Standard RS232 is supported by default. The settings are:

|            |        |               |      |
|------------|--------|---------------|------|
| Baud rate: | 115200 | Stop bits:    | 1    |
| Parity:    | None   | Flow control: | None |
| Data bits: | 8      |               |      |

### 21.1.7


#### USB

### USB

USB is supported on the TS60/MS60/TM60. The USB interface on port 1 can be used to:

- connected to the CS using the USB interface.
- configure **GeoCOM Connection** (cable). USB and serial interface are possible.
- configure **GSI Output Connection** (cable). USB and serial interface are possible.
- configure **Export Job Connection** (cable). USB and serial interface are possible.

If cable is selected (serial – RS232), then the USB interface is also available. If USB is selected, the serial interface is also available but with the default respectively previously set parameters.

 The IP address of the RNDIS interface of the TS60/MS60/TM60 cannot be changed within Leica Captivate. Use Windows CE to change the IP address, for example when connecting two instruments using USB to the same computer.

### 21.1.8

### Hidden Point Measurement Devices

#### Typical uses


To measure

- distances (reflectorless distance measurements using laser technology)
- angles
- azimuths

to points which are not directly accessible with GNSS, for example house corners or trees. If the device is connected to the instrument, the measurements taken with hidden point measurement devices are directly transferred. If the device is not connected, measurement can be typed in manually to calculate the coordinates of a hidden point.

#### Example of use

1. An instrument must be a rover with or without real-time settings.
2. A hidden point measurement device is connected to the instrument using cable or Bluetooth.
3. Hidden point measurements are configured and activated.
4. Distances, angles and azimuths are measured to the hidden point with the hidden point measurement device.
5. The measurements are directly transferred to the instrument and displayed in the appropriate fields.

 Hidden point measurement devices can be connected in addition to any of the other devices. They can be active at the same time. Changing of ports is not required.

#### Supported hidden point measurement devices

Some devices are predefined.

Hidden point measurement devices of the same type but with different settings must be defined by creating a new hidden point measurement device. Refer to [21.3 Creating/Editing a Device](#).

### 21.1.9

### GPRS / Internet Devices

#### Description

GPRS is a telecommunication standard for transmitting data packages using the Internet Protocol.

When using GPRS technology, charges are made based on the amount of transferred data and not, as per normal digital cellular phones, for the connection time.

## Typical uses

To access the Internet with an instrument in order to receive real-time data from the Internet.

### Example use



The following is an example use for receiving data from the Internet.

1. Rover must be equipped with a GPRS / Internet device.
2. The GPRS / Internet device accesses the Internet where the rover connects for example to Ntrip.
3. The rover receives real-time corrections via the Internet.

## Requirements for using GPRS / Internet devices

- AT command language must be supported by the digital cellular phone.
- **Access Point Name** of a server from the network provider. The APN can be thought of as the home page of a provider supporting GPRS data transfer.
- **SIM card**. This SIM card is the same as is normally used in mobile phones. The SIM card must be enabled to transmit data. Contact the service provider to enable the SIM card.
- **Personal Identification Number**
- **Registration**

## Supported GPRS / Internet devices

Some GPRS/Internet devices are predefined. Other GPRS capable devices can be used as long as they use AT commands. Their settings must be defined by creating a new device configuration. Refer to [21.3 Creating/Editing a Device](#). Please contact the local selling unit or dealer for further information.

## Advantages

- Unlimited range of the data channel between base and rover.
- Free of jamming from other users.
- Fees are charged for the amount of data being transferred.

## 21.2

### Accessing Devices

#### Description

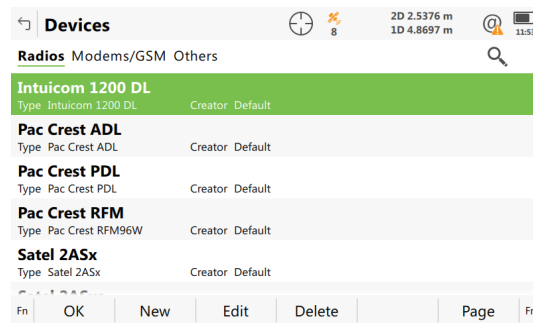
Allows devices to be created, edited, selected and deleted.

#### Access step-by-step

1. For RTK rover and TS:
  - Select **Leica Captivate - Home: Settings\Connections\All other connections**.For RTK base:
  - Select **Leica Captivate - Home: Settings\Connections\All other connections**.
2. Highlight the appropriate interface based on the type of device to be configured. For example, highlight **RTK rover** for a radio configuration.
3. **Edit**.
4. Activate the interface by checking the check box.
5. **Device** to access **Devices**.


## Devices

This panel may consist of several pages and provides different devices for selection depending on which interface the panel was accessed from. The functionality described here is always the same.



| Key                 | Description   |
|---------------------|---|
| OK                  | To select the highlighted device and return to the panel from where this panel was accessed.                                      |
| New                 | To create a device. Refer to <a href="#">21.3 Creating/Editing a Device</a> .   |
| Edit                | To edit the highlighted device. Refer to <a href="#">21.3 Creating/Editing a Device</a> .   |
| Delete              | To delete the highlighted device.   |
| More                | To display information about the type of device and the creator of the device.  |
| Page                | To change to another page on this panel.  |
| Fn All or Fn Filter | Available for Internet and Bluetooth devices. To list all devices or to hide devices which are not Internet or Bluetooth capable. |
| Fn Default          | To recall previously deleted default devices and to reset default devices to the default settings.                                |

### Description of metadata

| Metadata | Description  |
|----------|--|
| -        | Listed are all available devices.  |
| Type     | Type of device defined when creating the device.   |
| Creator  | The creator of the device. The creator can be either Default when the device is a default, or User when the device has been created.   |
|          |  If a Default device is edited by using <b>Edit</b> then its creator is still displayed as Default. |

## 21.3

### Creating/Editing a Device

#### Description

Allows a new device to be configured or an existing device to be edited.

#### Access

In **Devices**, highlight a device of the same type as the device to be created, from the list. Press **New** or **Edit**.

## New Device or Edit Device

**New Device**

Name: **Intuicom 1200 DL**

Type: **Intuicom 1200 DL**

Baud rate: **38400**

Parity: **None**

Data bits: **8**

Stop bit: **1**

Flow control: **None**

Store

| Key           | Description  |
|---------------|--|
| <b>Store</b>  | To store the new device and to return to the panel from where this panel was accessed. |
| <b>AT Msg</b> | Available for digital cellular phones and modems. To configure communication commands. |

### Description of fields

| Field               | Option                             | Description   |
|---------------------|------------------------------------|---|
| <b>Name</b>         | Editable field                     | Name of new device.   |
| <b>Type</b>         | Display only                       | Same device type as was highlighted when <b>New</b> or <b>Edit</b> was used.  |
| <b>Baud rate</b>    | From <b>1200</b> to <b>230400</b>  | Frequency of data transfer from instrument to device in bits per second. Unavailable for CS modem.  |
| <b>Parity</b>       | <b>None, Even</b> or <b>Odd</b>    | Error checksum at the end of a block of digital data. Unavailable for CS modem.   |
| <b>Data bits</b>    | <b>6, 7</b> or <b>8</b>            | Number of bits in a block of digital data. Unavailable for CS modem.  |
| <b>Stop bit</b>     | <b>1</b> or <b>2</b>               | Number of bits at the end of a block of digital data. Unavailable for CS modem.   |
| <b>Flow control</b> | <b>None</b> or <b>Flow control</b> | Activates hardware handshake. When the instrument/device is ready for data, it asserts the <b>Ready To Send</b> line indicating it is ready to receive data. The sender at the <b>Clear To Send</b> input reads this line, indicating it is clear to send the data. Available for some phone devices. |

### Next step

| IF the device is a   | THEN   |
|--|--|
| radio or device other than digital cellular phone or modem | <b>Store</b> to close the panel and to return to the panel from where this panel was accessed. |
| digital cellular phone or modem                            | <b>AT Msg.</b>   |

## AT Command Lines

The AT commands configure the devices. Refer to the manual of device for information about which AT commands must be entered or contact the supplier.

### Description of fields

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| <b>Initialisation 1</b> | Editable field | Initialisation sequence to initialise digital cellular phone/modem.<br>When the device is used, between <b>Initialisation 1</b> and <b>Initialisation 2</b> , a check for the PIN is performed. |
| <b>(continued)</b>      | Editable field | Allows the <b>Initialisation 1</b> , <b>Initialisation 2</b> or the <b>Dial</b> string to continue onto a new line.   |
| <b>Initialisation 2</b> | Editable field | Initialisation sequence to initialise digital cellular phone/modem.   |
| <b>Dial</b>             | Editable field | Dialling string used to dial the phone number of the real-time base.  |
| <b>Hang-up</b>          | Editable field | Hangup sequence used to end the network connection.   |
| <b>Escape</b>           | Editable field | Escape sequence used to switch to the command mode before using the hangup sequence.  |
| <b>Connect</b>          | Editable field | Dialling string used to dial into the Internet.   |

### Next step

**Store** returns to **New Device** or **Edit Device**.

---

## 22

## Instrument - Base Settings

### 22.1

### Satellite tracking

#### Description

The settings on this panel define which satellite system, satellites and satellite signals the instrument uses.

#### Access

For RTK base:

Select **Leica Captivate - Base: Settings\GS base\Satellite tracking**.

OR

Press a hot key or favourites key configured to **GS - Satellite tracking**.



This panel contains the same settings as the RTK rover **Satellite Tracking** panel. Changes made to the settings here in RTK base mode, are reflected in the RTK rover mode and vice versa.

#### Satellite Tracking, Global page

| Key  | Description                              |
|------|--|
| OK   | To accept changes.                       |
| Page | To change to another page on this panel. |

#### Description of fields

- Any of the GNSS can only be disabled, if at least one other GNSS is enabled.
- At least one GNSS must be enabled.
- **GPS** can never be disabled on the base station.

| Field   | Option    | Description  |
|---|-----------|--|
| <b>GPS</b>  | Check box | Defines if the instrument accepts the GPS L1, L2 and L5 signals when tracking satellites. For L2 and L5 the multi-frequency licence is required. |
| <b>Glonass</b>  | Check box | Defines if the instrument accepts GLONASS L1, L2 and L3 signals when tracking satellites.  |
| <b>Galileo</b>  | Check box | Defines if the instrument accepts Galileo E1, E5a, E5b, E6 and AltBOC signals when tracking satellites.  |
| <b>BeiDou</b>   | Check box | Defines if the instrument accepts BeiDou B1, B2 and B3 signals when tracking satellites.   |
| <b>Show message &amp; audio warning, when loss of lock occurs</b> | Check box | Activates an acoustic warning signal and a message given by the instrument when the position is lost.  |

#### Next step

**Page** changes to the **Regional** page.

## Satellite Tracking, Regional page

| Key  | Description                              |
|------|--|
| OK   | To accept changes.                       |
| Page | To change to another page on this panel. |

### Description of fields

| Field | Option    | Description  |
|-------|-----------|--|
| QZSS  | Check box | Defines if the instrument accepts the QZSS signals when tracking satellites. |


### Next step

Page changes to the **Advanced** page.

## Satellite Tracking, Advanced page

| Key    | Description   |
|--------|---|
| OK     | To accept changes.  |
| Health | Available for <b>Satellite health: User defined</b> . To configure the satellites used. |
| Page   | To change to another page on this panel.  |

### Description of fields

| Field                   | Option                                      | Description   |
|-------------------------|---|---|
| <b>Cut-off angle</b>    | Editable field                              | Sets the elevation in degrees below which satellite signals are not recorded and are not shown to be tracked. Recommended settings: <ul style="list-style-type: none"> <li>For real-time: 10°.</li> <li>For purely post-processing applications: 15°.</li> </ul>  |
| <b>DOP limit</b>        | <b>None, GDOP, HDOP, PDOP or VDOP</b>       | If activated, the limit defined in <b>Limiting value</b> is checked. GNSS positions are unavailable when the limit is exceeded.   |
| <b>Limiting value</b>   | Editable field                              | The maximum acceptable DOP value. Available unless <b>DOP limit: None</b> .   |
| <b>L2C tracking</b>     | <b>Always track</b><br><br><b>Automatic</b> | L2C signals are always tracked. The system uses the L2C signals instead of L2P signals, if available.<br><br>L2 signals which are flagged as unhealthy are not recorded or used for real-time computations.   |
| <b>Satellite health</b> |   | Sets the satellite tracking behaviour.<br><br><div style="display: flex; align-items: center;">  <p>This setting is remembered when the instrument is turned off.</p> </div><br><b>Automatic</b> <p>The instrument monitors incoming satellite signals. Data from signals which are flagged as unhealthy is not recorded or used for real-time computations.</p> |



| Field                          | Option              | Description  |
|--------------------------------|---------------------|--|
|                                | <b>User defined</b> | Satellites must manually be included/excluded from data recording and real-time computations with <b>Health</b> .  |
| <b>Multipath reduction</b>     | Check box           | When this box is checked, the RTK performance under multipath conditions is improved by a multipath estimation and correction. When this box is not checked, no improvements are applied.  |
| <b>Interference mitigation</b> | Check box           | <p>When this box is checked, the interference mitigation option is active. It mitigates out-of-band interferences and enables filtering functionalities to remove in-band distortions. The option allows obtaining the highest robustness of signal tracking against interferences.</p> <p>When this box is not checked, interfering signals are treated in the same way as signals of good quality.</p> <p>Available on the GS18, GS16 and GS10/GS25 GNSS receivers with 555 channels. GS07 receivers support the out-of-band interference mitigation option without the extra filtering functionalities.</p> |

#### Next step

**Health** changes to **Satellite Health**.

## Satellite Health

The panel contains a page for each GNSS system the receiver is configured to track. The explanations given for the softkeys are valid for all pages.

| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Use</b>  | To change between the options for the metadata <b>User</b> .                  |
| <b>Page</b> | To change to another page on this panel.                                      |

#### Description of metadata

| Metadata | Option          | Description   |
|----------|-----------------|---|
| -        | <b>01 to 63</b> | <p>The Pseudo Random Noise number (GPS, 1 to 32), the Slot ID (GLONASS, 1 to 24) or the Space Vehicle number (Galileo, 1 to 50, and BeiDou, 1 to 63, and QZSS, 1 to 10) of the satellites.</p> <p>The prefixes are:</p> <ul style="list-style-type: none"> <li>• G for GPS satellites</li> <li>• R for GLONASS satellites</li> <li>• C for BeiDou satellites.</li> <li>• E for Galileo satellites</li> <li>• I for NavIC satellites</li> <li>• J for QZSS satellites</li> </ul> |

| Metadata      | Option                      | Description  |
|---------------|-----------------------------|--|
| <b>System</b> | <b>OK, N/A or Unhealthy</b> | Information on the satellite health taken from the almanac. <b>N/A</b> stands for not available. |
| <b>User</b>   | <b>Bad</b>                  | Excludes satellite from tracking.  |
|               | <b>OK</b>                   | Includes satellite in tracking.  |
|               | <b>Auto</b>                 | Automatic satellite tracking when satellite is healthy.  |

### Next steps

1. **Page** changes to the **Glonass** page, to the **Galileo** page, to the **QZSS** page, to the **NavIC** page and to the **BeiDou** page, where satellites used in the survey can be configured.
2. **OK** returns to **Satellite Tracking**.
3. **OK** returns to **Leica Captivate - Home** or **Leica Captivate - Base**.

## 22.2

### GNSS raw data logging

#### Description

Logged raw observations are used for

- static and kinematic operations. With these operations, raw data is always post-processed in the office. Raw data must therefore be logged on both base and rover instruments.
- real-time operations

to check the work in the office by post-processing.

OR

to fill in gaps when a real-time position could not be calculated in the field, for example, due to problems with the real-time data reception from the reference station or the RTK network provider

Observations must be logged on all instruments which are used for post-processing.

The settings on this panel define the logging of raw observations.

#### Access

For RTK base:

Select **Leica Captivate - Base: Settings\GS base\GNSS raw data logging**.

#### GNSS Raw Data Logging

| Key       | Description        |
|-----------|--------------------|
| <b>OK</b> | To accept changes. |

### Description of fields

| Field                    | Option   | Description  |
|--------------------------|--|--|
| <b>Log GNSS raw data</b> | Check box  | Activates raw data logging.  |
| <b>Store data on</b>     | <b>GS sensor</b>   | For GS:<br>Data is logged to the SD card in the GS.  |
|                          | <b>GS sensor (SD card), or GS sensor (Internal mem.)</b> | For GS18:<br>Data can either be logged to the SD card in the GS or to the internal memory of the the GS.   |
| <b>Log data every</b>    | From <b>0.05 sec</b> to <b>300.0 sec</b>                 | Rate at which raw observations are logged.<br><br>Recommendations: <ul style="list-style-type: none"> <li>• For static operations with long baselines and over long time <b>Rate: 15.0 sec</b> or <b>Rate: 30.0 sec</b>.</li> <li>• For base stations for post-processed and real-time kinematic rovers, <b>Rate</b> at the base should be the same rate as at the rover.</li> </ul> |
| <b>Log data to</b>       | Selectable list  | Data can be logged in the Leica proprietary MDB format or in RINEX.  |

**Description**

The settings on this panel define the active EDM (**E**lectronic **D**istance **M**easurement) and ATRplus (**A**utomatic **T**arget **R**ecognition) settings.



Available options depend on the purchased model, for example with or without ATRplus.

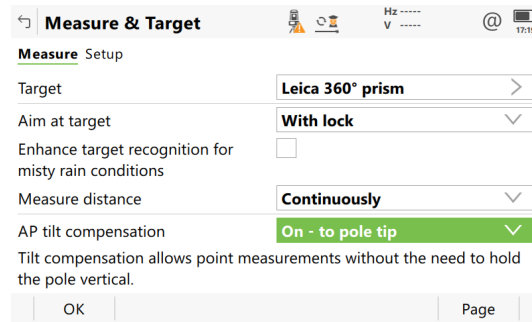
**Access**

Select **Leica Captivate - Home: Settings\TS instrument\Measure & target**.

**Measure & Target**

**Description**



- This panel has two pages - the **Measure** page and the **Setup** page.
- The settings made in the **Measure** page are used by all apps and all measurements taken outside of the **Setup** app.
- The settings made in the **Setup** page are only used inside the Setup app.
- Any changes made to the **Measure & Target**, for example using icons or hot keys, while the Setup app is active, only affect the **SetupMeasure & Target**.
- Any changes made to the **Measure & Target**, for example using icons or hot keys, while the Setup app is not active, only affect the **MeasureMeasure & Target**.
- When entering the Setup app, the **SetupMeasure & Target** are active.
- When leaving the Setup app, the **MeasureMeasure & Target** are active.
- Both **Measure** and **SetupMeasure & Target** are part of the working styles.



| Key     | Description   |
|---------|---|
| OK      | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page    | To change to another page on this panel.                        |
| Fn Test | To access the <b>Measurement Signal Test</b> panel.             |

**Description of fields**

| Field  | Option          | Description  |
|--------|-----------------|--|
| Target | Selectable list | Target names as configured in the <b>Targets</b> panel. Allows the measurements of distances to a prism or a tape. |


| Field   | Option                             | Description   |
|---|------------------------------------|---|
|   | <b>Any surface</b>                 | <p>To measure without reflector.</p> <p> Use a hot key or the favourites menu for a one-time reflectorless measurement without having to change the measure and target setting manually. The defined hot key or favourite is available in measure and stake out apps.</p> <p>When this hot key/favourite is used, <b>Target: Any surface</b> and <b>Measure distance: Once</b> are set, a measurement is done and the point is stored. Then, the settings for <b>Target</b> and <b>Any surface</b> are reverted to what is was before using the hot key/favourite.</p> |
| <b>Aim at target</b>  | <b>Manually</b>                    | Measurements are done without any automation. ATRplus search and/or ATRplus measurement are not performed.  |
|   | <b>Automatic</b>                   | Positioning to static prisms. The ATRplus sensor is used for measurements to static prisms. If needed, an ATRplus measurement or ATRplus search is performed after pressing <b>Measure</b> or <b>Distance</b> .   |
|   | <b>With lock</b>                   | The instrument locks onto and follows the moving prism. The ATRplus sensor is used to follow moving prisms and to find prisms after loss of lock. Depending on the setting for <b>Measure distance</b> , single or continuous measurements are performed. Unavailable for SmartStation.   |
|   | <b>Auto with highest precision</b> | Available for TS60/TM60. Similar to <b>Automatic</b> but with increased number of <b>Automatic</b> measurements to reach higher precision..   |
| <b>Enhance target recognition for misty rain conditions</b> | Check box                          | <p>Available on TS16/TS60/MS60/TM60 with <b>Aim at target: Automatic</b> or <b>Aim at target: With lock</b>.</p> <p>When this box is checked, the instrument measuring ability in misty rain conditions is increased. This setting is automatically deactivated when the instrument is turned off. If weather conditions are normal, then uncheck the box.</p> <p> Configure a hot key or favourites menu to <b>TS - Toggle enhanced target recognition on/off to activate/deactive the setting..</b></p>  |
| <b>Measure distance</b>                                     | <b>Once</b>                        | When a single measurement with high precision is required.  |

| Field                      | Option                            | Description  |
|----------------------------|-----------------------------------|--|
|                            | <b>Once &amp; fast</b>            | When a single measurement is required but the time to survey must be minimised. The highest accuracy is of less importance.<br>Use this setting for example when performing, "typical" topographical surveys.  |
|                            | <b>Continuously</b>               | When continuous distance measurements are required.<br>Performs a linear interpolation between the previous and following angle measurement, based on the timestamp of the EDM measurement. Using this interpolation procedure, a higher accuracy for all dynamic applications is possible.  |
|                            | <b>Repeatedly &amp; average</b>   | When an average of several measurements is required.<br>Repeats measurements in standard measuring mode. The average distance of <b>Number of distances</b> and the standard deviation for the averaged distance are calculated.<br>Use this setting for example when performing cadastral survey where rigid guidelines must be followed. |
|                            | <b>Greater than 4km</b>           | When long distances to prisms are needed. Use this setting for example for triangulation measurements.   |
|                            | <b>Greater than 4km &amp; avg</b> | Whenever long distances to prisms are needed but in addition, average values and standard deviations for multiple precise distance measurements are required.<br>Use this setting for example when performing triangulation measurements within a cadastral survey where rigid guidelines must be followed.                                |
|                            | <b>With highest precision</b>     | Available on TS60/TM60. Fine measuring for highest precision measurements with prisms.   |
| <b>Number of distances</b> | Editable field                    | Available if <b>Measure distance: Repeatedly &amp; average</b> or <b>Measure distance: Greater than 4km &amp; avg</b> . Editable fields for the maximum number of distances to be averaged from 2 to 999 distances.  |
| <b>Visibility</b>          |                                   | Available when a CS20 is connected to a TS15/TS50/TM50/MS50.<br>TS13/TS16/TS60/MS60/TM60 have integrated ATRplus which automatically adjust the settings for optimal performance.  |
|                            | <b>Good</b>                       | If weather conditions are normal, then select this mode.   |

| Field                               | Option                       | Description   |
|-------------------------------------|------------------------------|---|
|                                     | <b>Rain &amp; fog</b>        | To increase the instrument measuring ability during suboptimal weather conditions. This setting is automatically deactivated when the instrument is turned off.   |
|                                     | <b>Sun &amp; reflections</b> | To increase the instrument measuring ability during incident solar radiation and reflections, for example safety vests. This setting has a considerable influence on the range (restriction 100 - 150 m). This setting is automatically deactivated when the instrument is turned off.  |
| <b>High dynamics at short range</b> | Check box                    | Available for <b>Aim at target: With lock</b> . Available when a CS20 is connected to a TS15/TS50/TM50/MS50. TS13/TS16/TS60/MS60/TM60 automatically adjust the settings for optimal performance. When this box is checked, the performance improves for distances less than 20 m to the instrument. The instrument reacts faster to changes in prism speed and direction. |
| <b>AP tilt compensation</b>         | <b>Off</b>                   | The tilt compensation for AP20 is disabled.   |
|                                     | <b>On - to pole tip</b>      | The tilt compensation for AP20 is enabled. Tilt compensated point coordinates are calculated to the tip of the pole.  |
|                                     | <b>On - reversed</b>         | The tilt compensation for AP20 is enabled. Tilt compensated point coordinates are calculated to the opposite of the tip of pole. PoleHeight is not supported in this mode, target height needs to be entered manually.  |



a GLS51  
c GRZ122

| Field | Option | Description   |
|-------|--------|---|
|       |        |  |
|       | a      | GLS51   |
|       | b      | MPR122  |
|       | c      | GRZ122  |
|       | d      | CRP10 with optional CRP13*  |

### 23.1.2

### Targets

#### Description

Each prism type has an absolute constant.

Leica Geosystems prisms are predefined as defaults and can be selected. Additional prisms can be defined.

#### Default targets

Following default targets are always available on the instrument:

| Name                                | Name in list                 | Type  | Leica constant | Absolute constant |
|-------------------------------------|------------------------------|-------|----------------|-------------------|
| GRZ4, GRZ122                        | <b>Leica 360° prism</b>      | Prism | +23.1 mm       | -11.3 mm          |
| GMP111-0                            | <b>Leica mini 0</b>          | Prism | 0.0 mm         | -34.4 mm          |
| GRZ101                              | <b>Leica mini 360°</b>       | Prism | +30.0 mm       | -4.4 mm           |
| GMP101, GMP111                      | <b>Leica mini prism</b>      | Prism | +17.5 mm       | -16.9 mm          |
| GZM29, GZM30, GZM31, CPR105         | <b>Leica reflective tape</b> | Tape  | +34.4 mm       | 0.0 mm            |
| GPR1, GPR111, GPR113, GPR121, GPH1P | <b>Leica round prism</b>     | Prism | 0.0 mm         | -34.4 mm          |
| -                                   | <b>Any surface</b>           | RL    | +34.4 mm       | 0.0 mm            |
| MPR122                              | <b>MPR122</b>                | Prism | +28.1 mm       | -6.3 mm           |



For Machine Control purposes only!

#### Access

Open the selectable list for **Target** in **Measure & Target**.



## Targets

This panel shows information about the additive constant, the target type and the creator of the target.

| Targets                      |  |
|------------------------------|--|
| <b>Leica mini 360°</b>       | Abs constant -4.4mm      Leica const 30.0mm  |
| <b>Leica mini prism</b>      | Abs constant -16.9mm      Leica const 17.5mm |
| <b>Leica reflective tape</b> | Abs constant 0.0mm      Leica const 34.4mm   |
| <b>Leica round prism</b>     | Abs constant -34.4mm      Leica const 0.0mm  |
| <b>MPR122</b>                | Abs constant -6.3mm      Leica const 28.1mm  |
| <b>Any surface</b>           | Abs constant 0.0mm      Leica const 34.4mm   |

Fn   OK   New   Edit   Delete   Fn

| Key               | Description   |
|-------------------|---|
| <b>OK</b>         | To select the highlighted target and to return to the previous panel.   |
| <b>New</b>        | To define a new target. Refer to <a href="#">23.1.3 Creating/Editing a Target</a> .   |
| <b>Edit</b>       | To edit the highlighted target. It is not possible to edit default targets. Refer to <a href="#">23.1.3 Creating/Editing a Target</a> .   |
| <b>Delete</b>     | To delete the highlighted target. It is not possible to delete default targets.   |
| <b>Fn Default</b> | To recall previously deleted default targets and to reset default targets to the default settings. User-defined targets are not affected. |

### 23.1.3

### Creating/Editing a Target

#### Access

In **Targets**, highlight a target. All constants are copied from this target. Press **New** or **Edit**.

#### New Target



| New Target        |          |
|-------------------|----------|
| Name              | -----    |
| Type              | Prism    |
| Leica constant    | 0.0 mm   |
| Absolute constant | -34.4 mm |
| Creator           | -----    |

Store

| Key          | Description          |
|--------------|----------------------|
| <b>Store</b> | To store the target. |

#### Description of fields

| Field       | Option  | Description                            |
|-------------|---|--|
| <b>Name</b> | Editable field                                      | A significant name for the new target. |
| <b>Type</b> | <b>Prism,</b><br><b>Tape</b> or<br><b>Undefined</b> | The type of target to be defined.      |

| Field                    | Option         | Description   |
|--------------------------|----------------|---|
| <b>Leica constant</b>    | Editable field | <p>The additive constant for the selected prism as stored in the software.</p> <p> An additive constant of 0.0 mm has been defined for the Leica Geosystems standard targets GPR1, GPR111, and so on. All entered or selected additive constant values are differences to the 0.0 mm based Leica Geosystems TS prism system.</p>   |
| <b>Absolute constant</b> | Editable field | <p>The true additive constant. The additive constant is always in mm.</p> <p> The additive constants of non-Leica Geosystems prisms are often given in the true zero prism system. Use the following formula to convert the additive constant to the Leica Geosystems TS prism system. This Leica constant must be entered into the Leica instrument.</p> <p>Formula:<br/> <math>\text{True zero constant} + 34.4 \text{ mm} = \text{Leica constant.}</math></p> <p>It is highly recommended to check the additive constant for non-Leica Geosystems prisms on a baseline with an appropriate procedure.</p> |
| <b>Creator</b>           | Editable field | A name of the creator or other comments can be entered.   |

## 23.2

### Target search

#### Description

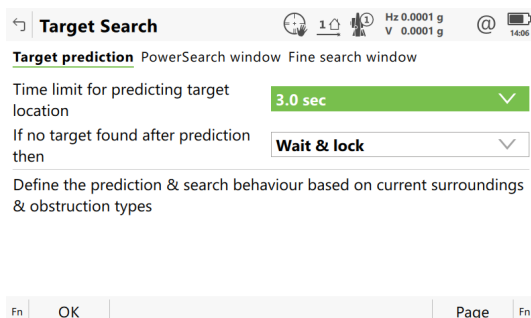
The settings on this panel define

- the size of search windows for prisms to be searched in. The prisms can be searched with PowerSearch in the **PowerSearch window** or with ATRplus in the **Fine search window**.
- the behaviour of automatic prism search after the target is lost in lock mode.
- the use of TargetID, if an AP20 supporting this functionality is configured.

#### Access

Select **Leica Captivate - Home: Settings\TS instrument\Target search**.

## Target Search, Target prediction page



| Key        | Description   |
|------------|---|
| OK         | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page       | To change to another page on this panel.                        |
| Fn Default | To recall the default settings.                                 |

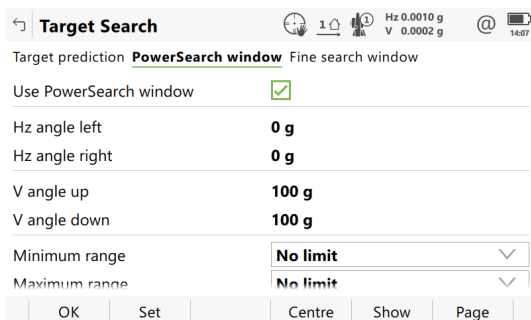
### Description of fields

| Field  | Option                             | Description  |
|--|------------------------------------|--|
| <b>Time limit for predicting target location</b> | From <b>1 s</b> to <b>5 s</b>      | If the target is lost when <b>Aim at target: With lock</b> the path of the prism is predicted for the selected number of seconds.  |
| <b>If no target found after prediction then</b>  | <b>Wait &amp; lock</b>             | Perform no search after prediction.  |
|  | <b>Start fine search</b>           | Perform search after prediction with ATRplus in a dynamic <b>Fine search window</b> .  |
|  | <b>Start Cube-Search</b>           | Perform search after prediction with PowerSearch. Activate PowerSearch on the <b>Power-Search window</b> page.   |
|  | <b>Turn to last measured point</b> | If the target is lost when <b>Aim at target: With lock</b> , then the instrument turns back to the last stored point. The field of view is disabled while the instrument is repositioning. |

### Next step

**Page** changes to the **PowerSearch window** page.

## Target Search, PowerSearch window page



| Key    | Description  |
|--------|--|
| OK     | To accept changes and return to <b>Leica Captivate - Home</b> .            |
| Set    | To define new PowerSearch window.  |
| Centre | To centre the PowerSearch window to the current position of the telescope. |
| Show   | To position the telescope to corners of PowerSearch window.                |
| Page   | To change to another page on this panel.                                   |

#### Description of fields

| Field  | Option                          | Description  |
|--|---------------------------------|--|
| Use PowerSearch window                                     | Check box                       | If checked, PowerSearch searches in the defined window.                |
| Hz angle left, Hz angle right, V angle up and V angle down | Display only                    | The left, right, upper and lower boundaries of the PowerSearch window. |
| Minimum range  | No limit and from 25 m to 175 m | Minimum distance of the search range for the PS window to be defined.  |
| Maximum range  | From 25 m to 175 m and No limit | Maximum distance of the search range for the PS window to be defined.  |

#### Next step

Page changes to the **Fine search window** page.

### Target Search, Fine search window page

Target prediction PowerSearch window **Fine search window**

Auto-aiming window **User defined** ✓

Width of Hz search **4 g**

Height of V search **4 g**

Define the size of the auto-aiming window based on the current working environment

Fn OK Page Fn

| Key        | Description   |
|------------|---|
| OK         | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page       | To change to another page on this panel.                        |
| Fn Default | To recall the default settings.                                 |

### Description of fields

| Field                     | Option              | Description  |
|---------------------------|---------------------|--|
| <b>Auto-aiming window</b> | <b>User defined</b> | Select this option to define the search window manually.   |
|                           | <b>Ultra fine</b>   | Reduces the field of view of the ATRplus. The setting is only applied for <b>Aim at target: Automatic</b> in <b>Measure &amp; Target</b> . |
| <b>Width of Hz search</b> | Editable field      | Horizontal extent of window.   |
| <b>Height of V search</b> | Editable field      | Vertical extent of window.   |

### Next step

**Page** changes to the TargetID page.

Target Search,  
TargetID page

| Key         | Description   |
|-------------|---|
| OK          | To accept changes and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b> | To change to another page on this panel.                        |

### Description of fields

| Field               | Option                     | Description  |
|---------------------|----------------------------|--|
| <b>Use TargetID</b> | Check box                  | If checked, target searches are performed using TargetID.  |
| <b>Choose ID</b>    | From <b>1</b> to <b>16</b> | Available when <b>Use TargetID</b> is checked. The number for TargetID can be selected. Up to 16 different IDs can be defined. |

### Next step

**Page** changes to another page on this panel.

## 23.3

### Atmospheric corrections

#### Description

The settings on this panel define the atmospheric ppm and the refraction. For standard applications, the distance is corrected due to atmospheric influences. The geometrical correction and the projection distortions are set to 0.00. Heights are reduced with the standard refraction coefficient. Refer to the product specific User Manuals for information on calculations.

#### Access

Select **Leica Captivate - Home: Settings\TS instrument\Atmospheric corrections**.

## Atmospheric Corrections, Atmospheric ppm page

The atmospheric distance corrections are derived from the dry air temperature, air pressure or elevation above mean sea level MSL, and the relative air humidity or wet bulb temperature.

**Atmospheric Corrections** Refraction

Temperature: 12.0 °C

Pressure: 1013.3 mbar

Humidity: 60.0 %

Atmospheric ppm: 0.0

Measurement accuracy is increased if the correct temperature, pressure & humidity are entered

Fn OK Page Fn

| Key      | Description  |
|----------|--|
| OK       | To accept changes and return to <b>Leica Captivate - Home</b> .              |
| Page     | To change to another page on this panel.                                     |
| Fn P<>E  | To change <b>Pressure</b> to <b>Elevation above mean sea level</b> and back. |
| Fn %<>T' | To change <b>Humidity</b> to <b>Wet-bulb temperature</b> and back.           |
| Fn ppm=0 | To set <b>Atmospheric ppm: 0.0</b> .   |

### Description of fields

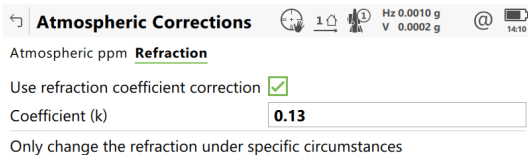
| Field   | Option                         | Description   |
|---|--------------------------------|---|
| <b>Temperature</b>                                | Editable field                 | Sets the temperature.   |
| <b>Pressure or Elevation above mean sea level</b> | Editable field                 | Sets the atmospheric pressure or the elevation above mean sea level dependent on selection. |
| <b>Humidity or Wet-bulb temperature</b>           | Editable field                 | Sets the relative air humidity or the wet bulb temperature dependent on selection.          |
| <b>Atmospheric ppm</b>                            | Editable field or display only | The atmospheric ppm is either set or calculated from the values in the previous fields.     |

### Next step

**Page** changes to the **Refraction** page.

## Atmospheric Corrections, Refraction page

The refraction correction is taken into account during the calculation of the height difference.



Fn OK Page Fn

| Key        | Description   |
|------------|---|
| OK         | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page       | To change to another page on this panel.                        |
| Fn Default | To recall the default settings.                                 |

### Description of fields

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Use refraction coefficient correction</b> | Check box      | If checked, refraction correction is applied to measurements. |
| <b>Coefficient (k)</b>                       | Editable field | Refraction coefficient to be used for calculation.            |

### Next step

**Page** changes to another page.

## 23.4

### Level & compensator

#### Description

For raw data display and recording, the compensator and the horizontal correction can be deactivated.

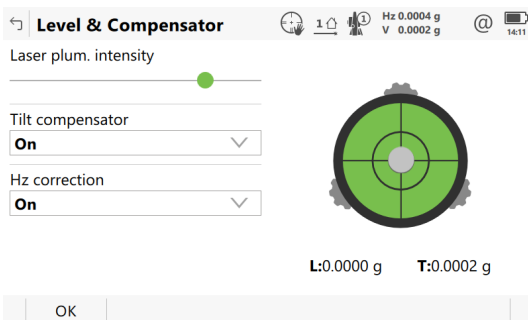


The graphical level bubble is displayed correctly for the situation when the first panel is aligned with two footscrews.

#### Access

Select **Leica Captivate - Home: Settings\TS instrument\Level & compensator**.

#### Level & Compensator



| Key | Description   |
|-----|---|
| OK  | To accept changes and return to <b>Leica Captivate - Home</b> .<br>For a TS remote controlled by a CS: To return to <b>Remote Control</b> . |

#### Description of fields

| Field                        | Option                   | Description  |
|------------------------------|--------------------------|--|
| <b>Laser plum. intensity</b> | Slider                   | To adjust the intensity of the laser plummet.  |
| <b>Tilt compensator</b>      | <b>On</b>                | Vertical angles are relative to plumb line. The horizontal angle is corrected for the transversal tilt errors if <b>Hz correction: On</b> .  |
|                              | <b>Off until restart</b> | Vertical angles are relative to vertical/standing axis.<br>Deactivates the compensator until the instrument is turned off. when the instrument is turned on again, the compensator is activated. |
|                              | <b>Off</b>               | The mode stays always deactivated.<br>The compensator is deactivated, also after turning off and on the instrument.  |
| <b>Hz correction</b>         | <b>On</b>                | The horizontal angles are corrected for the line of sight, tilting axis and if <b>Tilt compensator: On</b> transversal tilt errors.  |
|                              | <b>Off</b>               | Horizontal angles are not corrected.   |

## 23.5

### Lights & accessories

#### Description

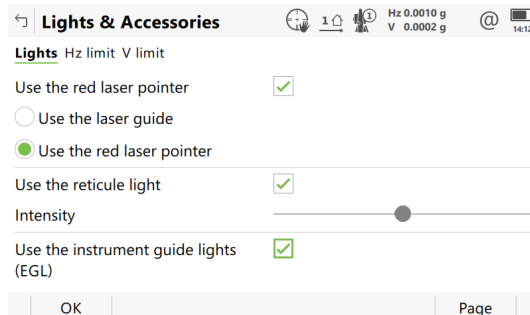
The settings on this panel allow the lights on the instrument to be configured. For motorised instruments, the horizontal/vertical boundaries of a search window can be defined.

#### Access

Select **Leica Captivate - Home: Settings\TS instrument\Lights & accessories**.

#### Lights & Accessories, Lights page

This panel is available for motorised instruments.



| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |



### Description of fields

| Field  | Option            | Description  |
|--|-------------------|--|
| <b>Use the red laser pointer</b>             | Check box         | When this box is checked, either the laser guide or the red laser pointer can be activated.                |
| <b>Use the laser guide</b>                   | Check box         | If checked, the laser guide is turned on.  |
| <b>Intensity</b>                             | From 0 % to 100 % | To adjust the intensity, slide the indicator left and right.   |
| <b>Use the red laser pointer</b>             | Check box         | If checked, the red laser of the reflectorless EDM is turned on.   |
| <b>Use the reticule light</b>                | Check box         | If checked, the reticule illumination is turned on.  |
| <b>Intensity</b>                             | From 0 % to 100 % | To adjust the reticule illumination intensity using the left and right arrow keys.                         |
| <b>Use the instrument guide lights (EGL)</b> | Check box         | If checked, the Emitting Guide Light (EGL) is turned on.<br>This field is only available if EGL is fitted. |
| <b>Intensity</b>                             | From 0 % to 100 % | To adjust the EGL/Laser Guide intensity using the left and right arrow keys.                               |

### Next step

**Page** changes to the **Hz limit** page.

### Lights & Accessories, Hz limit page

This panel is available for motorised instruments.

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To accept changes and return to <b>Leica Captivate - Home</b> .    |
| <b>Set</b>  | To define new search window. Follow the instructions on the panel. |
| <b>Show</b> | To position the telescope to corners of the search window.         |
| <b>Page</b> | To change to another page on this panel.                           |

### Description of fields

| Field                                  | Option         | Description   |
|--|----------------|---|
| <b>Limit Hz movement of instrument</b> | Check box      | When this box is checked, horizontal boundaries for the search window can be defined. |
| <b>Hz begin and Hz end</b>             | Editable field | The boundaries of the search window as horizontal angle where the search begins/ends. |

### Next step

Page changes to the **V limit** page.

### Lights & Accessories, V limit page

This panel is available for motorised instruments.

| Key  | Description  |
|------|--|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> .    |
| Set  | To define new search window. Follow the instructions on the panel. |
| Show | To position the telescope to corners of the search window.         |
| Page | To change to another page on this panel.                           |

### Description of fields

| Field                          | Option          | Description   |
|--------------------------------|-----------------|---|
| Limit V movement of instrument | Check box       | When this box is checked, vertical boundaries for the search window can be defined.                         |
| Limit movement for             | Selectable list | Limits can be set for eyepiece and/or lens.   |
| V begin and V end              | Editable field  | The boundaries of the search window as vertical angles where the search begins/ends. For eyepiece and lens. |

### Lights & Accessories, Battery & charging page

This panel is available for TS60/MS60/TM60 on the CS when connected to a TS60/MS60/TM60.

| Key | Description   |
|-----|---|
| OK  | To accept changes and return to <b>Leica Captivate - Home</b> . |

### Description of fields

| Field             | Option           | Description  |
|-------------------|------------------|--|
| Main power source |                  | Determines the power source to be used when internal and external batteries are attached at the same time.   |
|                   | Internal battery | Select this setting if an internal battery and an external power source are attached but the internal battery must be used first.  |
|                   | External power   | Select this setting if: <ul style="list-style-type: none"><li>• an internal battery is attached but an external battery is attached later. Then the external power source is used as power source.</li><li>• an external power source and an internal battery are attached but the external power source must be used.</li></ul> |

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Charge the internal battery when external power is connected</b> | Check box | If attached, the internal battery is charged from the external power source. |

## 23.6

### Cameras



For information on camera and images refer to [34 Camera & Imaging](#).

## 23.7

### Check & Adjust

#### 23.7.1

#### Overview

#### Description

Leica Geosystems instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument from time to time. This check and adjust can be done in the field by running through specific measurement procedures. The procedures are guided and must be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

#### Electronic adjustment

The following instrument errors can be checked and adjusted electronically:

| Instrument error | Description   |
|------------------|---|
| l, t             | Compensator longitudinal and transversal index errors   |
| i                | Vertical index error, related to the standing axis  |
| c                | Horizontal collimation error, also called line-of-sight error   |
| a                | Tilting-axis error  |
| ATRplus          | ATRplus zero point error for Hz and V - option  |
| Telescope camera | Telescope camera zero point error, relation between principal point of telescope camera and crosshair in telescope in Hz and V - option |

If the compensator and the horizontal corrections are activated in the instrument settings, every angle measured in the daily work is corrected automatically. Check whether the tilt correction and the horizontal correction are turned on.

The results are displayed as errors but used with the opposite sign as corrections when applied to measurements.

#### Mechanical adjustment

The following instrument parts can be adjusted mechanically:

- Circular level on instrument and tribrach
- Optical plummet - option on tribrach
- Allen screws on tripod

## Precise measurements

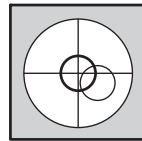
To get precise measurements in the daily work, it is important:

- To check and adjust the instrument from time to time.
- To take high precision measurements during the check and adjust procedures.
- To measure targets in two faces. Some of the instrument errors are eliminated by averaging the angles from both faces.



During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned above, these errors can change and it is highly recommended to redetermine them in the following situations:

- Before the first use
- Before every high precision survey
- After rough or long transportation
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20 °C



Before determining the instrument errors, the instrument has to be levelled using the electronic level. The tribrach, the tripod and the underground should be stable and secure from vibrations or other disturbances.



The instrument should be protected from direct sunlight to avoid thermal warming. It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are early in the morning or with overcast sky.



Before starting to work, the instrument has to become acclimatised to the ambient temperature. Take at least 15 minutes into account or approximately 2 minutes per °C of temperature difference from storage to working environment.



Even after adjustment of the ATRplus, the crosshairs may not be positioned exactly on the centre of the prism after an ATRplus measurement has been completed. This outcome is a normal effect. To speed up the ATRplus measurement, the telescope is normally not positioned exactly on the centre of the prism. These small deviations/ATRplus offsets, are calculated individually for each measurement and corrected electronically. The horizontal and vertical angles are corrected twice: first by the determined ATRplus errors for Hz and V, and then by the individual small deviations of the current aiming.

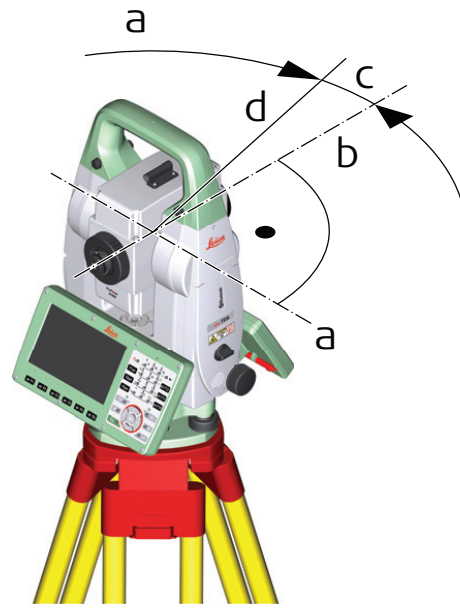
### 23.7.2

#### Details on Instrument Errors

##### Definition

Instrument errors occur, if the standing axis, the tilting axis and the line of sight are not precisely perpendicular to each other.

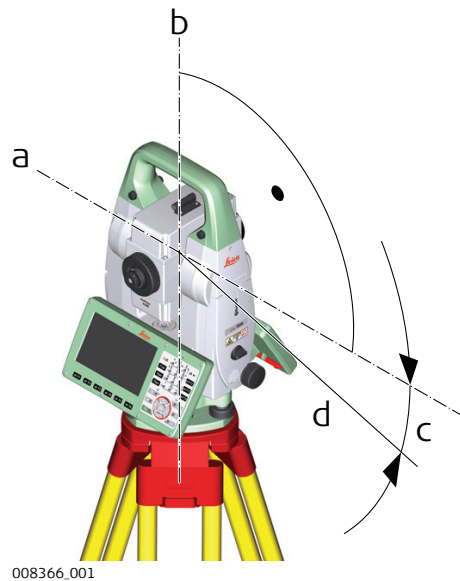
## Horizontal collimation error (c)



- a Tilting axis
- b Line perpendicular to tilting axis
- c Horizontal collimation error (c), also called line-of-sight error
- d Line of sight

The Horizontal collimation error (c) is also called line-of-sight error. The error is caused by the deviation between the optical line of sight, which means the direction in which the crosshairs points and the line perpendicular to the tilting axis. This error affects all horizontal readings and increases with steep sightings.

## Tilting-axis error (a)

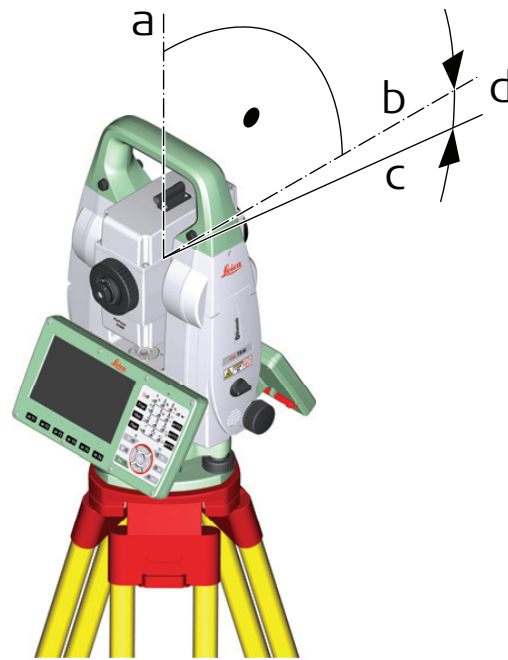


- a Axis perpendicular to the vertical axis
- b Mechanical vertical axis of the instrument, also called standing axis
- c Tilting-axis error
- d Tilting axis

The deviation between the mechanical tilting axis and the line perpendicular to the vertical axis causes the tilting-axis error (a).

This error affects horizontal angles. The effect is zero in the horizon and increases with steep sights. To determine this error, it is necessary to point to a target located significantly below or above the horizontal plane. To avoid influences from the horizontal collimation error (c), the horizontal collimation has to be determined prior to the tilting-axis error.

## Vertical index error (i)



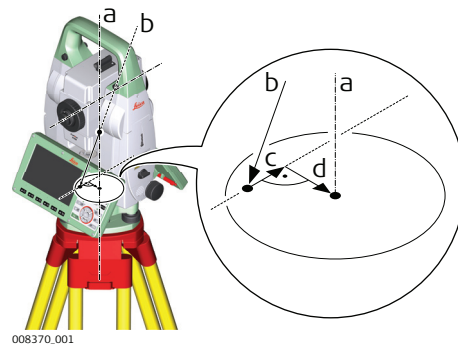
008367\_001

- a Mechanical vertical axis of the instrument, also called standing axis
- b Axis perpendicular to the vertical axis
- c  $V = 90^\circ$  reading in a specific face
- d Vertical index error

A vertical index error (i) exists, if the  $0^\circ$  mark of the vertical circle reading does not coincide with the mechanical vertical axis of the instrument, also called standing axis.

The vertical index error (i) is a constant error that affects all vertical angle readings.

## Compensator index errors (l, t)



008370\_001

- a Mechanical vertical axis of the instrument, also called standing axis
- b Plumb line
- c Longitudinal component (l) of the compensator index error
- d Transversal component (t) of the compensator index error

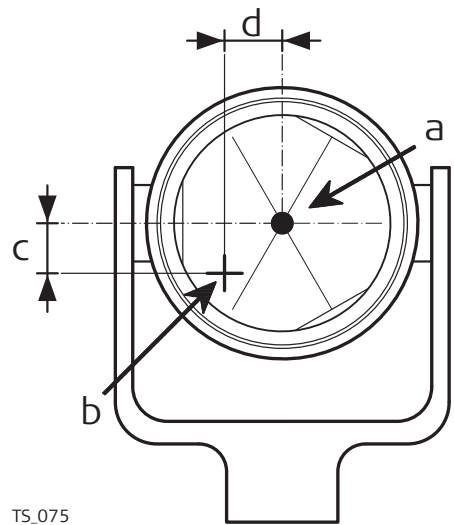
The compensator index errors (l, t) occur, if the vertical axis of the instrument and the plumb line are parallel but the zero points of the compensator and the circular level do not coincide. The calibration procedure electronically adjusts the zero point of the compensator.

A longitudinal component in direction of the telescope and a transversal component perpendicular to the telescope define the plane of the dual axis compensator of the instrument.

The longitudinal compensator index error (l) has a similar effect as the vertical index error and affects all vertical angle readings.

The transversal compensator index error (t) is similar to the tilting-axis error. The effect of this error to the horizontal angle readings is 0 at the horizon and increases with steep sightings.

## Automatic aiming collimation errors

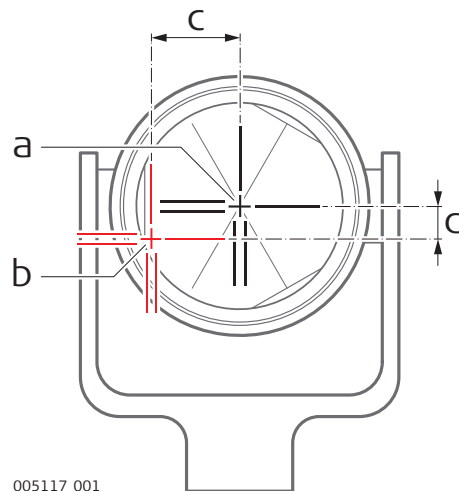


TS\_075

- a Centre of prism
- b Crosshairs
- c V component of ATRplus collimation error
- d Hz component of ATRplus collimation error

The ATRplus collimation error is the angular divergence between the line of sight, which means the direction in which the crosshairs point, and the ATRplus CCD camera axis, which detects the centre of the prism. The horizontal and vertical components of the ATRplus calibration errors correct the horizontal and vertical angles to measure exactly to the centre of the prism.

## Telescope camera collimation error



005117\_001

- a Physical crosshairs in the telescope
- b Digital crosshairs in the telescope camera view
- c Hz component of telescope camera collimation error
- d V component of telescope camera collimation error

The telescope camera collimation error is the angular divergence between the physical crosshairs in the telescope and digital crosshairs in the telescope camera view. The determined horizontal and vertical offset values are applied as constant offset to the recent calibration values.

A full telescope camera calibration takes other camera parameters into account, for example focus position, rotation, scale and lens distortion. The full calibration is performed after production and in service.

## Summary of errors to be adjusted electronically

| Instrument error                  | Effects Hz | Effects V | Elimination with two face measurement | Automatically corrected with proper adjustment |
|-----------------------------------|------------|-----------|---------------------------------------|--|
| c - Line of sight error           | ✓          | -         | ✓                                     | ✓  |
| a - Tilting axis error            | ✓          | -         | ✓                                     | ✓  |
| l - Compensator index error       | -          | ✓         | ✓                                     | ✓  |
| t - Compensator index error       | ✓          | -         | ✓                                     | ✓  |
| i - Vertical index error          | -          | ✓         | ✓                                     | ✓  |
| ATRplus Collimation error         | ✓          | ✓         | -                                     | ✓  |
| Co-axial camera collimation error | ✓          | ✓         | ✓                                     | ✓  |

### 23.7.3

### Accessing the Check & Adjust Wizard

#### Access

Select **Leica Captivate - Home: Settings\TS instrument\Check & adjust**.

#### Check & Adjust, What do you want to do?

| Key         | Description  |
|-------------|--|
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard. |

#### Next step

| IF you want to                      | THEN   |
|-------------------------------------|--|
| determine the instrument errors     | select one of the three available check and adjust procedures and refer to the relevant subchapters.         |
| view the current values             | select <b>View the current values</b> . Refer to <a href="#">23.7.7 Viewing the Current Values</a> .         |
| configure <b>Check &amp; adjust</b> | select <b>Check &amp; adjust settings</b> . Refer to <a href="#">23.7.8 Configuring Check &amp; adjust</a> . |
| adjust the circular level           | Refer to <a href="#">23.7.9 Adjusting the Circular Level of the Instrument and Tribrach</a> .                |
| inspect the laser plummet           | Refer to <a href="#">23.7.11 Inspecting the Laser Plummet of the Instrument</a> .                            |
| adjust the tripod                   | Refer to <a href="#">23.7.12 Servicing the Tripod</a> .  |



## Access

In **Check & Adjust, What do you want to do?** select **Check & adjust the compensator, index error, line of sight error & automatic target aiming** or **Check & adjust the compensator, index error, line of sight error, automatic target aiming & telescope camera** and press **Next**.

## Description

The combined adjustment procedure determines the following instrument errors in one process:

| Instrument error    | Description   |
|---------------------|---|
| I, t                | Compensator longitudinal and transversal index errors           |
| i                   | Vertical index error, related to the standing axis              |
| c                   | Horizontal collimation error, also called line of sight error   |
| ATRplus Hz          | ATRplus zero point error for horizontal angle                   |
| ATRplus V           | ATRplus zero point error for vertical angle                     |
| Telescope camera Hz | Telescope camera zero point error for horizontal angle - option |
| Telescope camera V  | Telescope camera zero point error for vertical angle - option   |



Before determining the instrument errors, the instrument has to be:




- levelled up using the electronic level
- protected from direct sunlight
- acclimatised to the ambient temperature, approximately 2 minutes per °C difference compared to the storage place.

## Check &amp; Adjust, Step 1


| Key     | Description            |
|---------|------------------------|
| Measure | To measure the target. |

## Description of fields

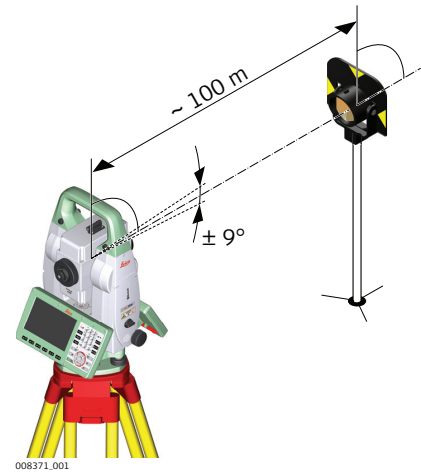
| Field                                   | Option   | Description   |
|---|--|---|
| <b>Calibrate the auto-target aiming</b> | Check box  | When this box is checked, the determination of the ATRplus horizontal and vertical adjustment values is included.                     |
|   | Use a clean Leica standard prism as target. Do not use a 360° prism. | When this box is not checked, the determination of the ATRplus horizontal and vertical adjustment value is excluded.                  |
| <b>Calibrate the telescope camera</b>   | Check box  | When this box is checked, the determination of the telescope camera horizontal and vertical zero point adjustment values is included. |

| Field | Option  | Description   |
|-------|---|---|
|       |  | In <b>Cameras, Overview camera</b> page, <b>Use TS overview camera</b> must be checked. |
|       |  | A prism is not required to run the procedure.   |
|       |  | Use a clean Leica standard prism as target. Do not use a 360° prism.                    |

1. Aim the telescope accurately at a target at a distance of about 100 m. The target must be positioned within  $\pm 9^\circ/\pm 10$  gon of the horizontal plane

 The fine aiming must be performed manually in both faces.

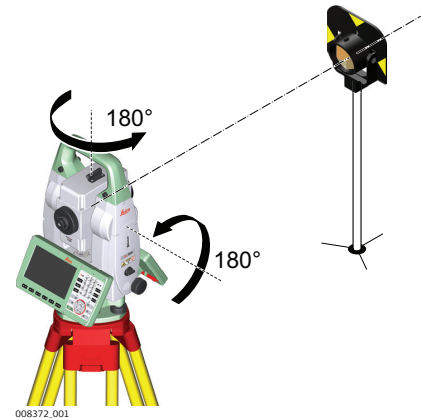
**Measure** to measure and to continue to the next panel.



For TS60/MS60/TM60:


If **Calibrate the telescope camera** has been checked, aim at the same target accurately with the telescope camera using the view finder and the digital crosshair on the display. **Measure** to measure and to continue to the next panel.

Motorised instruments change automatically to the other face.



Non-motorised instruments guide to the other face using the **Telescope Positioning** panel.

2. **Measure** to measure the same target in the other face and to calculate the instrument errors.

 If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.

Check & Adjust,  
Step 2

| Key  | Description            |
|------|------------------------|
| Next | To measure the target. |

### Description of fields

| Field                  | Option       | Description   |
|------------------------|--------------|---|
| Number of measurements | Display only | Shows the number of runs. One run consists of a measurement in face I and II.   |
| All other fields       | Display only | The standard deviations of the determined adjustment errors are displayed. The standard deviations can be calculated from the second run onwards. |

**Check & Adjust,**  
It is recommended to repeat the last calibration routine at least three times

Measure at least two more runs.

### Next step

| IF                         | THEN   |
|----------------------------|--|
| more runs must be added    | select <b>Add another calibration loop</b> and press <b>Next</b> .   |
| no more runs must be added | select <b>Finish the calibration &amp; store the results</b> and press <b>Next</b> to accept the measurements and to access the results panel. |

**Check & Adjust, Results**

Select the instrument errors which you want to accept and then store.

Do not check a box to keep the currently used error active on the instrument and rejects the new one.

| Key           | Description   |
|---------------|---|
| <b>Back</b>   | To return to the previous panel.  |
| <b>Redo</b>   | To reject all results and to repeat the complete check and adjust procedure.  |
| <b>Finish</b> | To accept and store the new determined instrument errors, which are selected. If the report sheet recording has been enabled, then the results are written or appended to an existing report sheet. |

### Description of metadata

| Metadata   | Description   |
|------------|---|
| <b>New</b> | The new determined and averaged instrument errors.                      |
| <b>Old</b> | The old adjustment errors, which are currently valid on the instrument. |

## 23.7.5

### Tilting Axis Adjustment (a)

**Access**

In **Check & Adjust, What do you want to do?** select **Check & adjust the tilting axis** and press **Next**.

**Description**

This adjustment procedure determines the following instrument error:

| Instrument error | Description        |
|------------------|--------------------|
| a                | Tilting-axis error |



Before determining the tilting-axis error, the instrument has to be:

- levelled up using the electronic level
- protected from direct sunlight
- acclimatised to the ambient temperature, approximately 2 minutes per °C difference compared to the storage place.
- The horizontal collimation error must be determined before.

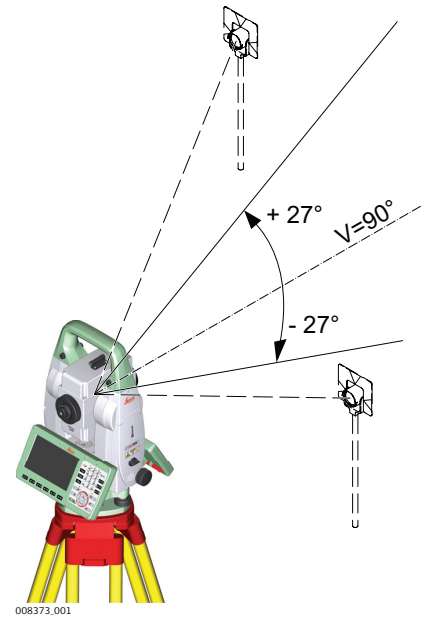
## Check & Adjust, Step 1

| Key     | Description            |
|---------|------------------------|
| Measure | To measure the target. |

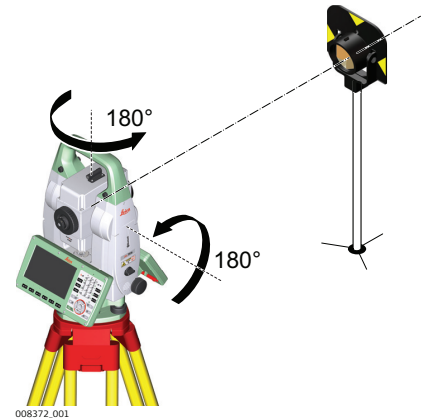
1. Aim the telescope accurately at a target at a distance of about 100 m. For distances less than 100 m, make sure to point to the target precisely. The target must be positioned within at least 27°/30 gon above or beneath the horizontal plane.



The fine aiming must be performed manually in both faces.



2. **Measure** to measure and to continue to the next panel. Motorised instruments change automatically to the other face.



3. Non-motorised instruments guide to the other face using the **Telescope Positioning** panel.
4. **Measure** to measure the same target in the other face and to calculate the instrument errors.



If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.

## Check & Adjust, Step 2

| Key                             | Description            |  |
|---------------------------------|------------------------|--|
| Next                            | To measure the target. |  |
| <b>Description of fields</b>    |                        |  |
| Field                           | Option                 | Description  |
| Number of measurements          | Display only           | The number of runs. One run consists of a measurement in face I and II.  |
| a T-axis quality ( $1 \sigma$ ) | Display only           | The standard deviation of the determined tilting-axis error. The standard deviation can be calculated from the second run onwards. |

## Check & Adjust, It is recommended to repeat the last calibration routine at least three times

Measure at least two more runs.

### Next step

| IF                         | THEN   |
|----------------------------|--|
| more runs must be added    | select <b>Add another calibration loop</b> and press <b>Next</b> .   |
| no more runs must be added | select <b>Finish the calibration &amp; store the results</b> and press <b>Next</b> to accept the measurements and to access the results panel. |

## Check & Adjust, Results

| Key                          | Description  |   |
|------------------------------|--|---|
| Back                         | To return to the previous panel.   |   |
| Finish                       | To accept and record the new determined tilting-axis error. If the report recording has been enabled, then the results are written to or appended to an existing report sheet. |   |
| Redo                         | To reject the result and to repeat the complete check and adjust procedure.  |   |
| <b>Description of fields</b> |  |   |
| Field                        | Option   | Description   |
| New                          | Display only   | The new determined and averaged tilting-axis error.         |
| Old                          | Display only   | The old instrument error, which is valid on the instrument. |

## 23.7.6

### Compensator Adjustment (I, t)

#### Access

In **Check & Adjust, What do you want to do?** select **Check & adjust the compensator** and press **Next**.

#### Description

The compensator adjustment procedure determines the following instrument errors:

| Instrument error | Description                          |
|------------------|--------------------------------------|
| I                | Compensator longitudinal index error |

| Instrument error | Description                         |
|------------------|-------------------------------------|
| t                | Compensator transversal index error |



Before determining the compensator index errors, the instrument has to be:

- levelled up using the electronic level
- protected from direct sunlight
- acclimatised to the ambient temperature, approximately 2 minutes per °C difference compared to the storage place.

**Check & Adjust,  
Make first tilt meas-  
urement in any face**

| Key  | Description            |
|------|------------------------|
| Next | To measure the target. |

1. **Measure** to measure the first face. No target has to be aimed at. Motorised instruments change to the other face and release a measurement automatically.



2. Non-motorised instruments guide to the other face using the **Telescope Positioning** panel.
3. **Measure** to start the measurement in the other face.



If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and are not averaged with the results from previous runs.

**Check & Adjust,  
Step 2**

| Key  | Description            |
|------|------------------------|
| Next | To measure the target. |

#### Description of fields

| Field  | Option       | Description   |
|--|--------------|---|
| <b>Number of measurements</b>  | Display only | The number of runs. One run consists of a measurement in face I and II.   |
| <b>I Component quality (1 <math>\sigma</math>) and t Component quality (1 <math>\sigma</math>)</b> | Display only | The standard deviations of the determined adjustment errors. The standard deviations can be calculated from the second run onwards. |

**Check & Adjust,  
It is recommended to  
repeat the last calib-  
ration routine at least  
three times**

Measure at least two more runs.

### Next step

| IF                         | THEN   |
|----------------------------|--|
| more runs must be added    | select <b>Add another calibration loop</b> and press <b>Next</b> .   |
| no more runs must be added | select <b>Finish the calibration &amp; store the results</b> and press <b>Next</b> to accept the measurements and to access the results panel. |

### Check & Adjust, Results

| Key           | Description   |
|---------------|---|
| <b>Back</b>   | To return to the previous panel.  |
| <b>Redo</b>   | To reject all results and to repeat the complete check and adjust procedure.  |
| <b>Finish</b> | To accept and record the new determined instrument errors. If the report sheet recording has been enabled, then the results are written and appended to an existing report sheet. |

### Description of metadata

| Metadata   | Option       | Description   |
|------------|--------------|---|
| <b>New</b> | Display only | The new determined and averaged instrument errors.                      |
| <b>Old</b> | Display only | The old instrument errors, which are currently valid on the instrument. |

### 23.7.7

### Viewing the Current Values

#### Access

In **Check & Adjust, What do you want to do?** select **View the current values** and press **Next**.

#### Check & Adjust

| Check & Adjust          |                   |             |
|-------------------------|-------------------|-------------|
| <b>I Component</b>      | Date: 20.03.2017  |             |
| Current[g] 0.0000       | Accuracy[g] ----- | Int T[°C] 0 |
| <b>t Component</b>      | Date: 20.03.2017  |             |
| Current[g] 0.0000       | Accuracy[g] ----- | Int T[°C] 0 |
| <b>i V-index</b>        | Date: 20.03.2017  |             |
| Current[g] 0.0000       | Accuracy[g] ----- | Int T[°C] 0 |
| <b>c Hz-collimation</b> | Date: 20.03.2017  |             |
| Current[g] 0.0000       | Accuracy[g] ----- | Int T[°C] 0 |
| <b>a T-axis</b>         | Date: 20.03.2017  |             |
| Current[g] 0.0000       | Accuracy[g] ----- | Int T[°C] 0 |
| <b>ATR Hz</b>           | Date: 20.03.2017  |             |
| Current[g] 0.0000       | Accuracy[g] ----- | Int T[°C] 0 |
| Fn                      | OK                | Fn          |

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To return to <b>Check &amp; Adjust, What do you want to do?</b>  |
| <b>More</b> | To display information about the date of the determination, the standard deviation of the errors and the temperature during the determination. |



The temperature of the environment around the instrument can differ from the temperature shown on the panel as it is the internal temperature of the instrument.

### 23.7.8

### Configuring Check & adjust

#### Access

In **Check & Adjust, What do you want to do?** select **Check & adjust settings** and press **Next**.

#### Check & Adjust

| Key  | Description  |
|------|--|
| Next | To accept changes and to continue with the subsequent panel within the wizard. |
| Back | To return to the previous panel.   |

#### Description of options

| Option  | Description   |
|---|---|
| Every 2 weeks,<br>Once a month,<br>Every 3 months,<br>Twice a year<br>or<br>Once a year | If one or more adjustment values were determined longer ago than the time specified with this parameter, then a reminder message is displayed each time the instrument is turned on. The reminder helps to redetermine the instrument errors regularly. |
| Never   | A reminder message to readjust the instrument is never displayed. This setting is not recommended.  |

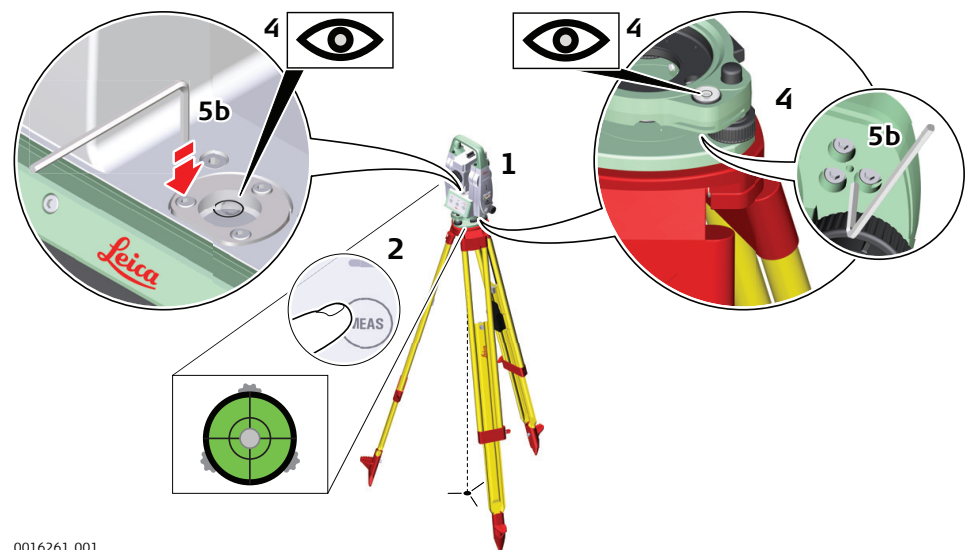
#### Next step

Next to change to the **Report sheet** panel.

### 23.7.9

### Adjusting the Circular Level of the Instrument and Tribrach

#### Adjusting the circular level step-by-step



0016261.001

1. Place and secure the instrument into the tribrach and onto a tripod.




2. Using the tribrach footscrews, level the instrument with the electronic level.
- 
3. Select **Settings\TS instrument\Level & compensator** to access the **Level & Compensator** panel.
- 

4. Check the position of the circular level on the instrument and tribrach.
- 

5.
  - a If both circular levels are centred, no adjustments are necessary
  - b If one or both circular levels are not centred, adjust as follows:

**Instrument:** If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws. Turn the instrument by 200 gon (180°). Repeat the adjustment procedure if the circular level does not stay centred.

**Tribrach:** If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws.

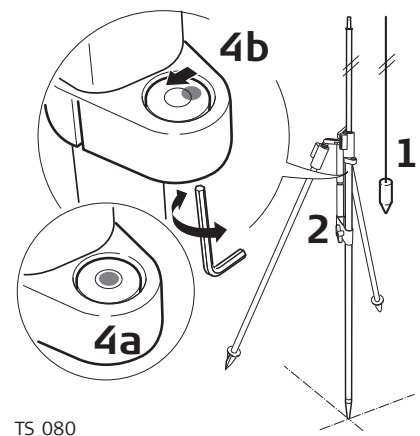
 After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.


### 23.7.10

### Adjusting the Circular Level of the Prism Pole

#### Adjusting the circular level step-by-step

1. Suspend a plumb line.
2. Use a pole bipod, to align the prism pole parallel to the plumb line.
3. Check the position of the circular level on the prism pole.
4.
  - a If the circular level is centred, no adjustment is necessary.
  - b If the circular level is not centred, use an allen key to centre it with the adjustment screws.



 After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

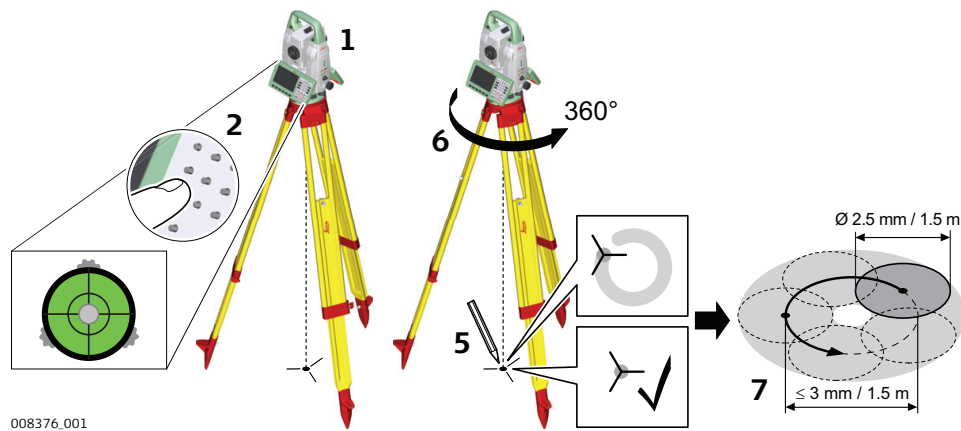
### 23.7.11

### Inspecting the Laser Plummet of the Instrument



The laser plummet is located in the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, return the instrument to any Leica Geosystems authorised service workshop.

## Inspecting the laser plummet step-by-step




008376\_001

The following table explains the most common settings.

1. Set up the instrument on the tripod approximately 1.5 m above the ground and level up.


---

2. Select **Settings\TS instrument\Level & compensator** to access the **Level & Compensator** panel.  
The laser plummet is switched on when the **Level & Compensator** panel is entered. Adjust the laser plummet intensity.
  -  Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, such as a sheet of paper.

---

3. Mark the centre of the red laser dot on the ground.

---

4. Turn the instrument slowly through 360°, carefully observing the movement of the red laser dot.
  -  The maximum diameter of the circular movement described by the centre of the laser dot should not exceed 3mm at a height of 1.5m.

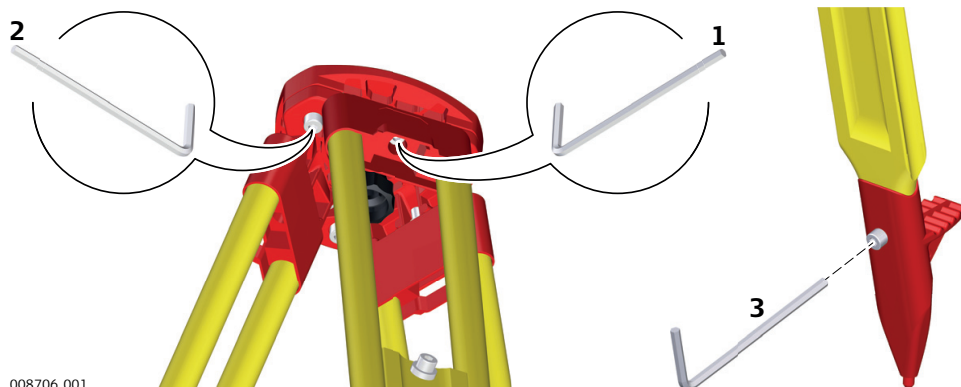
---

5. If the centre of the laser dot describes a perceptible circular movement, or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems authorised service centre. Depending on brightness and surface, the diameter of the laser dot can vary. At 1.5 m, it is about 2.5 mm.

### 23.7.12

### Servicing the Tripod

#### Servicing the tripod step-by-step



008706\_001

The following table explains the most common settings.



The connections between metal and timber components must always be firm and tight.

- 
1. Tighten the leg cap screws moderately, with the supplied Allen key.
  2. Tighten the articulated joints on the tripod head enough to keep the tripod legs open when lifting the tripod off the ground.
  3. Tighten the Allen screws of the tripod legs.
-

## 24

## Settings - GS sensor

### 24.1

### Satellite tracking

#### 24.1.1

#### General Settings

##### Description

The settings on this panel define which satellite system, satellites and satellite signals the instrument uses.

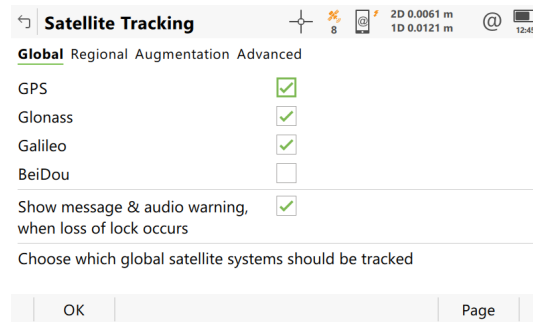
##### Access

Select **Leica Captivate - Home: Settings\GS sensor\Satellite tracking**.

OR

Press a hot key or favourites key configured to **GS - Satellite tracking**.

##### Satellite Tracking, Global page



| Key | Description |
|-----|-------------|
|-----|-------------|

|    |                    |
|----|--------------------|
| OK | To accept changes. |
|----|--------------------|

|      |  |
|------|--|
| Page | To change to another page on this panel. |
|------|--|

##### Description of fields

- Any of the GNSS can only be disabled, if at least one other GNSS is enabled.
- At least one GNSS must be enabled.
- **GPS** can never be disabled on the base station.

| Field          | Option    | Description  |
|----------------|-----------|--|
| <b>GPS</b>     | Check box | Defines if the instrument accepts the GPS L1, L2 and L5 signals when tracking satellites. For L2 and L5 the multi-frequency licence is required. |
| <b>Glonass</b> | Check box | Defines if the instrument accepts GLONASS L1, L2 and L3 signals when tracking satellites.  |
| <b>Galileo</b> | Check box | Defines if the instrument accepts Galileo E1, E5a, E5b, E6 and AltBOC signals when tracking satellites.  |
| <b>BeiDou</b>  | Check box | Defines if the instrument accepts BeiDou B1, B2 and B3 signals when tracking satellites.   |

| Field   | Option    | Description   |
|---|-----------|---|
| <b>Show message &amp; audio warning, when loss of lock occurs</b> | Check box | Activates an acoustic warning signal and a message given by the instrument when the position is lost. |

**Next step**

**Page** changes to the **Regional** page.

**Satellite Tracking, Regional page**

| Key         | Description                              |
|-------------|--|
| <b>OK</b>   | To accept changes.                       |
| <b>Page</b> | To change to another page on this panel. |

**Description of fields**

| Field       | Option    | Description  |
|-------------|-----------|--|
| <b>QZSS</b> | Check box | Defines if the instrument accepts the QZSS signals when tracking satellites. |

**Next step**

**Page** changes to the **Augmentation** page.



**Satellite Tracking, Augmentation page**




Available on CS20 and CS30/CS35 when connected to GS07/GS10/GS16/GS18/GS25.

| Key         | Description                              |
|-------------|--|
| <b>OK</b>   | To accept changes.                       |
| <b>Page</b> | To change to another page on this panel. |

**Fn Control** To modify the IP stream access details. After a Captivate reset of the instrument, the default settings are set again. Available for **Use PPP service/Use RTK bridging service: Via IP stream** and **Use PPP service/Use RTK bridging service: Via IP stream and satellite**. Only NTRIP connections are supported. Press **Default** to recall the default values.

## Description of fields

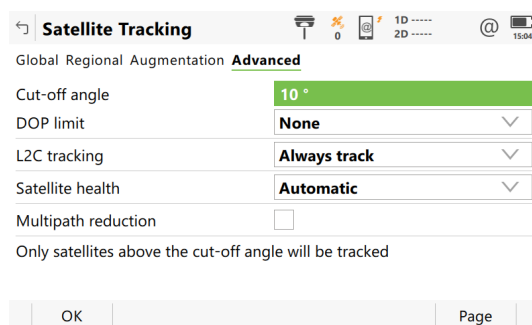
| Field                                    | Option                      | Description  |
|--|-----------------------------|--|
| Use PPP service/Use RTK bridging service |                             | <p> The <b>Use PPP service/Use RTK bridging service</b> functionality is licenced.</p> <p>If the <b>Use PPP service/Use RTK bridging service</b> licence is available, the system calculates a PPP solution. RTK outages are bridged as long as needed.</p> <p>If the bridging licence is available, the system bridges RTK outages for 10 minutes.</p> <p>Unavailable:</p> <ul style="list-style-type: none"> <li>For <b>Rate: 0.05 sec</b> (20 Hz) configured in <b>GNSS Raw Data Logging</b>.</li> <li>On GS instruments with measurement engines other than OEM7, GPS L5, Galileo E5a/E5b/AltBOC and BeiDou B2 satellite signals are unavailable in bridging mode. Check the information provided for the field <b>ME HW version</b> in <b>About Leica Captivate, GS sensor</b> page. Refer to <a href="#">32 Settings - About Leica Captivate</a>. Or use the Webserver.</li> </ul> <p> The settings in <b>Satellite Tracking</b> are not changed.</p> |
|  | No                          | PPP/bridging services are disabled.  |
|  | Via satellite               | PPP/bridging services are enabled. Corrections are received via satellite only. Defines if the instrument accepts L-Band tracking to receive PPP correction data coming from satellites.   |
|  | Via IP stream               | PPP/bridging services are enabled. Corrections are received via the configured stream only. Defines if the instrument accepts to receive PPP correction data coming from an IP stream. Only NTRIP streams are supported to receive PPP corrections. The stream access details can be modified with <b>Fn Control</b> .   |
|  | Via IP stream and satellite | PPP/bridging services are enabled. PPP corrections are received via the configured stream or satellite. Only NTRIP streams are supported to receive PPP corrections. The stream access details can be modified with <b>Fn Control</b> .  |

| Field                    | Option                   | Description  |
|--------------------------|--------------------------|--|
| <b>Connect using</b>     | Selectable list          |  The selected option must differ from the one selected for the RTK stream, if configured.   |
|                          |                          |  The Internet access configuration must be done before selecting an option from the list.   |
| <b>Reference frame</b>   |                          | Available for a valid <b>PPP service</b> licence. A PPP solution is independent from a reference station or network and therefore the link to the reference frame of the used coordinate system is not given any more. The coordinates need to be transformed into the reference frame of the coordinate system. |
|                          |                          |  The usage of an incorrect reference frame can create a position error bigger than the accuracy of a PPP solution (> 6 cm).   |
|                          | Selectable list          | The provided list contains predefined reference frames. Select the reference frame of the coordinate system in use.  |
|                          | <b>Custom adjustment</b> | To ensure that the PPP positions match the jobs reference frame when the reference frame is unknown or not available in the list of predefined ones.   |
| <b>Adjustment to use</b> | Selectable list          | Available for <b>Reference frame: Custom adjustment</b> . Select a customised adjustment to transform the PPP solution from its original reference frame to any RTK based reference frame already used within the same job. Refer to <a href="#">24.1.3 Adjustment Settings</a> .                                |

### Next step

Page changes to the **Advanced** page.

## Satellite Tracking, Advanced page



Global Regional Augmentation **Advanced**

Cut-off angle: 10 °

DOP limit: None

L2C tracking: Always track

Satellite health: Automatic

Multipath reduction:


Only satellites above the cut-off angle will be tracked

OK Page

| Key | Description        |
|-----|--------------------|
| OK  | To accept changes. |

| Key           | Description  |
|---------------|--|
| <b>Health</b> | Available for <b>Satellite health: User defined</b> . To configure the satellites used. Refer to <a href="#">24.1.2 Satellite Health</a> . |
| <b>Page</b>   | To change to another page on this panel.   |

#### Description of fields

| Field                      | Option                                | Description   |
|----------------------------|---------------------------------------|---|
| <b>Cut-off angle</b>       | Editable field                        | Sets the elevation in degrees below which satellite signals are not recorded and are not shown to be tracked. The recommended setting is 10° for both real-time and post-processing applications.   |
| <b>DOP limit</b>           | <b>None, GDOP, HDOP, PDOP or VDOP</b> | If activated, the limit defined in <b>Limiting value</b> is checked. GNSS positions are unavailable when the limit is exceeded.   |
| <b>Limiting value</b>      | Editable field                        | The maximum acceptable DOP value. Available unless <b>DOP limit: None</b> .   |
| <b>L2C tracking</b>        | <b>Always track</b>                   | L2C signals are always tracked. The system uses the L2C signals instead of L2P signals, if available.   |
|                            | <b>Automatic</b>                      | L2 signals which are flagged as unhealthy are not recorded or used for real-time computations.  |
| <b>Satellite health</b>    |                                       | Sets the satellite tracking behaviour.  |
|                            |                                       |  This setting is remembered when the instrument is turned off.   |
|                            | <b>Automatic</b>                      | The instrument monitors incoming satellite signals. Data from signals which are flagged as unhealthy is not recorded or used for real-time computations.  |
|                            | <b>User defined</b>                   | Satellites must manually be included/excluded from data recording and real-time computations with <b>Health</b> .   |
| <b>Multipath reduction</b> | Check box                             | <p>Available on GS16/GS18 and GS10/GS15/GS25 GNSS receivers with 555 channels or GS07 receivers with measurement engine firmware version 7.804.</p> <p>When this box is checked, the GNSS signal tracking quality is improved when working in harsh environments. The result is better RTK availability and accuracy.</p> <p>In a single base RTK setup, if multipath reduction is enabled at the rover, it is recommended to also enabled this option at the base.</p> <p>When this box is not checked, no multipath reduction is are applied.</p> |



| Field                          | Option    | Description  |
|--------------------------------|-----------|--|
| <b>Interference mitigation</b> | Check box | <p>The interference mitigation option mitigates out-of-band interferences and enables filtering functionalities to remove in-band distortions. The option allows obtaining the highest robustness of signal tracking against interferences.</p> <p>Available on the GS16/GS18 and GS10/GS25 GNSS receivers with 555 channels. GS07 receivers support the out-of-band interference mitigation option without the extra filtering functionalities.</p> |

### Next step

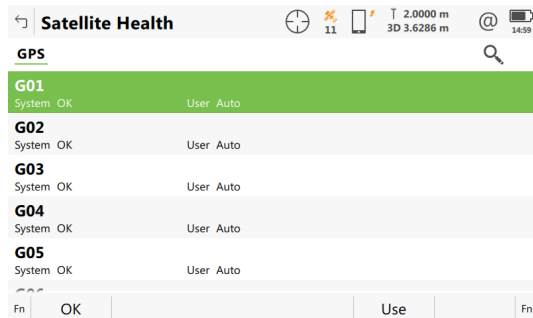
**Health** changes to **Satellite Health**.

## 24.1.2

### Satellite Health

#### Satellite Health

The panel contains a page for each GNSS system the receiver is configured to track. The explanations given for the softkeys are valid for all pages.



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Use</b>  | To change between the options for the metadata <b>User</b> .                  |
| <b>Page</b> | To change to another page on this panel.                                      |

#### Description of metadata

| Metadata | Option          | Description   |
|----------|-----------------|---|
| -        | <b>01 to 63</b> | <p>The Pseudo Random Noise number (GPS, 1 to 32), the Slot ID (GLONASS, 1 to 24) or the Space Vehicle number (Galileo, 1 to 50, and BeiDou, 1 to 63, and QZSS, 1 to 10) of the satellites.</p> <p>The prefixes are:</p> <ul style="list-style-type: none"> <li>• G for GPS satellites</li> <li>• R for GLONASS satellites</li> <li>• C for BeiDou satellites.</li> <li>• E for Galileo satellites</li> <li>• I for NavIC satellites</li> <li>• J for QZSS satellites</li> </ul> |

| Metadata      | Option                      | Description  |
|---------------|-----------------------------|--|
| <b>System</b> | <b>OK, N/A or Unhealthy</b> | Information on the satellite health taken from the almanac. <b>N/A</b> stands for not available. |
| <b>User</b>   | <b>Bad</b>                  | Excludes satellite from tracking.  |
|               | <b>OK</b>                   | Includes satellite in tracking.  |
|               | <b>Auto</b>                 | Automatic satellite tracking when satellite is healthy.  |

#### Next steps

1. **Page** changes to the **Glonass** page, to the **Galileo** page, to the **QZSS** page, to the **NavIC** page and to the **BeiDou** page, where satellites used in the survey can be configured.
2. **OK** returns to **Satellite Tracking**.
3. **OK** returns to **Leica Captivate - Home** or **Leica Captivate - Base**.

### 24.1.3

#### Adjustment Settings

##### Adjustment to Use

Listed are all user-defined adjustments stored in the database DBX. Any unavailable information is shown as -----.

##### Accessing Adjustment to Use




1. In **Satellite Tracking, Augmentation** page, select **Reference frame: Custom adjustment**.
2. Open the selectable list for **Adjustment to use**.

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To select the highlighted adjustment and to return to the previous panel. The selected adjustment is used for the transformation of PPP points. |
| <b>New</b>    | To create a custom adjustment manually. Refer to <a href="#">New Adjustment</a> .   |
| <b>Info</b>   | To display the name of the adjustment, the creation date, the distance from the current location, azimuth, distances and quality.               |
| <b>Delete</b> | To delete the highlighted adjustment. Even if the highlighted adjustment is active, it can be deleted.  |

##### Next step

**New** changes to the **New Adjustment** panel.

## New Adjustment

| Key   | Description  |
|---|--|
| OK  | To store the adjustment.   |
|  | The customised adjustment is only applied to PPP points measured after the creation of the adjustment.   |
|  | The selected custom adjustment will be applied to any PPP measurement until the configuration is being changed by the user.  |
|  | A customised adjustment cannot be transferred directly to another controller. The two points used for the calculation can be transferred to another controller. The adjustment must be re-created. |

### Description of fields

| Field  | Option          | Description  |
|--|-----------------|--|
| <b>Name</b>  | Editable field  | A unique name for the new reference frame.   |
| <b>PPP point</b>   | Selectable list | Points of type PPP from the current working job.<br>Any PPP point can be selected, regardless of the coordinate quality.   |
| <b>RTK point</b>   | Selectable list | Points from the current working job. Points of type PPP are not listed.  |
| The values for the following fields are calculated automatically based on the selection of <b>PPP point</b> and <b>RTK point</b> . |                 |  |
| <b>Date</b>  | Display only    | Creation date of the PPP point.<br>Creation date of the point shall be within the last two months.   |
| <b>Distance from current location</b>  | Display only    | 2D distance from <b>RTK point</b> to the current position regardless of its coordinate quality. The result is rounded to full metre. The value is calculated when <b>RTK point</b> is selected. Distance shall not exceed 50 km. |
| <b>Horizontal distance</b>   | Display only    | 2D distance from <b>PPP point</b> to <b>RTK point</b> .  |
| <b>Height difference</b>   | Display only    | Height difference between <b>PPP point</b> and <b>RTK point</b> .  |
| <b>Slope distance</b>  | Display only    | 3D distance from <b>PPP point</b> to <b>RTK point</b> .  |
| <b>Position quality</b>  | Display only    | <b>2D quality of the custom adjustment</b>   |
| <b>Height quality</b>  | Display only    | <b>Height quality of the custom adjustment</b>   |

## 24.2

### Antenna heights

### 24.2.1

#### Antenna Heights

#### Access

Select **Leica Captivate - Home: Settings\GS sensor\Antenna heights**.

## Antenna Heights

**Antenna Heights**

Rover antenna **GS15 Pole**

Vertical offset **0.0000 m**

Antenna height when measuring points **2.0000 m**

Use offset for moving antenna

Show antenna type when starting an app

Ensure to choose the correct antenna type.

OK

| Key | Description                                      |
|-----|--|
| OK  | To return to the <b>Leica Captivate - Home</b> . |

### Description of fields for the External page

| Field   | Option          | Description   |
|---|-----------------|---|
| <b>Rover antenna</b>                          | Selectable list | Leica Geosystems antennas are predefined as default and can be selected from the list. Default antennas contain an elevation-dependent correction model. New antenna correction models can be set up and transferred to the instrument using Infinity. Open the list to define or edit antennas. Refer to <a href="#">24.2.2 Antennas</a> .   |
| <b>Vertical offset</b>                        | Display only    | The vertical antenna offset for the selected antenna.   |
| <b>Antenna height when measuring points</b>   | Editable field  | Sets the default antenna height for the current working style. This height is then also the default antenna height during the use of apps. The antenna height can still be changed during a survey. The initial value depends on the selected antenna.<br><br>Unavailable for SmartStation. The height is added in the Setup and Measure app. |
| <b>Use offset for moving antenna</b>          | Check box       | When unchecked, the moving antenna height is considered the same as the default antenna height.   |
| <b>Show antenna type when starting an app</b> | Check box       | When this box is checked and an app with measurement functionality is started, the configured antenna type and offset are displayed in an information window.   |
| <b>Offset</b>                                 | Editable field  | When the check box <b>Use offset for moving antenna</b> is checked: Sets the offset to the default antenna height for auto points and for the moving part of a track when logging raw observations.   |

## 24.2.2

### Antennas

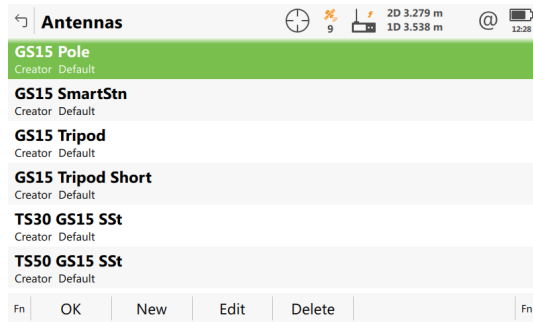
#### Description

Listed are antennas in the instrument's internal memory.

## Access

Open the selectable list for **Rover antenna** in **Antenna Heights**.

## Antennas



| Key        | Description  |
|------------|--|
| OK         | To select the highlighted antenna and to return to the previous panel.   |
| New        | To define a new antenna. Refer to <a href="#">24.2.3 Creating/Editing an Antenna</a> .   |
| Edit       | To edit the highlighted antenna. It is not possible to edit default antennas. Refer to <a href="#">24.2.3 Creating/Editing an Antenna</a> .  |
| Delete     | To delete the highlighted antenna.   |
| Fn Default | To recall previously deleted default antennas and to reset default antennas to the default settings. User-defined antennas are not affected. |

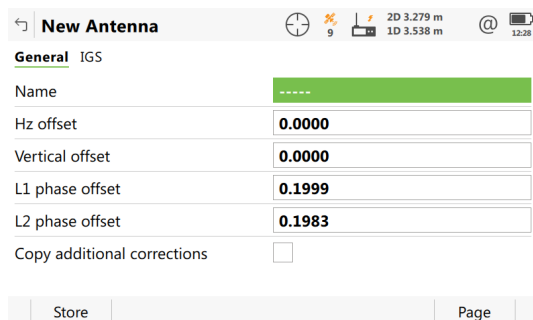
## 24.2.3

### Creating/Editing an Antenna

## Access

In **Antennas**, highlight an antenna. All offsets are copied from this antenna. Press **New** or **Edit**.

## New Antenna or Edit Antenna, General page



| Key   | Description                              |
|-------|--|
| Store | To store the antenna.                    |
| Page  | To change to another page on this panel. |

### Description of fields

| Field | Option         | Description                        |
|-------|----------------|------------------------------------|
| Name  | Editable field | A unique name for the new antenna. |

| Field                              | Option         | Description  |
|------------------------------------|----------------|--|
| <b>Hz offset</b>                   | Editable field | Horizontal offset of measurement reference point.  |
| <b>Vertical off-set</b>            | Editable field | Vertical offset of measurement reference point.  |
| <b>L1 phase offset</b>             | Editable field | Offset of L1 phase centre.   |
| <b>L2 phase offset</b>             | Editable field | Offset of L2 phase centre.   |
| <b>Copy additional corrections</b> | Check box      | Allow phase centre variations to be copied to be copied from the antenna which was highlighted before this panel was accessed. |

#### Next step

**Page** changes to the **IGS** page.

### New Antenna or Edit Antenna, IGS page

The combination of values typed in here provides a unique standardised ID for the antenna being used.

#### Description of fields

| Field                | Option         | Description  |
|----------------------|----------------|--|
| <b>IGS name</b>      | Editable field | The International GPS/GNSS Service name of the antenna.                                    |
| <b>Serial number</b> | Editable field | The serial number of the antenna.  |
| <b>Setup number</b>  | Editable field | The setup number of the antenna. Identifies the version number of the current calibration. |

#### Next step

**Store** stores the new antenna.

## 24.3

### GNSS raw data logging

#### Description

Logged raw observations are used for

- static and kinematic operations. With these operations, raw data is always post-processed in the office. Raw data must therefore be logged on both base and rover instruments.
- real-time operations

to check the work in the office by post-processing.

OR

to fill in gaps when a real-time position could not be calculated in the field, for example, due to problems with the real-time data reception from the reference station or the RTK network provider

Observations must be logged on all instruments which are used for post-processing.

The settings on this panel define the logging of raw observations.

## Access

- The licence for raw data logging is required to log GNSS raw data on the GS, CS or TS instrument.
- The licence for RINEX logging is required to log RINEX data on the GS or CS. RINEX data cannot be logged on the TS instrument.


The licence key can only be loaded from an SD card using the Webserver or myWorld@Leica Geosystems.

Select **Leica Captivate - Home: Settings\GS sensor\GNSS raw data logging**.

## GNSS Raw Data Logging

| Key | Description        |
|-----|--------------------|
| OK  | To accept changes. |

### Description of fields

| Field                             | Option   | Description   |
|-----------------------------------|--|---|
| <b>Log GNSS raw data</b>          | Check box  | Activates raw data logging.<br> Not possible on GS18 when <b>Use tilt compensation: On</b> is set in <b>Tilt Compensation</b> .  |
| <b>Store data on</b>              | <b>CS controller,</b><br>or<br><b>GS sensor</b><br><br><b>GS sensor (SD card),</b><br>or<br><b>GS sensor (Internal mem.)</b><br><br><b>TS instrument</b><br>or<br><b>GS sensor</b> | For GS:<br>Data can either be logged to the field controller or to the internal memory of the GS. For GS07, data can only be logged to the field controller.<br><br>For GS18:<br>Data can either be logged to the SD card in the GS or to the internal memory of the GS.<br><br>For SmartStation, data can either be logged to the TS or to the GS. |
| <b>Log data when dynamics are</b> | <b>Static</b>  | Raw observation logging during static intervals when occupying a point. The instrument has to be stationary. Available for SmartStation.  |

| Field                      | Option                                   | Description   |
|----------------------------|--|---|
|                            | <b>Static &amp; kinematic</b>            | Raw observation logging during static and moving intervals. For post-processed kinematic rover operations. Unavailable for SmartStation.  |
|                            | <b>Kinematic</b>                         | Raw observation logging during moving intervals. For post-processed kinematic antenna operations. Unavailable for SmartStation.   |
| <b>Rate</b>                | From <b>0.05 sec</b> to <b>300.0 sec</b> | <p>Rate at which raw observations are logged. For <b>Rate: 0.05 sec</b>, the use of <b>Use PPP service</b> is disabled (<b>Satellite Tracking, Augmentation</b> page).</p> <p>For GS07 logging rates of 0.2 s and slower are supported.</p> <p>Recommendations:</p> <ul style="list-style-type: none"> <li>• The maximum logging rate using Bluetooth on the field controller is 0.2 s.</li> <li>• For static operations with long baselines and over long time <b>Rate: 15.0 sec</b> or <b>Rate: 30.0 sec</b>.</li> <li>• For base stations for post-processed and real-time kinematic rovers, <b>Rate</b> at the base should be the same rate as at the rover.</li> <li>• For initialisation while static and occupying distinct points in kinematic chains <b>Rate</b> between <b>0.1 sec</b> and <b>2.0 sec</b>.</li> </ul> |
| <b>Logging starts when</b> | Selectable list                          | <p>Available for <b>Store data on: GS sensor</b>. Data logging can start as soon as the instrument is turned on or only while in the Measure app.</p> <p>For GS07, data can only be logged with the Measure app.</p>  |
| <b>Log data to</b>         | Selectable list                          | <p>Unavailable for SmartStation.</p> <p>Available for <b>Store data on: GS sensor</b> and <b>Log data when dynamics are: Static</b>. Data can be logged in the Leica proprietary MDB format or in RINEX.</p> <p>For GS07, this field is available for <b>Log data when dynamics are: Static</b>.</p>  |

## 24.4

### Tilt compensation

#### Access

For GS18 when operating as RTK rover:


Select **Leica Captivate - Home: Settings\GS sensor\Tilt compensation**.

#### Tilt Compensation

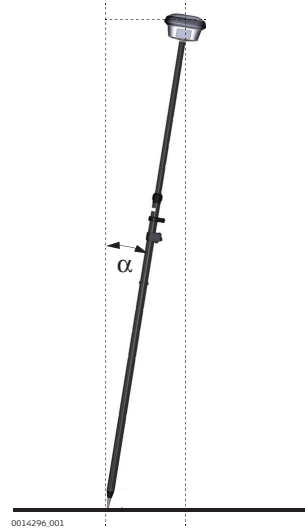
| Key | Description        |
|-----|--------------------|
| OK  | To accept changes. |



## Description of fields

| Field                        | Option    | Description  |
|------------------------------|-----------|--|
| <b>Use tilt compensation</b> | Check box | <p>When this box is checked, the pole can be held in a slanting position over the point to be measured without checking the circular bubble on the pole.</p> <p>Initialise the tile to perform accurate measurements. To initialise it, walk a few metres with the GS sensor. Do not rotate the GS sensor around the pole.</p> <p>Measurements are reliable and accurate even if the pole is not levelled as the tilt values are calculated by an Inertial Measurement Unit. Tilt values contain information about the 3D position of the pole.</p> <p>The measurements are immune to magnetic disturbances as there is no magnetometer used.</p> <p>Tilt compensation also works with Navigated and Code solutions. High accuracy positions are recommended to speed up the tilt compensation initialization.</p> <p>Raw data logging is turned off when tilt compensation is on.</p> <p>When measuring a point, the pole tip must be stable on the point while the pole should be in slight movement. Tilt compensation is indicated by an icon and the Tilt LED and is maintained by natural pole movement, for example while moving to the next point to be measured.</p> <p>Advantages:</p> <ul style="list-style-type: none"><li>• No need to level the pole</li><li>• Faster surveying procedure</li></ul> <p> The GS18 can work without connection to the data logger and keeps the setting after turning off and on.</p> |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



$\alpha$  **Tilt**

When this box is not checked, the pole must be held vertically over the survey mark using the circular bubble on the pole.

## 25

## Antenna Heights

### 25.1

### Overview

#### Description

The height of the GNSS antenna above a point consists of three components:

- the vertical or slope height reading,
- the vertical offset,
- the vertical phase centre offset.

For most operations, pre-configured standard settings in the instrument can be used. They automatically take the vertical phase centre offsets into account.

#### Vertical or slope height

Only vertical antenna heights measured to the **Antenna Reference Plane** are accepted.

#### Measurements required

This table is an overview of required measurements depending on antennas, setup and accessories. All former Leica antenna types are supported.

| <b>IF the antenna is</b> | <b>AND the accessories are</b>    | <b>AND the setup is</b> | <b>THEN the measurements required are</b>  |
|--------------------------|-----------------------------------|-------------------------|--|
| Leica antenna            | standard Leica                    | tripod or tripod short  | vertical height from height hook   |
| Leica antenna            | standard Leica                    | pole                    | none.<br>Value is 2.00 m (as indicated on the pole)  |
| Leica antenna            | standard Leica                    | pillar                  | vertical height to the MRP.  |
| Leica antenna            | non-Leica                         | any                     | <ul style="list-style-type: none"><li>• vertical height to the MRP.</li><li>• possibly vertical offset.</li></ul>  |
| non-Leica antenna        | standard Leica<br>OR<br>non-Leica | any                     | <ul style="list-style-type: none"><li>• vertical height to the MRP.</li><li>• possibly vertical offset.</li><li>• phase centre offsets.</li><li>• horizontal offset if a slope height reading.</li></ul> |

## Vertical phase centre offsets

### For Leica antennas:

Are handled automatically in the standard antenna records.

### For non-Leica antennas:

Can be stored in a newly created antenna record.

OR

Antenna records including azimuth and elevation-dependent corrections must be created using Infinity or imported using the ANTEX format.

The antenna calibrations to determine the phase centre offsets of all Leica antennas were executed by Geo++® GmbH.

## 25.2

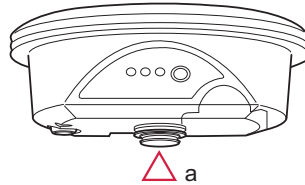
## Antenna Reference Planes, ARP

### General

The **Antenna Reference Plane**

- is where the antenna heights are measured to.
- is where the phase centre offsets refer to.
- varies for different antennas.

### GS16/GS14/GS07



- a The Antenna Reference Plane is the underside of the thread.

### GS18



- a Antenna reference plane (ARP)

### AS11



- a The Antenna Reference Plane (ARP) is the underside of the threaded metal insert.

## 25.3

## Determining Antenna Heights

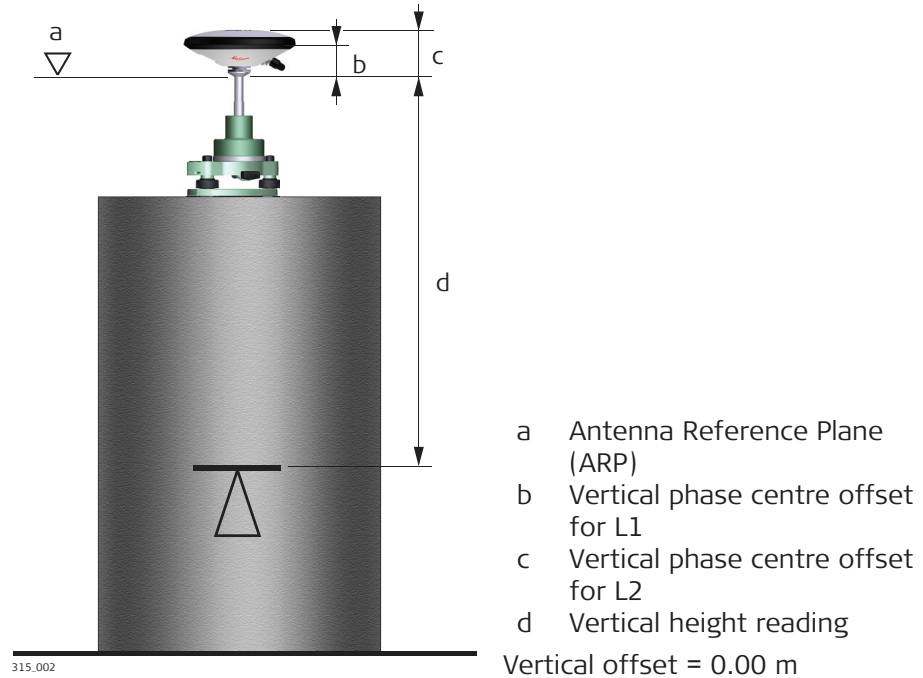
### 25.3.1

### Pillar Setup



- One of the Leica standard antennas is used. All former Leica antenna types are supported.
- Leica standard accessories are used.

#### Pillar setup



#### Vertical height reading

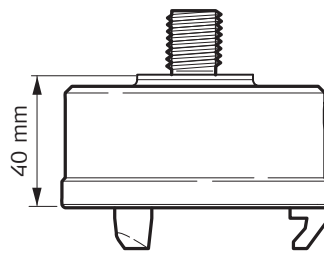
The vertical height reading is the height difference between the pillar benchmark and the Antenna Reference Plane of the antenna. Normally, it is determined indirectly by levelling.

#### Determine the antenna height step-by-step

Sometimes, it is difficult to measure to the MRP directly.

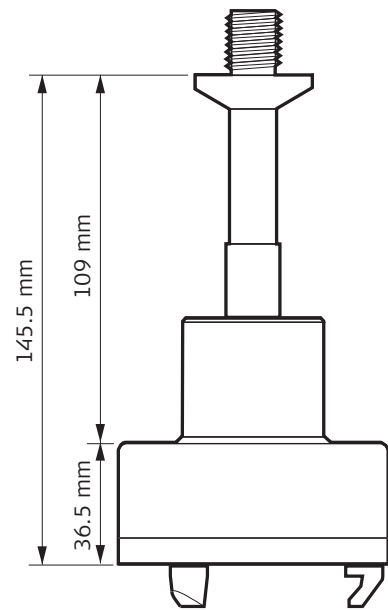
1. Determine the height difference between the pillar benchmark and a surface on the carrier.
2. Look up the height difference between this surface on the carrier and where the MRP of the antenna sits on the carrier.
3. Add the values determined in step 1. and 2., to get the **vertical height reading**.
4. For Leica standard antennas plus accessories, the **vertical offset** is 0.00 m.

## Carrier and adapter dimensions



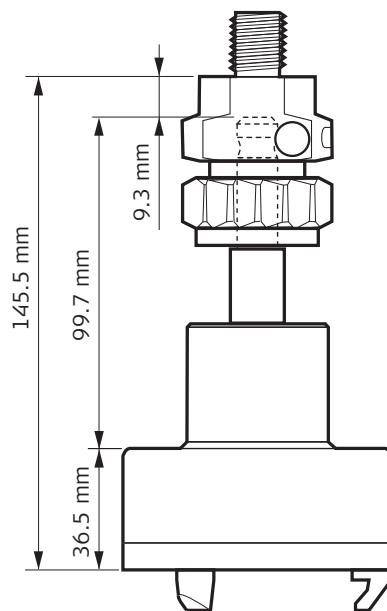
GS.038

GRT247 carrier - **Tripod Short** setup



GS.036

GRT146 carrier - **Tripod** setup



GS.037

GRT144 carrier with GAD31 screw-to-stub adapter - **Tripod** setup

### Next step

- At the beginning of a survey, enter the vertical height reading into the instrument.
- The vertical offset of 0.00 m is stored in the antenna setup record for a pillar setup and will automatically be taken into account.
- Refer to [25.1 Overview](#) for the vertical phase centre offsets.



For carriers other than those shown in the diagram above, the dimensions must be determined.



Except for Leica standard antennas plus accessories, the vertical offset must be measured. This value must be entered in the antenna setup record.

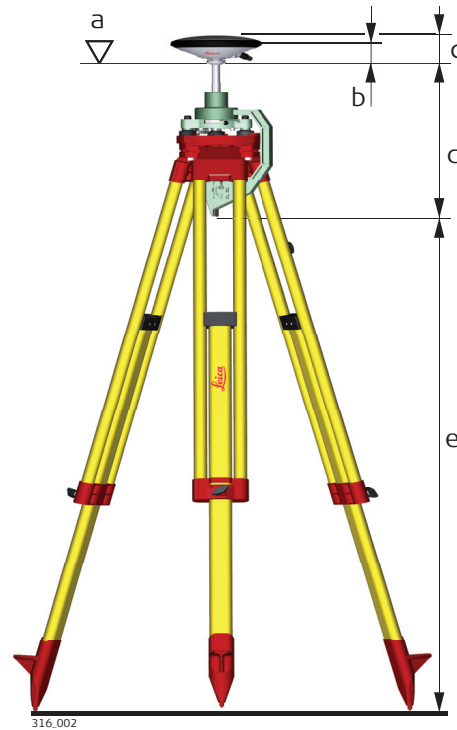
### 25.3.2

### Tripod Setup



- One of the Leica standard antennas is used. All former Leica antenna types are supported.
- Leica standard accessories are used.

#### Tripod setup



- a Antenna Reference Plane (ARP)
- b Vertical phase centre offset for L1
- c Vertical phase centre offset for L2
- d Vertical offset
- e Vertical height reading

#### Vertical height reading

The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. It is determined using the height hook.

#### Determine the antenna height step-by-step

1. Determine the **vertical height reading** using the height hook.
2. For Leica standard antennas plus accessories, the **vertical offset** is 0.36 m for a **Tripod** setup and 0.2545 m for a **Tripod Short** setup.

#### Next step

- Determine the antenna type.
- At the beginning of a survey, enter the vertical height reading into the instrument.
- The vertical offset is stored in the antenna setup record for all tripod setups and will automatically be taken into account. It does not need to be entered.
- Refer to [25.1 Overview](#) for the vertical phase centre offsets.



For other than the carriers shown in the diagram above, the dimensions must be determined, the vertical offset must be adapted and entered into a new antenna record.



For other height measurement devices than the height hook, the dimensions must be determined and the vertical offset must be adapted.



For other than Leica standard antennas, the vertical offset must be measured. It must be entered in the antenna setup record.

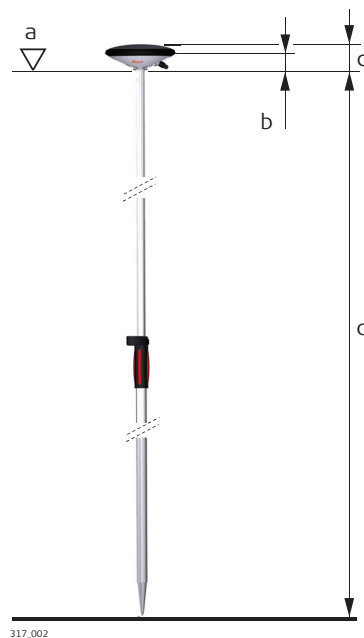
### 25.3.3

#### Pole Setup



- One of the Leica standard antennas is used. All former Leica antenna types are supported.
- Leica standard accessories are used.

#### Pole setup



- a Antenna Reference Plane (ARP)
- b Vertical phase centre offset for L1
- c Vertical phase centre offset for L2
- d Vertical height reading, 2.00 m for the fully extended Leica telescopic pole.

Vertical offset = 0.00 m

#### Vertical height reading

The vertical height reading is the height difference between the bottom end and the top end of the pole. Usually, this height difference is a fixed value.

#### Next step

- At the beginning of a survey, enter the vertical height reading into the instrument. A standard rover configuration with a standard antenna setup record for a pole setup uses the value of 2.00 m already as default.
- The vertical offset of 0.00 m is stored in the antenna setup record for a pole setup and will automatically be taken into account. It does not need to be entered.
- Refer to [25.1 Overview](#) for the vertical phase centre offsets.



For other than the Leica standard poles, the dimensions must be determined.





For other than Leica standard antennas, the vertical offset must be measured. It must be entered in the antenna setup record.

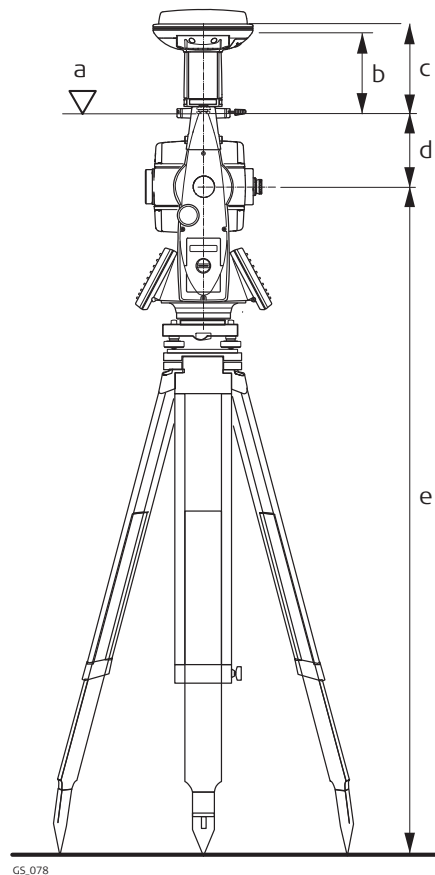
## 25.4

### SmartStation Setup



- For a SmartStation setup, select the SmartStation antenna in use. This setting depends on both the used GS and the used TS instrument. The setting ensures that the correct vertical offset is applied to the antenna heights.
- For a SmartStation setup, the antenna height value in the Measure panel must equal the value for **Instrument height**. **Instrument height** is seen in the preceding **Choose Setup Point**.
- Leica standard accessories are used.

#### SmartStation setup



- a Antenna Reference Plane
- b Vertical phase centre offset for L1
- c Vertical phase centre offset for L2
- d Vertical offset
- e Instrument height reading

## Access

Select **Leica Captivate - Home: Settings\Point storage\Duplicate points.**

## Duplicate Points

In order to check measurements, the same point can be measured more than once. If activated, an average or an absolute difference is calculated.

The averaging is always done by using TS and GS.

## Description of fields

| Field  | Option                    | Description  |
|--|---------------------------|--|
| <b>When a point is stored with same point ID as existing point</b> |                           | Defines the averaging principles for multiple measured points. The selection determines the availability of the subsequent fields for setting the acceptable averaging limits or absolute differences. |
|  | <b>Check the average</b>  | Computes the average for the position and the height. Points exceeding the defined limits are marked with ! on the <b>Mean</b> page.   |
|  | Show warning message      | In order to avoid possible non-desired averaged points due to wrong user IDs, a warning message is displayed in case a point should be stored with an ID already existing in the database.             |
|  | <b>Check the abs diff</b> | Computes the absolute differences between two points selected from a list of measured points which are all stored with the same point ID.  |
|  | <b>Don't check</b>        | The points will be saved with no checks against existing points with the same point ID.  |
| <b>Method</b>  |                           | The method used for computing the average. Available for <b>When a point is stored with same point ID as existing point: Check the average.</b>  |
|  | <b>Weighted</b>           | Calculates a weighted average  |
|  | <b>No weighting</b>       | Calculates an arithmetic average.  |
| <b>Limit in position and Limit in height</b>                       | Editable field            | The acceptable difference for the position and height components. Available for <b>When a point is stored with same point ID as existing point: Check the average.</b>                                 |
| From <b>Easting</b> to <b>Cartesian Z</b>                          | Editable fields           | The acceptable absolute differences for each coordinate component. Available for <b>When a point is stored with same point ID as existing point: Check the abs diff.</b>                               |

## 26.2

## Prompt before storing

### Access

Select **Leica Captivate - Home: Settings\Point storage\Prompt before storing**.

### Prompt Before Storing, GS and TS page

Check a box if you want to be asked for input/selection when storing a point with **Store**.

### Enter the Following

This panel is displayed when prompting is configured in **Prompt Before Storing** and when storing a point with **Store** or **Measure**.



Only the fields relating to the ticked check boxes in **Prompt Before Storing** are shown.

## 26.3

## GS quality control

### Description

The settings on this panel define the limits for coordinate quality accepted for point occupations.

### Access

Select **Leica Captivate - Home: Settings\Point storage\GS quality control**.

### GS Quality Control, General page

GS Quality Control

General Advanced

Automatically stop point measurement

Automatically store point

Check quality before storing

These settings control the storage of points measured with a GS sensor

OK Page

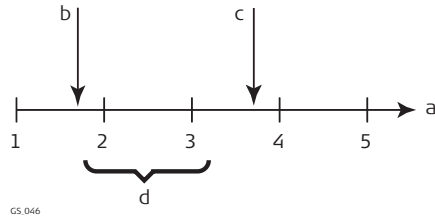
| Key       | Description   |
|-----------|---|
| OK        | To accept changes.  |
| Parameter | To configure the time interval after which a point occupation can be stopped automatically. |
| Page      | To change to another page on this panel.  |

### Description of fields

| Field                                       | Option    | Description   |
|---|-----------|---|
| <b>Automatically stop point measurement</b> | Check box | Activates a selectable list for the stop criteria. Stops the measurements automatically when the parameter defined for <b>Stop measurement based on</b> reaches 100 %.  |
| <b>Stop measurement based on</b>            |           | Defines the method used for <b>Automatically stop point measurement</b> . The setting determines the computation and value to be shown in the Measure panel. Parameters for the selected method are defined with <b>Parameter</b> . |

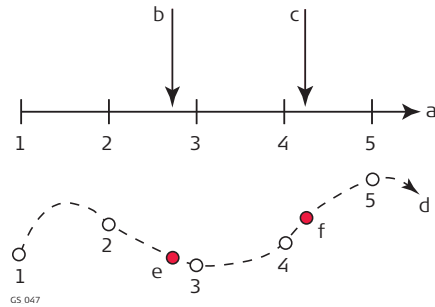
| Field                               | Option  | Description   |
|-------------------------------------|---|---|
|                                     | <b>Accuracy or Positions</b>  | Available when working with real-time device. Records observations between pressing <b>Measure</b> and <b>Stop</b> . Recommended for normal real-time applications. Refer to the diagram below.   |
|                                     | <b>Instantaneous</b>  | Records the time tag when <b>Measure</b> is pressed. A coordinate is interpolated between the positions at the neighbouring two epochs to filter out effects of slight movement. Recommended when measuring positions of objects while the antenna is moving very fast.<br><br>Example: Measuring the position of lamp-posts by driving in a car along the road and pressing <b>Measure</b> when the car is next to the lamppost. Refer to the diagram below. |
|                                     | <b>Stop &amp; go indicator</b>  | Available when raw data logging is configured.<br>The occupation time is based on a user-defined baseline length, the number of satellites and the GDOP.  |
|                                     | <b>Time, Observations or Number of satellites</b>                       | Available when working without real-time device and when raw data are recorded for post-processing.   |
| <b>Automatically store point</b>    | Check box   | Stores points automatically after stopping the point occupation. If <b>Automatically stop point measurement</b> and <b>Automatically store point</b> are checked, then points are recorded by pressing one key.   |
| <b>Check quality before storing</b> | Check box   | If activated, the limit defined in <b>Tolerance</b> is checked before storing a point. A warning signal is given when the limit is exceeded.  |
| <b>Check</b>                        | <b>Position only, Height only</b><br>or<br><b>Position &amp; height</b> | The type of coordinate quality to be checked before storing a point.  |
| <b>Tolerance</b>                    | Editable field  | The maximum acceptable coordinate quality.  |

### Stop measurement based on: Accuracy or Positions



- a Time in epochs
- b **Measure** pressed
- c **Stop** pressed
- d Post-processed coordinates computed by averaging resulting positions of epochs 2 and 3

### Stop measurement based on: Instantaneous



- a Time in epochs
- b **Measure** pressed and point coordinates interpolated based on epochs 2 and 3
- c **Measure** pressed and point coordinates interpolated based on epochs 4 and 5
- d Plan view
- e **Measure** pressed and point coordinates interpolated based on epochs 2 and 3
- f **Measure** pressed and point coordinates interpolated based on epochs 4 and 5

### Next step

| IF parameters for stop criteria | THEN  |
|---------------------------------|---|
| are not to be configured        | <b>Page</b> changes to the <b>Advanced</b> page.  |
| are to be configured            | <b>Parameter</b> changes to <b>Parameters for Auto Stop</b> or <b>Real-Time Stop Criteria</b> . |

GS Quality Control,  
Advanced page

### Description of fields

| Field  | Option | Description  |
|--|--------|--|
| Automatic-ly start measuring point on entering the Measure app | No     | Starts point occupation when pressing <b>Measure</b> .   |
|  | Yes    | Starts point occupation automatically when entering the Measure panel. All subsequent points must be occupied by pressing <b>Measure</b> . |
|  | Timed  | Starts point occupation automatically at a certain time.   |

## Next step

OK closes the panel.

## Parameters for Auto Stop

The parameters shown on this panel depend on the setting for **Stop measurement based on**.

Parameters for Auto Stop  2D 3.263 m  
1D 3.520 m @ 12:29

Enter the values to be reached to automatically stop the point measurement

Number of obs

At logging rate **1.00 s**

OK

| Key | Description        |
|-----|--------------------|
| OK  | To accept changes. |

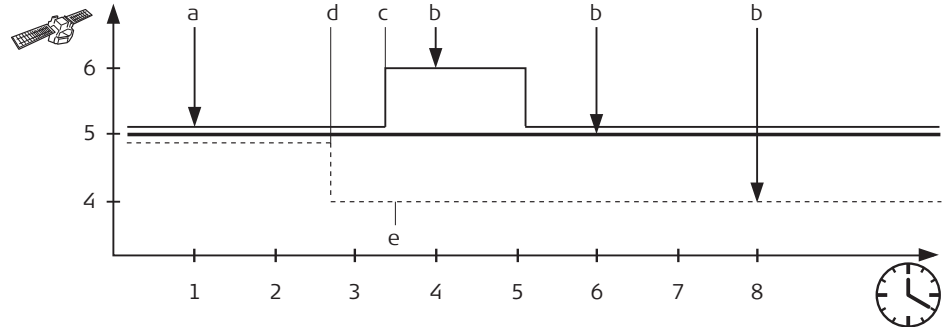
### Description of fields

| Field   | Option                        | Description   |
|---|-------------------------------|---|
| <b>Time at point</b>  | Editable fields               | Sets the required observation time for each point. Counting time starts when <b>Measure</b> is pressed. The instrument stops measuring when the set length of time is reached.  |
| <b>Number of obs</b>  | Editable fields               | Sets the required number of observations that are to be recorded at each point. Counting observations starts when <b>Measure</b> is pressed. The instrument stops measuring when the set number of observations is reached.   |
| <b>At logging rate</b>  | Display only                  | Displays the rate at which static raw observations are logged as configured.  |
| <b>8+ satellites for, 7 satellites for, 6 satellites for, 5 satellites for and 4 satellites for</b> | Editable field                | Sets the required observation time depending on the number of satellites available. Counting time starts when <b>Measure</b> is pressed. The instrument stops measuring when the set length of time for a certain number of satellites is reached. Should the number of available satellites change during observation, the observations already recorded are taken into account. |
| <b>Baseline length</b>  | Selectable list               | Used for the calculation of the occupation time for <b>Stop measurement based on: Stop &amp; go indicator</b> .   |
| <b>Extend occupation time by factor of</b>  | From <b>1.0</b> to <b>5.0</b> | The factor extends the point occupation time recommended by the software. It directly influences the occupation time shown in <b>Time at point</b> in <b>Measure</b> .  |

### Next step

1. **OK** closes the panel.
2. **OK** returns to the panel from where **Parameters for Auto Stop** was accessed.

Observation time depending on the number of satellites available



GS 048

- a **Measure** is pressed. Counting time starts.
- b Observation is stopped.
- c 40 % for six satellites.
- d 30 % for five satellites.
- e 30 % for four satellites.

Thin line represents **6 satellites for: 3 min.**

Bold line represents **5 satellites for: 5 min.**

Dashed line represents **4 satellites for: 7 min.**

### Real-Time Stop Criteria

The parameters shown on this panel depend on the setting for **Stop measurement based on**.

Real-Time Stop Criteria 2D 3.278 m 1D 3.537 m 12:28

Enter the values to be reached to automatically stop the point measurement

Position quality better than

Height quality better than

For a min number of positions

Positions

Position update

OK

| Key | Description        |
|-----|--------------------|
| OK  | To accept changes. |

### Description of fields

| Field   | Option         | Description  |
|---|----------------|--|
| <b>Position quality better than</b> and <b>Height quality better than</b> | Editable field | Sets the maximum position and height qualities for each point occupation. Calculating the qualities starts when <b>Measure</b> is pressed. The instrument stops measuring when the position and height qualities are both less than the configured values. |

| Field                      | Option          | Description  |
|----------------------------|-----------------|--|
| <b>Positions</b>           | Editable field  | Raw data is logged for a minimum number of positions even when the <b>Position quality better than</b> and <b>Height quality better than</b> is already less than the specified maximum. |
| <b>Position update</b>     | Display only    | Displays the value for <b>GS position update rate</b> as configured in <b>Screen, Audio &amp; Text Input, Screen</b> page.   |
| <b>Number of positions</b> | Editable field  | Sets the number the positions which must be observed before the instrument stops measuring. Counting the number of positions starts when <b>Measure</b> is pressed.                      |
| <b>Baseline length</b>     | Selectable list | Used for the calculation of the occupation time for <b>Stop measurement based on: Stop &amp; go indicator</b> .  |

#### Next step

OK closes the panel.

## 26.4

### Imaging quality control

#### Description

The settings on this panel define the limits for image quality accepted for capturing images with an antenna.

#### Access

Select **Leica Captivate - Home: Settings\Point storage\Imaging quality control**.

#### GS Quality Control, Imaging Quality Control page

| Key | Description        |
|-----|--------------------|
| OK  | To accept changes. |

#### Description of fields

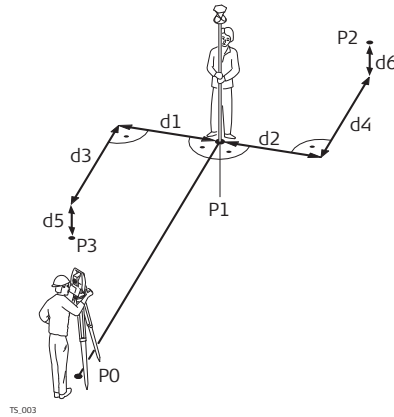
| Field                               | Option  | Description   |
|-------------------------------------|---|---|
| <b>Automatic-ly store point</b>     | Check box   | Stores images automatically after stopping the capturing.   |
| <b>Check quality before storing</b> | Check box   | If activated, the limit defined in <b>Tolerance</b> is checked before storing an image. A warning signal is given when the limit is exceeded. |
| <b>Check</b>                        | <b>Position only,</b><br><b>Height only</b><br>or<br><b>Position &amp; height</b> | The type of image quality to be checked before storing an image.  |
| <b>Tolerance</b>                    | Editable field  | The maximum acceptable image quality.   |



## Description

## Offsets

The offset values are applied to measured points. The Offset function allows offset points to be determined, for instance when the reflector cannot be set up directly on a point. Transverse, longitudinal and/or elevation offsets can be defined from the reflector position to the offset point. All the displayed and recorded measurement data is in relation to the offset point.



- P0 Setup
- P1 Current position
- P2 Offset point
- P3 Offset point
- d1 Offset cross left
- d2 Offset cross right
- d3 Offset length toward instrument
- d4 Offset length away from instrument
- d5 Offset height down
- d6 Offset height up

## Repeat measurement checks

The instrument can be configured to monitor sequentially stored measurements and to notify the user if the coordinates lie within a defined range of each other.

If configured, the X,Y coordinates of a point being stored can be compared to the coordinates of the last previously stored point. If the difference is less than the defined position tolerance then a warning is shown. It can now be decided whether to store the point or not.

If configured, backsight target points and resection target points which were measured during the setup procedure are then also checked in this manner.

## Two face tolerance check

Available for all apps where a two face measurement can be done and stored as face I and face II measurement.

A warning is displayed when the tolerances between face I and face II measurements are exceeded.



If tolerances are frequently exceeded, it is recommended to run a Check & adjust.

## Access

Select **Leica Captivate - Home: Settings\Point storage\TS offsets & checks.**

## TS Offsets & Checks, Target offsets page

**TS Offsets & Checks** Hz 19°01'32" V 0°00'01" 10:37

Target offsets Repeat measurement check Two face tolerance check

Offset mode **Reset after storing** ✓

Offset left/right **0.000 m**

Offset in/out **0.000 m**

Offset height **0.000 m**

Offsets allow points to be measured which cannot be directly measured with the instrument

Fn OK Page Fn

| Key      | Description   |
|----------|---|
| OK       | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Offset=0 | To set all offsets to 0.000.                                    |
| Page     | To change to another page on this panel.                        |

### Description of fields

| Field             | Option              | Description  |
|-------------------|---------------------|--|
| Offset mode       | Reset after storing | The offset values are reset to 0.000 after a point is measured with <b>Store</b> or <b>Measure</b> . |
|                   | Permanent           | The offset values are applied to every measured point until reset or changed.                        |
| Offset left/right | Editable field      | Sets cross offset of target point, perpendicular to the line of sight.                               |
| Offset in/out     | Editable field      | Sets length offset of target point, in the direction of the line of sight.                           |
| Offset height     | Editable field      | Sets height offset of target point.  |

### Next step

**Page** changes to another page.

## TS Offsets & Checks, AP quality check page



Available if an AP20 with tilt compensation is configured or connected.

**TS Offsets & Checks** Hz 0°00'03" V 0°00'01" 14:02

Target offsets **AP quality check** Repeat measurement check Two face tol <>

Check quality before storing

Check **Position only** ✓

Position tolerance **0.025 m**

These settings control the storage of points measured with an AP sensor

OK Page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |

### Description of fields

| Field                               | Option  | Description   |
|-------------------------------------|---|---|
| <b>Check quality before storing</b> | Check box   | If activated, the limit defined in <b>Position tolerance</b> or <b>Height tolerance</b> is checked before storing tilt compensated point coordinates. A warning signal is given when the limit is exceeded. |
| <b>Check</b>                        | <b>Position only,</b><br><b>Height only</b><br>or<br><b>Position &amp; height</b> | The type of coordinate quality to be checked before storing a point.  |
| <b>Position tolerance</b>           | Editable field  | Tolerance for position.   |
| <b>Height tolerance</b>             | Editable field  | Tolerance for height.   |

### Next step

**Page** changes to another page.

### TS Offsets & Checks, Repeat measurement check page

TS Offsets & Checks

Target offsets **Repeat measurement check** Two face tolerance check

Check for duplicate measurements

Check distance

A warning will be shown if a second point is stored with coordinates within the limit to the previous point

OK Page

| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b> | To change to another page on this panel.                        |

### Description of fields


| Field                                   | Option         | Description  |
|---|----------------|--|
| <b>Check for duplicate measurements</b> | Check box      | If checked, target checking is activated.  |
| <b>Check distance</b>                   | Editable field | The position tolerance. The units are defined in <b>Settings\System\Regional</b> . |

### Next step

**Page** changes to another page.

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |

#### Description of fields

| Field                                | Option         | Description  |
|--------------------------------------|----------------|--|
| <b>Check for two face tolerances</b> | Check box      | <p>When this box is checked, the differences between face I and face II measurement data in apps where two-face measurements can be done and stored is checked. When a tolerance is exceeded, a warning message is displayed.</p> <p>The apps affected are: Measure, Setup, Stake points, Stake DTM, Stake pts &amp; DTM, Stake to line and Measure to line</p> <p>Activate one of the settings in the app itself:<br/> <b>Use two face measurements</b><br/> <b>Measure all points in two faces</b></p> <p>Execute the two-face measurement depending on the app:</p> <ul style="list-style-type: none"> <li>• <b>Fn 2 Face</b></li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• <b>Fn Tools 2 Store</b></li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• <b>Fn Tools 2 Face</b></li> </ul> <p> In some apps, the face I and face II measurement are separate measurements. Therefore, the two face tolerance check must be set in the apps directly (Measure sets, Traverse, Measure foresight).</p> |
| <b>Hz tolerance</b>                  | Editable field | Tolerance for horizontal directions.   |
| <b>V tolerance</b>                   | Editable field | Tolerance for vertical directions.   |
| <b>Slope distance tolerance</b>      | Editable field | Tolerance for distance.  |

#### Next step

**Page** changes to another page.

## 27 Settings - Customisation

### 27.1 Working style wizard

#### 27.1.1 Overview

##### Description

The software has many configurable parameters and functions which are user-definable to suit their preferred method of working. These preferred settings can be saved as a Working Style.

Using the wizard, all the settings can be defined at once. Alternatively, all panels of this wizard can also be accessed individually.

##### Default working style

A default working style exists on the instrument. It uses standard settings for most applications. The default working style can be edited or deleted. It is always possible to restore the default working style by formatting the internal memory.

##### User defined working styles

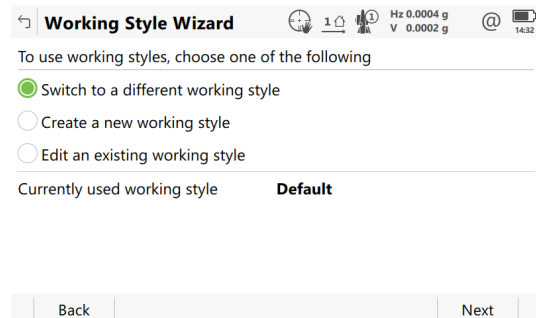
New working styles can be created. The working style wizard assists in editing working styles.

#### 27.1.2 Accessing the Working Style Wizard

##### Access

Select **Leica Captivate - Home: Settings\Customisation\Working style wizard**.

##### Working Style Wizard



| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.   |
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard. |

##### Next step

| IF you want to                     | THEN  |
|------------------------------------|---|
| select a different set of settings | select <b>Switch to a different working style</b> , press <b>Next</b> and continue with <a href="#">27.1.3 Choosing a Different Working Style</a> . |
| create a set of settings           | select <b>Create a new working style</b> , press <b>Next</b> and continue with <a href="#">27.1.4 Creating a New Working Style</a> .                |

**IF you want to**

edit an existing set of settings

**THEN**select **Edit an existing working style**, press **Next** and continue with [27.1.5 Editing a Working Style](#).**27.1.3****Choosing a Different Working Style****Working Style Wizard, Choose the working style to be used**

Select an existing working style from the selectable list.

Back Delete Next

| Key           | Description  |
|---------------|--|
| <b>Back</b>   | To return to the previous panel.   |
| <b>Delete</b> | To delete the highlighted working style.                                       |
| <b>Next</b>   | To accept changes and to continue with the subsequent panel within the wizard. |

**27.1.4****Creating a New Working Style****Working Style Wizard, Enter the working style details**

Type in the name and a description for the new working style.

Back Next

| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.   |
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard. |

## 27.1.5

## Editing a Working Style

### Working Style Wizard, Choose the working style to be edited

Select the working style to be edited from the selectable list.

Working Style Wizard

Choose the working style to be edited

Working Style: **Default**

Description: **Basic**

Creator: **Leica Geosystems**

Create a copy:

Back Delete Next

| Key           | Description   |
|---------------|---|
| <b>Back</b>   | To return to the previous panel.  |
| <b>Delete</b> | To delete the working style currently shown in the selectable list immediately. |
| <b>Next</b>   | To accept changes and to continue with the subsequent panel within the wizard.  |

### Description of fields

| Field                | Option    | Description   |
|----------------------|-----------|---|
| <b>Create a copy</b> | Check box | When this box is checked, a copy of the highlighted working style is created before the editing process starts. |

## 27.2

## User defined pages

### Description

Display settings define the parameters shown on a page on the Measure panel.

Four pages are definable.

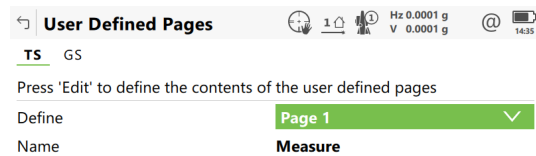
| Page          | Description                                  |
|---------------|--|
| <b>Page 1</b> | Always shown on the Measure panel.           |
| <b>Page 2</b> | Can be shown or hidden on the Measure panel. |
| <b>Page 3</b> | Can be shown or hidden on the Measure panel. |

The settings on this panel define the layout of the four pages.

### Access

Select **Leica Captivate - Home: Settings\Customisation\User defined pages**.

## User Defined Pages, TS and GS page



|    |      |      |
|----|------|------|
| OK | Edit | Page |
|----|------|------|

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Edit | To configure the selected page.                                 |
| Page | To change to another page on this panel.                        |

### Description of fields

| Field  | Option         | Description                    |
|--------|----------------|--------------------------------|
| Define | Page 1, 2 or 3 | Selected page.                 |
| Name   | Display only   | The name of the selected page. |

### Next step

Highlight the page and **Edit** to access **Page Settings**.

## Page Settings

| Key        | Description  |
|------------|--|
| OK         | To accept changes and to return to previous panel. |
| Clear      | To set all fields to <b>Unused line</b> .          |
| Fn Default | To recall the default settings.                    |

### Description of fields

| Field                 | Option             | Description   |
|-----------------------|--------------------|---|
| Name                  | Editable field     | The name of the page.   |
| 1st line              | Display only       | Fixed to <b>Point ID</b> .  |
| 2nd line to 16th line |                    | For each line, one of the following options can be selected.  |
|                       | <b>Angle right</b> | For TS:<br>Displays the horizontal angle difference between the backsight point and the current telescope position.   |
|                       | <b>% completed</b> | For GS:<br>Display only field for the percentage of the time for which the point has been occupied based on the setting for <b>Stop measurement based on</b> in the <b>GS Quality Control</b> panel. Appears in the page during the point occupation if <b>Automatically stop point measurement</b> is checked. |



| Field | Option  | Description   |
|-------|---|---|
|       | <b>Annotation 1 to Annotation 4</b>               | Editable field for comments to be stored with the point.  |
|       | <b>Antenna height</b>                             | For GS:<br>Editable field for antenna height for static and moving observations.  |
|       | <b>Attribute (free) 01 to Attribute (free) 20</b> | Display only field for attributes for free codes.   |
|       | <b>Attribute 01 to Attribute 20</b>               | Editable field for attributes for codes.  |
|       | <b>Azimuth</b>                                    | For TS:<br>Display only field for the azimuth.  |
|       | <b>Code</b>                                       | Editable field for codes.   |
|       | <b>Code (free)</b>                                | Editable field for free codes.  |
|       | <b>Code description (free)</b>                    | Display only field for the description of free codes.   |
|       | <b>Code description</b>                           | Display only field for the description of codes.  |
|       | <b>Easting</b>                                    | For TS:<br>Display only field for Easting coordinate of measured point.   |
|       | <b>GDOP</b>                                       | For GS:<br>Display only field for the current GDOP of the computed position.  |
|       | <b>HDOP</b>                                       | For GS:<br>Display only field for the current HDOP of the computed position.  |
|       | <b>Height</b>                                     | For TS:<br>Display only field for the height coordinate of the measured point.  |
|       | <b>Difference in height</b>                       | For TS:<br>Display only field for the height difference between setup and reflector.  |
|       | <b>Horizontal distance</b>                        | For TS:<br>Display only field for horizontal distance.  |
|       | <b>Humidity</b>                                   | For GS:<br>Editable field for relative humidity to be stored with point.  |
|       | <b>Hz (compensated)</b>                           | For TS:<br>Display only field for the compensated horizontal angle of tilt measured points. The value is recalculated to a virtually levelled pole. |

| Field | Option                         | Description  |
|-------|--------------------------------|--|
|       | <b>Hz angle</b>                | For TS:<br>Display only field for the horizontal angle.  |
|       | <b>Local ellipsoid height</b>  | For GS:<br>Display only field for the elevation of the current GNSS position.  |
|       | <b>Logged raw data counter</b> | For GS:<br>Display only field for the number of static observations recorded over the period of point occupation. Appears in the page when recording of static observations is configured. |
|       | <b>Northing</b>                | For TS:<br>Display only field for Northing coordinate of measured point.   |
|       | <b>Offset height</b>           | For TS:<br>Editable field for height offset for measured point.  |
|       | <b>Offset in/out</b>           | For TS:<br>Editable field for horizontal distance offset, in the direction of line of sight.   |
|       | <b>Offset left/right</b>       | For TS:<br>Editable field for horizontal distance offset for measured point, perpendicular to the line of sight.   |
|       | <b>Offset mode</b>             | For TS:<br>Select offset mode.   |
|       | <b>PDOP</b>                    | For GS:<br>Display only field for the current PDOP of the computed position.   |
|       | <b>PPM total</b>               | For TS:<br>Display only field for the total ppm value.   |
|       | <b>Point ID</b>                | Editable field for the point ID.   |
|       | <b>Pressure</b>                | For GS:<br>Editable field for atmospheric pressure.  |
|       | <b>Prism constant</b>          | For TS:<br>Display only field for additive constant of currently selected reflector.   |
|       | <b>1D quality</b>              | Display only field for the current height coordinate quality of computed position.   |
|       | <b>2D quality</b>              | Display only field for the current 2D coordinate quality of computed position.   |
|       | <b>3D quality</b>              | Display only field for the current 3D coordinate quality of computed position.   |
|       | <b>RTK positions</b>           | For GS:<br>Display only field for the number of positions recorded over the period of point occupation. Appears in the page of real-time rover settings.                                   |

| Field | Option                              | Description  |
|-------|-------------------------------------|--|
|       | <b>SD (compensated)</b>             | For TS:<br>Display only field for the compensated slope distance of tilt measured points. The value is recalculated to a virtually levelled pole.              |
|       | <b>Separator</b>                    | Insert half line space.  |
|       | <b>Slope distance</b>               | For TS:<br>Display only field for measured slope distance.   |
|       | <b>Slope distance (last stored)</b> | For TS:<br>Display only field for the last recorded distance.  |
|       | <b>Standard deviation</b>           | For TS:<br>Display only field of standard deviation in millimetres of averaged distances.  |
|       | <b>Target height</b>                | For TS:<br>Editable field for prism height.  |
|       | <b>Unused line</b>                  | Insert full line space.  |
|       | <b>Temperature (dry)</b>            | For GS:<br>Editable field for dry temperature to be stored with point.   |
|       | <b>Temperature (wet)</b>            | For GS:<br>Editable field for wet temperature to be stored with point.   |
|       | <b>Time at point</b>                | For GS:<br>Display only field for the time from when the point is occupied until point occupation is stopped. Appears in the page during the point occupation. |
|       | <b>V (compensated)</b>              | For TS:<br>Display only field for the compensated vertical angle of tilt measured points. The value is recalculated to a virtually levelled pole.              |
|       | <b>V angle</b>                      | For TS:<br>Display or select vertical angle.   |
|       | <b>VDOP</b>                         | For GS:<br>Display only field for the current VDOP of the computed position.   |
|       | <b>WGS84 ellipsoid height</b>       | For GS:<br>Display only field for the current GNSS position.   |
|       | <b>WGS84 latitude</b>               | For GS:<br>Display only field for the current GNSS position.   |
|       | <b>WGS84 longitude</b>              | For GS:<br>Display only field for the current GNSS position.   |

## 27.3

## ID templates

### 27.3.1

### Accessing ID Template Configuration

#### Description

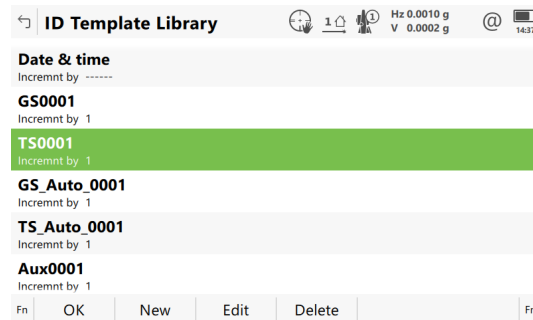
ID templates are predefined templates for object IDs. ID templates save having to type in the ID for each object. They are useful when many objects are collected quickly, for example in post-processed and real-time kinematic operations.

The ID templates that are selected to be used suggest IDs when objects are measured.

#### Access

Select **Leica Captivate - Home: Settings\Customisation\ID templates**. Tap on the required selectable list.

#### ID Template Library



| Key        | Description   |
|------------|---|
| OK         | To select the highlighted template.   |
| New        | To create an ID template.   |
| Edit       | To edit the highlighted ID template.  |
| Delete     | To delete the highlighted ID template. It does not matter if the ID template is being used in a working style. The ID template is rebuilt when that working style becomes active. |
| Fn Default | To recall deleted default ID templates.   |

#### Description of metadata

| Metadata     | Description  |
|--------------|--|
| -            | The name of the ID template and the format of the ID object. |
| Increment by | The amount by which the object ID is incremented.            |

#### Default ID templates

Some ID templates are implemented by default.

| Default ID template | Description  |
|---------------------|--|
| <Manually enter>    | The last object ID during a survey is displayed. This ID is automatically incremented if it contains numerical characters. If this ID is overwritten, the auto increment starts from the new ID. The automatic incrementation can be turned off when editing this ID template. |

| Default ID template     | Description   |
|-------------------------|---|
| <b>Date &amp; time</b>  | Last four digits of the serial number of the instrument plus current local time and date is the ID.   |
| <b>Aux0001</b>          | Suggested as ID for auxiliary points in default working styles. These points are used when trying to find a stakeout point. This ID is automatically incremented. |
| <b>GPS0001</b>          | Suggested as ID for GS measured points in default working styles. This ID is automatically incremented.   |
| <b>GPS_Auto_0001</b>    | Suggested as ID for GS auto points in default working styles. These points are automatically recorded at a specific rate. This ID is automatically incremented.   |
| <b>TPS0001</b>          | Suggested as ID for TS measured points in default working styles. This ID is automatically incremented.   |
| <b>TPS_Auto_0001</b>    | Suggested as ID for TS auto points in default working styles. These points are automatically recorded at a specific rate. This ID is automatically incremented.   |
| <b>Image_Group_0001</b> | Suggested as ID for GS18 I captured image groups. This ID is automatically incremented.   |

## 27.3.2

### Creating/Editing an ID Template

#### Access

In **ID Template Library**, highlight an ID template. A copy of this ID template is taken for further settings. **New**.

#### New ID Template/ Edit ID Template

| Key       | Description  |
|-----------|--|
| <b>OK</b> | To store the new ID template into the ID template library. |

#### Description of fields

| Field     | Option         | Description  |
|-----------|----------------|--|
| <b>ID</b> | Editable field | The name of the ID template and the format of the ID object. Any characters including spaces are allowed. Leading spaces are not accepted. |

| Field   | Option          | Description   |
|---|-----------------|---|
| <b>Increment point ID</b>                                       | Selectable list | IDs are incremented numerically or alphanumerically.  |
| <b>Increment by</b>   | Editable field  | The amount by which the point ID is incremented.  |
| <b>When point ID is edited, place cursor in position number</b> | Selectable list | The character position at which the cursor is placed when <b>ENTER</b> is pressed in <b>Point ID</b> or <b>Line ID</b> when surveying points. <b>Last Character</b> means that the cursor is placed immediately to the right of the last character. |

## Examples for incrementation

### For Increment point ID: Only numerically

The rightmost numeric part is incremented within the point ID.

| ID                | Increment by | Next point ID                                   | Notes  |
|-------------------|--------------|---|--|
| Point994          | 5            | Point999<br>Point1004<br>...                    | -  |
| 994point          | 5            | 999point<br>1004point<br>...                    | -  |
| 123point123       | -10          | 123point113                                     | Numbers on the right are incremented. Negative increments allowed.   |
| Point11           | -6           | Point5<br>Point-1<br>Point-7<br>Point-13<br>... | -  |
| Abcde-fghijklmn94 | 5            | Abcde-fghijklmno99<br>Point ID increment fail   | Incrementation fails if next increment will result in more than 16 characters.                                   |
| Abcde-fghijklmno9 | -5           | Abcde-fghijklmnop4<br>Point ID increment fail   | Negative incrementing fails if next increment requires negative sign and will result in more than 16 characters. |

### For Increment point ID: Alphanumerically

The rightmost character within the point ID is incremented regardless of whether that character is numeric or alphanumeric.

| ID       | Increment by | Next point ID   | Notes   |
|----------|--------------|---|---|
| Point994 | 5            | Point999<br>Point99E<br>Point99J<br>...                           | -   |
| 994point | 5            | 994poiny<br>Point ID incre-<br>ment fail                          | Lower case alpha characters increment until z is reached. Then a new point ID must be entered.                          |
| Abcdef   | -5           | Abcdea<br>AbcdeV<br>...<br>AbcdeB<br>Point ID incre-<br>ment fail | Lower case alpha characters decrement from lower to upper case until A is reached. Then a new point ID must be entered. |
| ABCDEB   | 5            | ABCDEG<br>ABCDEL<br>...<br>Abcdez<br>Point ID incre-<br>ment fail | Upper case alpha characters increment from upper to lower case until z is reached. Then a new point ID must be entered. |

## 27.4

### Hot keys & favourites

#### Description

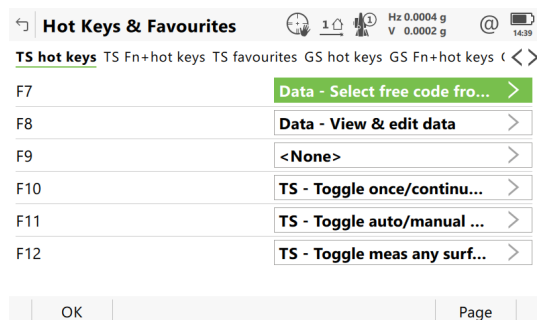
The settings on this panel assign functions or panels to each of the first and second level of hot keys, including the **F13**, the key on the side of the instrument, and the favourites key.

#### Access

Select **Leica Captivate - Home: Settings\Customisation\Hot keys & favourites**.

#### Hot Keys & Favourites, GS Hot Keys/TS Hot Keys page

To configure the first level of hot keys.



| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |

## Description of fields

| Field                            | Option          | Description   |
|----------------------------------|-----------------|---|
| <b>F7 to F12</b>                 | Selectable list | All functions or panels which can be assigned to the particular key.  |
| <b>Key on side of instrument</b> | Selectable list | Available for TS60/MS60/TM60. All functions or panels which can be assigned to the key on the side of the instrument. |

## Next step

Page changes to the **GS Fn+hot keys/TS Fn+hot keys** page.

## Hot Keys & Favourites, GS Fn+hot keys/TS Fn+hot keys page

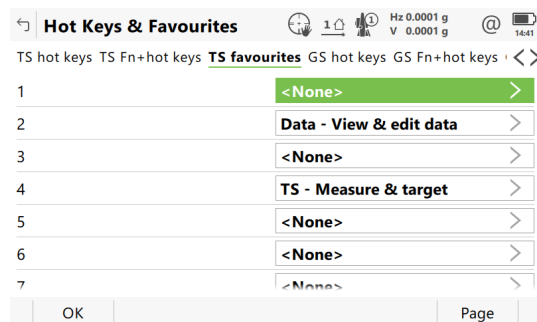
To configure the second level of hot keys.

The functionality on this page is identical to the one on the **GS Hot Keys/TS Hot Keys** page.

## Next step

Page changes to the **GS favourites/TS favourites** page.

## Hot Keys & Favourites, GS favourites/TS favourites page



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b> | To change to another page on this panel.                        |

## Description of fields

| Field         | Option          | Description   |
|---------------|-----------------|---|
| <b>1 to 9</b> | Selectable list | All functions or panels which can be assigned to the individual buttons in the user-defined bubble. |

## 27.5

## Coding

### Description

The settings on this panel define the method of coding. Refer to [28 Coding](#) for a complete description of coding.

### Access

Select **Leica Captivate - Home: Settings\Customisation\Coding**.



## Coding, Code & attributes page

**Coding**    Hz 0.0001 g    V 0.0001 g    16:42

**Code & attributes** Linework

Coding functionality: **Create linework**

Allow new codes to be created:

Show code description alongside code:

Allow lines to be coded independently of points:

Suggested attribute values: **Default**



Prompt for mandatory attributes: **Always prompt**

OK    Page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |

### Description of fields

| Field                                | Option                              | Description  |
|--------------------------------------|-------------------------------------|--|
| <b>Coding functionality</b>          | <b>Create line-work</b>             | A quick way for a code to be selected and a point to be measured. Stringing and linework can be done at the same time. In the apps, a non-customisable page is displayed. The page consists of: <ul style="list-style-type: none"> <li>An editable field for a code</li> <li>One box per code. The boxes show the code name including metadata. Symbols indicate the type of linework and if attributes are assigned to the code.</li> </ul>   |
|                                      | <b>Only code pts (no line-work)</b> | Codes are selected from a list or can be typed in manually.  |
| <b>Allow new codes to be created</b> | Check box                           | When this box is checked, the field for code selection is a selectable list and an editable field at the same time. Enter text to create a code or to search in the list for already available codes. Open the list to display the codes in the codelist including their metadata.<br><br>When this box is not checked and <b>Coding functionality: Create linework</b> , the field for codes appears on an extra page and is a simple list.<br>When this box is not checked and <b>Coding functionality: Only code pts (no line-work)</b> , the codes are listed in a simple list without metadata. |
| <b>Search for codes when typing</b>  | Check box                           | Available for <b>Coding functionality: Only code pts (no line-work)</b> and <b>Allow new codes to be created</b> being checked.  |

| Field  | Option         | Description   |
|--|----------------|---|
|  |                | <p>When this box is checked, existing codes starting with the same letters are suggested when typing into the <b>Code</b> field. By pressing <b>OK</b>, the code is selected.</p> <p>To stop the search and to accept the current text as the new code do one of the following:</p> <ul style="list-style-type: none"> <li>Click the icon on the screen: </li> <li>Press <b>ESC</b> on the hardware: </li> </ul> <p>When this box is not checked, existing codes are still suggested but not highlighted. By pressing <b>OK</b>, the typed letters will create a new code instead of using an existing.</p>   |
| <b>Show code description alongside code</b>            | Check box      | When this box is checked, then the description of a code is shown in brackets next to the code in a code box. Example: TREE (Tree description).   |
| <b>Allow lines to be coded independently of points</b> | Check box      | <p>Available for <b>Coding functionality: Create linework</b>.</p> <p>When this box is checked, codes with attributes can be assigned to lines. The code assignment is done in the edit line panel which is displayed each time a new string is created.</p> <p>Depending on the needs and later workflows, codes and attribute values must be linked to lines or points.</p> <p>Example for coding a line of trees by coding the line:<br/>Measure two trees in the line as points and code them by a point code "Tree" with attribute "Height". Create linework between both tree points. Assign the line code "Tree" with the attribute "Tree type" to the line. The information regarding the tree type is linked to the line geometry.</p> <p>Example for coding a line of trees by coding the points:<br/>Measure two trees in the line as points and code them by a point code "Tree" with attribute "Tree type". Both points define the line of trees. The information regarding the tree type is linked to the points.</p> |
| <b>Suggested attribute values</b>                      |                | Determines the attribute values displayed under certain circumstances. This setting is applicable to both the storing and displaying of attribute values.   |
|  | <b>Default</b> | When available, the default attribute values, as stored in the job, are displayed and stored.   |

| Field                                  | Option                      | Description  |
|--|-----------------------------|--|
|  | <b>Last used</b>            | When available, the last used attribute values as stored in the job are displayed and stored.  |
| <b>Prompt for mandatory attributes</b> | <b>Always prompt</b>        | A panel to enter mandatory attributes always appears when codes being stored have one or more attributes of attribute type mandatory. Attributes of attribute type mandatory or fixed can only be created in Infinity.                     |
|  | <b>Only if no value</b>     | A panel to enter mandatory attributes only appears when codes being stored have one or more attributes of attribute type mandatory, without an attribute value. Attributes of attribute type mandatory must always be created in Infinity. |
|  | <b>When code is changed</b> | A panel to type in mandatory attributes only appears when a new code with a mandatory attribute was selected.  |

### Next step

For **Coding functionality: Create linework**, **Page** changes to the **Linework** page.

For **Coding functionality: Only code pts (no linework)**, **Page** changes to the **Quickcoding** page.

## Coding, Linework page

The flags for Linework are defined on this screen. A flag

- is stored as a property of a point.
- can be exported with a format file.
- is different to a code.

The flags defined on this screen are linked to the options available for **Linework** in an app. The selection for **Linework** determines the flag stored with a point. Refer to [28.2 Coding functionality: Create linework](#) for information on Linework.

### Description of fields

| Field                 | Option         | Description   |
|-----------------------|----------------|---|
| <b>Begin line</b>     | Editable field | Opens a new line when the next point is stored. Any lines which are currently open are closed. The point can be stored with a point code. |
| <b>Begin 3 pt arc</b> | Editable field | Stores the linework flag for a curve through the next three measured points and continues a line.   |
| <b>Continue line</b>  | Editable field | Indicates a line is open.   |
| <b>Begin spline</b>   | Editable field | Stores the linework flag for beginning either a spline or a best fit arc and continues any open line.                                     |

| Field              | Option         | Description  |
|--------------------|----------------|--|
| <b>End spline</b>  | Editable field | Stores the linework flag to stop a spline or a best fit arc.     |
| <b>Cont spline</b> | Editable field | Indicates a line is open with spline line or best fit arc types. |
| <b>Close line</b>  | Editable field | Closes all open lines.   |

Coding,  
Quickcoding page

Description of fields

| Field                  | Option   | Description  |
|------------------------|--|--|
| <b>Quick-coding</b>    | <b>Never</b>   | Prevents the use of quick coding completely.   |
|                        | <b>On</b>  | Allows the use of quick coding and activates it.   |
|                        | <b>Off</b>   | Allows the use of quick coding, but keeps it deactivated.  |
| <b>Digits to use</b>   | <b>1, 2 or 3</b>   | Sets the mostly used number of digits for the quick code. Quick codes with fewer digits can still be used. While typing a quick code during a survey, using ENTER after typing one or two digits of the quick code indicates the end of the input. |
| <b>Store free code</b> | <b>After point is stored</b> or <b>Before pt is stored</b> | Determines if a free code measured with a quick code is stored before or after the point.  |

27.6

App visibility

Access

Select **Leica Captivate - Home: Settings\Customisation\App visibility**.

App Visibility

Click the icon if you want to hide or display an app in the **Leica Captivate - Home** panel.


The order of apps in this list defines the order of apps in the **Leica Captivate - Home** panel.



Use **Up** and **Down** to move an app to another position.

**Description**

A code is a description which can be stored by itself or with a point.  
The ability to plot the measured lines in real-time is an added value to coding.

**Code types**

| Code Types        | Characteristic | Description  |
|-------------------|----------------|--|
| <b>Point code</b> | Use            | To store a description together with an object inside an app or in <b>View &amp; edit data</b> from the job menu.<br><br>By a setting, stringing of points can be activated. The generated point is strung to the previous one with the same code and string number. A string number is automatically appended to the generated line.<br><br> It is possible to ignore the stringing temporarily. The assigned linework operation must be set <b>&lt;None&gt;</b> . |
|                   | Selection      | On a configured page, codes are selected from a list or entered into an editable field.  |
|                   | Recording      | Together with the objects.   |
| <b>Free code</b>  | Use            | To store a description independent of an object at any time. A free code can be used to store a description related to an object, or extra descriptions such as the job name or temperature.   |
|                   | Selection      | <ul style="list-style-type: none"> <li>For free coding using a codelist: Pressing the configured hot key opens a selectable list with the free codes of the job codelist. The job codelist must contain free codes.</li> <li>For free coding with direct input: Pressing the configured hot key opens a panel for alphanumeric input.</li> </ul>   |
|                   | Recording      | Stored as time-related information. A time stamp is stored with each free code. Free codes selected using quickcoding can be configured to be stored before or after the object.   |
| <b>Quick code</b> | Use            | Quick coding is the storing of an object plus a point or free code using a minimum number of keystrokes.   |

| Code Types | Characteristic  | Description   |
|------------|---|---|
|            | Selection   | Shortcuts must be assigned to codes in the job codelist. <b>Quickcoding: On</b> must be set in <b>Coding, Quickcoding</b> page. Typing the shortcut searches for the assigned code. Point measurement begins.   |
|            | Recording   | <ul style="list-style-type: none"> <li>For point codes:<br/>Together with the objects. With <b>Automatically stop point measurement</b> and <b>Automatically store point</b> both checked in <b>GS Quality Control</b>, the points and codes are immediately stored.</li> <li>For free codes:<br/>Stored as time-related information before or after the points. A time stamp is stored with each free code.</li> </ul> |
|            |  | Quick codes must be created in Infinity.  |
|            |  | Characters that can be assigned to quick codes are: <ul style="list-style-type: none"> <li>0 to 9</li> <li>A to Z</li> <li>a to z</li> </ul>  |

### Code types and code modes

| Feature                                 | Coding functionality |                             |
|---|----------------------|-----------------------------|
|   | Create line-work     | Only code pts (no linework) |
| Point coding                            | ✓                    | ✓                           |
| Automatic stringing                     | ✓                    | -                           |
| Free coding                             | ✓                    | ✓                           |
| Quick coding                            | -                    | ✓                           |
| Page customisable with simple fields    | -                    | ✓                           |
| Page fixed to code field and code boxes | ✓                    | -                           |

### Hierarchy of code modes

| Hierarchy | Description  |
|-----------|--|
| 1.        | Quick coding, if configured and used                                 |
| 2.        | String number from highlighted code box with a stringable point code |
| 3.        | Numeric input in code field  |

### Configure coding

Refer to [27.5 Coding](#) for information on configuring coding.

## 28.2

## Coding functionality: Create linework

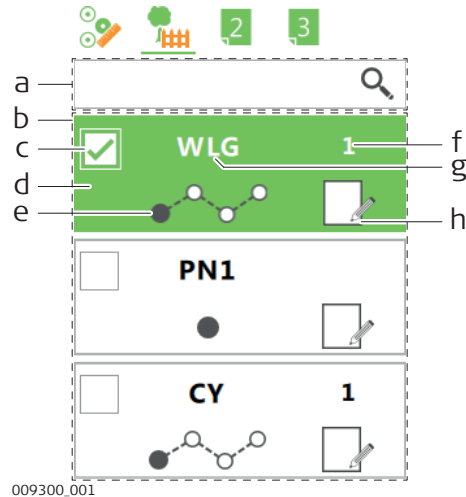
### 28.2.1

### Point Coding and Stringing

#### Requirements


- **Coding functionality: Create linework** is selected in **Coding**.
- The user-defined page for codes must be configured.

#### Fields and icons



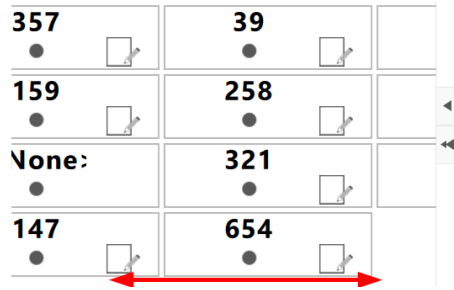
- a Code input field
- b Code box list
- c Multicode check box
- d Code box
- e Linework operation
- f String number
- g Code and, if available, code description in brackets
- h Attributes

#### Code input field

| Part  | Key combination     | Description  |
|---|---------------------|--|
|  | -                   | Code input field<br>The code input field is a dynamic listbox.<br>The working principle is:<br>Click into the listbox.<br>Type in the first characters of the code.<br>If the code exists in the codelist, the listbox populates dynamically and drops down. Codes fitting to the input are loaded from the job codelist.<br><br>If the code does not exist in the codelist, press <b>ENTER</b> key at the end of the entry. A code box with the new code is added at the beginning of the list. The new code has no linework attached by default. |
|   | <b>Fn Clear one</b> | To remove the highlighted code box from the list.  |
|   | <b>Fn Clear all</b> | To remove all code boxes from the list.  |

#### Code box

A code box combines within itself a code with metadata of string, linework operation and attributes.









The used codes are shown in the code box list. The code box for the latest code is at the beginning of the list.





Use the up and down arrow key to select a code from the code box list. When more than eight code boxes are available, use the horizontal scroll bar underneath the code boxes to get to additional code boxes.

For the Measure, Measure to line, Stake road and Check rail apps, the current list of up to 48 code boxes can be stored to a template and reloaded. Refer to [39 Apps - The Toolbox](#).

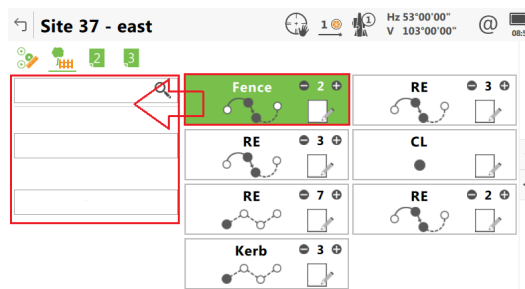
The metadata of a code box is editable. Tap on specified parts of a code box. Or use the key combinations listed in the table.







| Part in code box  | Key combination                              | Description   |
|---|--|---|
|  | <b>Multi on</b>                              | Multicoding<br>To measure one point but store it multi-times. The stored points have different point IDs and codes but the same coordinates.<br>The number of selected codes defines the number of stored points. Up to 48 codes are selectable.                            |
|  | <b>Multi on</b> + Tap into check box         | Multicoding is enabled and selected   |
|  | <b>Multi off</b>                             | Multicoding is disabled   |
|  | <b>Define Code</b>                           | Code  |
|  | <b>Define String+</b><br>or type in a number | Stringing<br>Surveyed points with the same code and stringing metadata are strung together on one line. The stringing metadata is linked to the line ID. The stringing icon is visible when linework is defined to be created.<br>To increase the number of strings by one. |
|  | <b>Define String-</b>                        | To decrease the number of strings by one.   |





| Part in code box  | Key combination          | Description   |
|---|--------------------------|---|
|   |                          | or type in a number   |
|  | <b>Define Linework</b>   | <p>Linework</p> <p>The stringing icon is visible when linework is defined to be created. The type of linework icon shows the outstanding linework operation. Refer to <a href="#">Select Linework</a> for information on the linework icons and their meaning.</p> <p>Change the selected geometry with a configured hot key or favourites menu when a code box is highlighted.</p> <p> If multicoding is used in the Measure app, changing line commands (lines, arcs, best fit arcs, splines, etc.) is unavailable.</p> |
|  | <b>Define Attributes</b> | <p>Attributes</p> <p>The use of attributes allows additional information to be stored with the code.</p> <p>Additional information has been edited and stored with the code.</p> <p> If multicoding is used in the Measure app, editing attributes is unavailable.</p>  |

### Switching the focus between code boxes and app fields



| Key combination   | Description   |
|---|---|
|    | No action   |
|    | Moves the focus from the code box to the app fields.                |
|    | Moves the focus upwards.  |
|    | Moves the focus downwards.  |
|  +  | Increases the string number if the code box has a linework defined. |

| Key combination   | Description   |
|---|---|
|  +  | Decreases the string number if the code box has a linework defined. |

## Selecting a code

### Using the code input field

1. Click into the listbox.
2. Type the first characters of the code into the code input field.
3. Select the code from the drop-down list.

### Using the code box

1. Tap on the left bottom part of the code box for a code.
2. The measured point is stored with the selected code and the metadata displayed in the code box.

### Using the code box list

1. Use the up and down arrow key to highlight a code in the code box list.  
When more than eight code boxes are available and the 3D viewer is hidden, use the horizontal scroll bar underneath the code boxes to get to additional code boxes.
2. The measured point is stored with the selected code and the metadata displayed in the code box.

### Using the code box list


1. Highlight a code in the code box list.
2. Press **Define** and then **Code**.
3. Select a code from the list.
4. Press **OK**.

## Creating a code


### Using the code input field

1. Click into the code input field.
2. Type the new code name into the code input field.
3. Press **OK** on the keyboard.
4. The new code box for the new code is added at the beginning of the code box list.



### Using the code box

1. Tap on a code in the code box list.
2. Press **New**.
3. Type in a code name and select the metadata. Refer to [8.4.2 Creating/Editing a Code](#).
-  To add attributes, press **New attrb**.
4. Press **Store**.

### Using the code box list


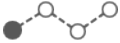

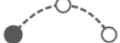
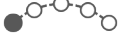

1. Highlight a code in the code box list.
  2. Press **Define** and then **Code**.
  3. Press **New**.
  4. Type in a code name and select the metadata. Refer to [8.4.2 Creating/Editing a Code](#).
- 
-  To add attributes, press **New attrib**.
- 
5. Press **OK**.

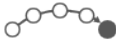
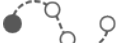



### Editing code attributes

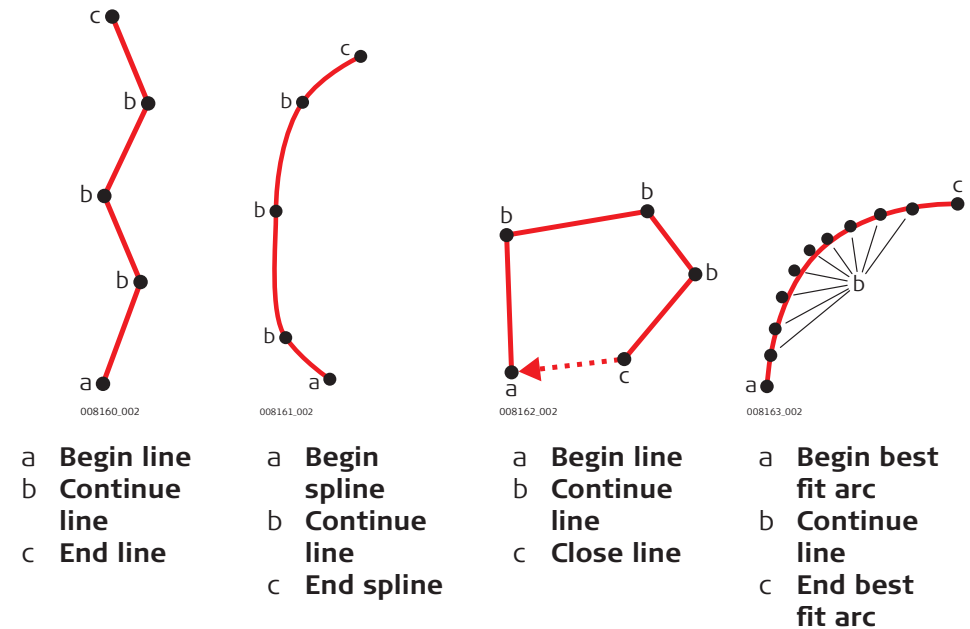
1. Tap on a code in the code box list.
  2. Press **Define** and then **Attributes**.
  3. Change the code attributes.
  4. Press **OK**.
- 
-  If the user defined page  is configured such that attribute fields are displayed, then the attributes can also be entered on that page.

### Select Linework

#### Description of icons

| Icon  | Description  |
|---|--|
|    | <None>   |
|  | <b>Begin line</b><br>Opens a new line with a new string number. Starts from the current point.   |
|  | <b>Continue line</b><br>Continues the line/arc assigned to the current line and string.  |
|  | <b>Begin 3 pt arc</b><br>Starts a new arc. The next three points form the arc. If there is a line with the current code and string already open, the arc is appended to it.<br>The arc is displayed in 3D viewer when all three points are measured.   |
|  | <b>Begin best fit arc</b><br>Starts a new curve. A smoothing mathematical function is used to best fit the subsequent points. The curve starts with the first measured position. If there is a line with the current code and string already open, the best fit curve is appended to it.<br>The best fit curve is a single radius curve. A compound curve is not supported.<br>The best fit curve is displayed in 3D viewer when a point was measured with <b>End best fit arc</b> . |
|  | <b>Continue best fit arc</b><br>Adds a new point to the sequence of points that define the shape of the best fit curve.  |

| Icon  | Description   |
|---|---|
|    | <p><b>End best fit arc</b><br/>Calculates the best fit curve of single radius. Start point is a previous point of the same line with <b>Begin best fit arc</b>. All points measured between <b>Begin best fit arc</b> and <b>End best fit arc</b> are included in the curve.<br/>The best fit curve is displayed in 3D viewer.<br/>Once the best fit curve is ended, it continues the line.</p>                   |
|    | <p><b>Begin spline</b><br/>Starts a new spline passing by the subsequent points. The spline starts with the first measured position. If there is a line with the current code and string already open, the spline is appended to it.<br/>The spline is a multiple radius curve. A compound curve is not supported.<br/>The spline is displayed in 3D viewer when a point was measured with <b>End spline</b>.</p> |
|    | <p><b>Cont spline</b><br/>Adds a new point to the sequence of points that define the shape of the spline.</p>   |
|    | <p><b>End spline</b><br/>Calculates the spline. Start point is a previous point of the same line with <b>Begin best fit arc</b>. All points measured between <b>Begin spline</b> and <b>End spline</b> are included in the curve.<br/>The spline is displayed in 3D viewer.<br/>Once the spline is ended, it continues the line.</p>  |
|  | <p><b>Close line</b><br/>Continues the line at the current measured point. Closes the line by joining it to the first point of the line. The first point of the line is added to the bottom of the list as closing point.</p>   |



## 28.3 Coding functionality: Only code pts (no linework)

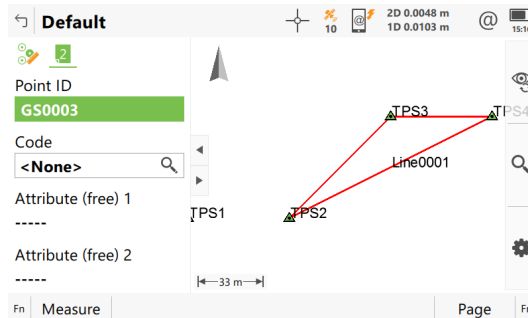
### 28.3.1 Point Coding with Dynamic List

#### Requirements

- **Coding functionality: Only code pts (no linework)** is selected in **Coding**.
- **Allow new codes to be created** is checked in **Coding**.
- The user-defined page with a field for codes must be configured.

#### Coding

1. Click in the field **Code** or **Code (auto)** in a user-defined page in an app.



2. Type in a point code or select a code from the list.
3. Type in attribute if defined.
4. Press **Measure**.

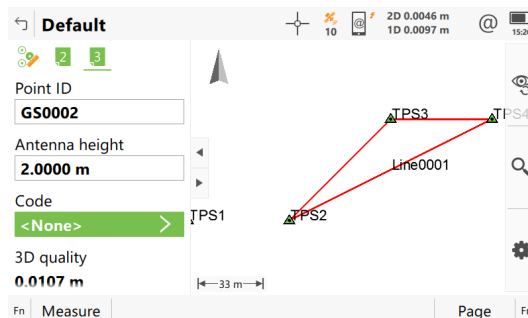
### 28.3.2 Point Coding without Dynamic List

#### Requirements

- **Coding functionality: Only code pts (no linework)** is selected in **Coding**.
- **Allow new codes to be created** is not checked in **Coding**.
- The user-defined page with a field for codes must be configured.

#### Coding

1. Click in the field **Code** or **Code (auto)** in a user-defined page in an app.

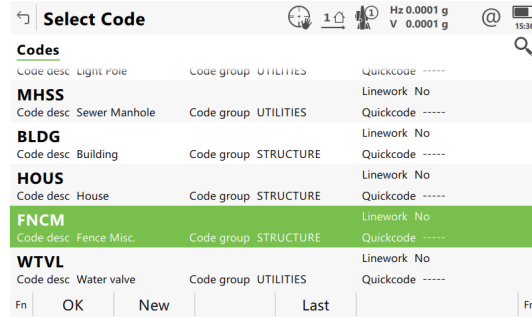


2. Select a code from the list.
3. Type in attribute if defined.
4. Press **Measure**.

#### Select Code

Codes from the job codelist, which belong to an active code group, are available for selection.

Codes are listed with the code description, the code group, the code type and the quick code if codes with quick codes exist in the job.



| Key               | Description  |
|-------------------|--|
| <b>OK</b>         | To accept changes and to return to the panel from where this panel was accessed.   |
| <b>New</b>        | To create a code.  |
| <b>Attributes</b> | Available unless creating/editing a point/line. To type in attribute values for the selected code and/or add new attributes for the selected code.                                       |
| <b>Last</b>       | Available if a code has been previously used in the job. To select from a list of last used codes. The codes are sorted by time with the most recently used code at the top of the list. |
| <b>Fn Group</b>   | To view, create, delete, activate and deactivate code groups. Refer to <a href="#">8.5 Managing Code Groups</a> .  |
| <b>Fn Sort</b>    | To sort codes by code name, code description, quick code, in the order they were added to the codelist, or the last used.  |

### Next step

Highlight the desired code.

Press **OK** to return to the Measure panel.

Or press **Attributes** to access **Enter Attributes**.

### Enter Attributes

If configured for the selected code, editable fields for attribute values are available. Any preconfigured attribute rules, for example, integer numbers only, a set range, or a selectable list, control what values can be entered.

Tap in the field of the attribute name or attribute value.

Edit the name of the attribute.

Type in a default attribute value.

|    |           |      |         |
|----|-----------|------|---------|
| OK | New attrb | Last | Default |
|----|-----------|------|---------|

| Key              | Description   |
|------------------|---|
| <b>OK</b>        | To return to the panel from where this panel was accessed.  |
| <b>New attrb</b> | To add an attribute of type normal and of value type text. Up to twenty attributes can be added. Attributes of type mandatory or fixed and of value type real or integer must be created in Infinity. |
| <b>Last</b>      | To recall the last used attribute values for the selected code.   |
| <b>Default</b>   | To recall the default attribute values for the selected code.   |

### Next step

Press **OK**. The code and any associated attribute values are stored when the point is stored. If a point with the same point ID exists in the job, the codes, attribute names and attribute values of the new and existing points must be identical. Should they not be identical, a panel opens where the code or attribute mismatch can be corrected.

## 28.3.3

### Quick Coding

#### Requirements

- The job codelist contains quick codes.
- According to the user requirements, set **Store free code: Before pt is stored** or **Store free code: After point is stored** in **Coding, Quickcoding**.

#### Activate quick coding

- For **Quickcoding: On**, quick coding is active and can be used.
- For **Quickcoding: Off**, use a hot key or the favourites menu.
- For **Quickcoding: Never**, change the setting manually.

#### Performing quick coding

A panel must be active where points can be measured.

Type in the one, two or three digits of the quick code. The current setting for **Digits to use** in **Coding, Quickcoding** page determines by how many keystrokes quick coding is executed.

Press **ENTER** to execute quick coding after less than the configured keystrokes. This action is possible after one keystroke for **Digits to use: 2** and one or two keystrokes for **Digits to use: 3**.

Press **ESC** to clear digits from the entry.

Only mandatory attribute values can be entered. For non-mandatory attributes, either the default or the last used attribute values are stored, depending on the setting for **Suggested attribute values** in **Coding, Code & attributes** page.

For point codes:

- The point code assigned to the quick code is searched for in the job codelist and point measurement begins.
- The point code and any associated attribute values are stored with the point.
- If a point with the same point ID exists in the job, the codes, attribute names and attribute values of the new and existing points must be identical. Should they not be identical, a panel opens where the code or attribute mismatch can be corrected.

For free codes:

- The free code assigned to the quick code is searched for in the job codelist and point measurement begins.
- The free code, associated attribute values and time-related information are stored. The setting for **Store free code** in **Coding, Quickcoding** page determines if the free code is stored before or after the point.

## 28.4

## Free Coding

### 28.4.1

### Free Coding Using a Codelist

#### Requirements

- The job codelist contains free codes.
- A hot key is configured to access the panel **Free Code & Attributes** or the favourites menu is configured to display the option **Data - Select free code from list**.

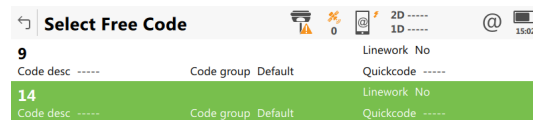
#### Access

Press a hot key configured to access the panel **Free Code & Attributes**. Refer to [2.2.1 Hot Keys](#) for information on hot keys.

#### Select Free Code

All free codes from the job codelist which belong to an active code group, are available for selection.

Codes are listed with the code description, the code group, the code type and the quick code if codes with quick codes exist in the job.



Fn Store New Attributes Fn

| Key               | Description   |
|-------------------|---|
| <b>Store</b>      | To store the free code and any associated attribute values and to return to the panel from where this panel was accessed.                             |
| <b>New</b>        | To create a code.   |
| <b>Attributes</b> | To type in attribute values and/or add new attributes for the selected free code. Refer to <a href="#">28.3.2 Point Coding without Dynamic List</a> . |



| Key             | Description   |
|-----------------|---|
| <b>Last</b>     | Available if a free code has been previously used in the job. To select from a list of last used free codes. The free codes are sorted by time with the most recently used code at the top of the list. |
| <b>Fn Group</b> | To view, create, delete, activate and deactivate code groups. Refer to <a href="#">8.5 Managing Code Groups</a> .   |
| <b>Fn Sort</b>  | To sort codes by code name, code description, quick code or the last used.  |

## 28.4.2

### Free Coding with Direct Input

#### Requirements

A hot key is configured to access the panel **Free Code & Attributes** or the favourites menu is configured to display the option **Data - Enter free code**.

#### Access

Press a hot key configured to access the panel **Free Code & Attributes**. Refer to [27.4 Hot keys & favourites](#) for information on hot keys.

#### Free Code & Attributes

Type in a code and attribute values. As soon as a free code is typed in, a codelist is created within the job. Up to eight attributes can be added. Refer to [28.4.1 Free Coding Using a Codelist](#) for a description of keys.

#### Next step

Press **Store**.

## 28.5

### Code and Attribute Mismatch

#### 28.5.1

#### Code Mismatch

#### Description

When storing a point with a code, it can happen that a point with the same point ID exists in the job. If the codes of the new and the existing point do not match, a panel opens where the code can be corrected. One point cannot have different codes.

#### Point Code Mismatch

This panel opens automatically if the codes of the new and the existing point do not match. Highlight the code to be stored with the new point.

← **Point Code Mismatch** 2D 3,210 m 1D 6,190 m 11:51

Point ID **GS0001**

New Code **FNCM**

Code description **Fence Misc.**

Stored Code **HOUS**

Code description **House**

Fn Store More Fn

| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store the highlighted code and any associated attributes with the point being stored and to continue with the app or data management. |

| Key         | Description  |
|-------------|--|
| <b>More</b> | To display information about the code description, the code group and any attributes associated with the highlighted code. |

#### Description of fields

| Field              | Option       | Description   |
|--------------------|--------------|---|
| <b>New Code</b>    | Display only | The code for the point.                               |
| <b>Stored Code</b> | Display only | The code as stored for the existing point in the job. |

## 28.5.2

### Attribute Mismatch

#### Description

If a point with the same point ID exists in the job, the codes, attribute names and attribute values of the new and existing points must be identical. Should the attributes not be identical, a panel opens where the attribute mismatch can be corrected. One point cannot have different attribute information.

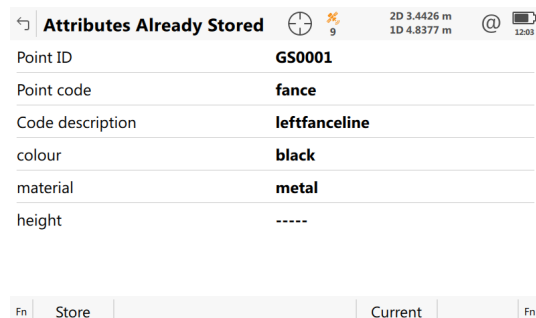


The name of the panel changes with pressing **Current** or **Stored**:

Pressing **Current**:                      **Attributes Being Stored**  
Pressing **Stored**:                         **Attributes Already Stored**

#### Attributes Already Stored

This panel opens automatically if the attribute names and/or values of the new and the existing point do not match.



| Key                             | Description  |
|---------------------------------|--|
| <b>Store</b>                    | To store the selected attributes with the new/created point and to continue with the app or data management.                                 |
| <b>Current</b> or <b>Stored</b> | To change between viewing the attribute names and values of the new/created point and those values stored for the existing point in the job. |

#### Description of fields

| Field             | Option       | Description  |
|-------------------|--------------|--|
| <b>Point code</b> | Display only | <ul style="list-style-type: none"> <li>For <b>Attributes Already Stored</b>: The code of the existing point in the job.</li> <li>For <b>Attributes Being Stored</b>: The code of the new point.</li> </ul> |

| Field      | Option       | Description  |
|------------|--------------|--|
| Attributes | Display only | <ul style="list-style-type: none"><li>• For <b>Attributes Already Stored</b>: The attributes as stored for the existing point in the job.</li><li>• For <b>Attributes Being Stored</b>: The attributes of the new point.</li></ul> |

**Description**

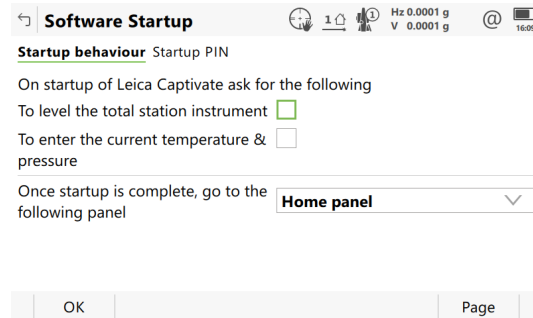
The settings on this panel define the behaviour of the instrument for a general startup.

**Access**

Select **Leica Captivate - Home: Settings\System\Software startup**.

**Software Startup, Startup behaviour page**

If a check box is checked, the corresponding panel is shown during startup. If all check boxes are unchecked, then, after turning on the instrument, the **Leica Captivate - Home** is accessed immediately.



| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |

**Next step**

**Page** changes to the **Startup PIN** page.

**Software Startup, Startup PIN page**

If **Activate PIN lock: Yes**, then, after turning on the instrument, a PIN code must be entered.

**Description of fields**

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Activate PIN lock</b>    | Check box      | When this box is checked, then PIN protection is activated and a PIN code must be entered at startup.<br>When this box is not checked, PIN protection is not activated and no PIN code is required at startup. |
| <b>Enter PIN to be used</b> | Editable field | Available if <b>Activate PIN lock</b> is checked. The new PIN code that is required at startup. PIN codes must be numerical only and 4 digits in length.   |

**Description**

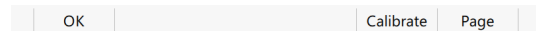
The settings on this panel allow the screen appearance to be configured, turn the notification beeps on and off and define the behaviour of the keys.

The settings are stored on the field controller itself. If the field controller is exchanged, the settings stored on the new field controller apply.

**Access**

Select **Leica Captivate - Home: Settings\System\Screen, audio & text input.**

**Screen, Audio & Text Input, Screen page**



| Key       | Description   |
|-----------|---|
| OK        | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Calibrate | To calibrate the touch screen.                                  |
| Page      | To change to another page on this panel.                        |

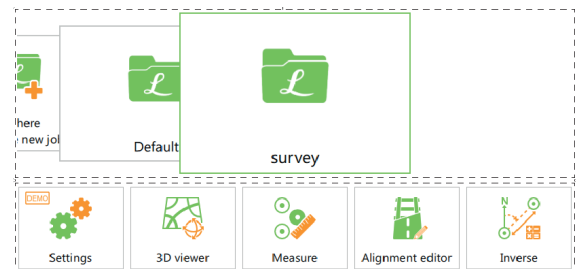
**Description of fields**

| Field                                   | Option    | Description  |
|---|-----------|--|
| <b>Use the touch screen</b>             | Check box | If checked, the touch screen is turned on.                           |
| <b>Use animations &amp; transitions</b> | Check box | When this box is checked, all animations and transitions are active. |

When this box not is checked, the majority of animations and transitions are inactive, especially panel to panel animations.

Some animations remain always active:

- All animations of the job carousel in **Leica Captivate - Home**

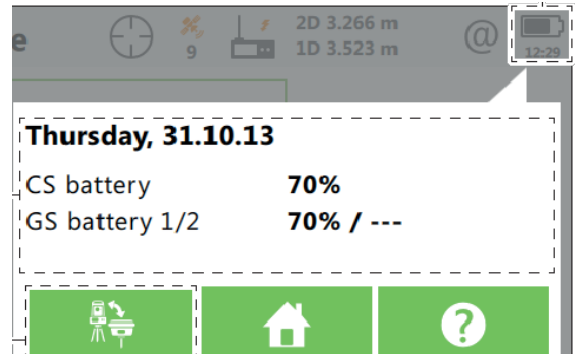


| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

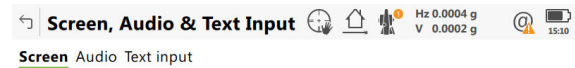
- The job spin when a job is tapped



- The icon pop-up bubbles when an icon is tapped



- The sliding of the underline when pages are selected



Animations are a method of drawing attention to the user that a change has happened inside Leica Captivate. This change could be caused by the user himself or could be automatically generated by Leica Captivate to notify the user that something has changed.

Transitions are a method designed to notify the user that the panel being displayed in the Leica Captivate software is changing. These visual aids are useful as Leica Captivate has many similar looking panels. Transitions allow the user to navigate through the software more easily.



The setting is stored as part of the system and always remembered even after restarting the instrument.

|                                |                            |   |
|--------------------------------|----------------------------|---|
| <b>GS position update rate</b> | <b>0.2s, 0.5s, or 1.0s</b> | The panel update rate for the GNSS positions. |
|--------------------------------|----------------------------|---|

**Next step**

**Page** changes to the **Audio** page.

## Screen, Audio & Text Input, Audio page

### Description of fields

| Field  | Option                    | Description  |
|--|---------------------------|--|
| <b>For messages, play</b>                                    | <b>Sounds only</b>        | A sound alert is given when an information message appears.  |
|  | <b>Sounds &amp; voice</b> | A sound and voice alert is given when an information message appears.  |
| <b>Beep when total station turns past 0, 90, 180 or 270°</b> | Check box                 | If checked, the horizontal sector beep is turned on. The instrument beeps when within 5 gon/4°30' of the defined sector, has a long and consistent beep within 0.5 gon/27' and no beep within 0.005 gon/16". |
| <b>Hz sector angle</b>                                       | Editable field            | Editable field for the sector angle for which a beep sounds.   |

### Next step

Page changes to the **Text input** page.

## Screen, Audio & Text Input, Text input page

### Description of fields

| Field                     | Option  | Description   |
|---------------------------|---|---|
| <b>Data input method</b>  | <b>None, Function keys, Mobile phone style or Pop-up keyboard</b> | Alphanumeric input can either be through function, numeric keys or through a pop-up keyboard to be used with the stylus.  |
| <b>Default characters</b> | Selectable list   | Sets the set of extra characters available through <b>Data input method: Function keys</b> or <b>F1-F6</b> whenever an entry is made. The choices available depend on the character sets loaded on the instrument and the language configured to be used. |

## 29.3

### Regional

#### Description

The settings on this panel define

- the units for all types of measurement data displayed.
- information related to some types of measurement data.
- the order in which coordinates are displayed.
- the instrument identification number.
- the languages available on the instrument.

#### Access

Select **Leica Captivate - Home: Settings\System\Regional**.

## Regional, Distance page

Regional Hz 0.0001 g V 0.0001 g 16:11

Distance Slope Angle Time Coordinates Language Others Device ID

Distance **Metre (m)** ▾

Distance decimal **4** ▾

Chainage format **+123456.789** ▾

Area **m<sup>2</sup>** ▾

Volume **m<sup>3</sup>** ▾

OK Page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| Page | To change to another page on this panel.                        |

### Description of fields

| Field                   | Option                                       | Description  |
|-------------------------|--|--|
| <b>Distance</b>         |  | The units shown for all distance and coordinate related fields.  |
|                         | <b>Metre (m)</b>                             | Metres [m]   |
|                         | <b>International ft (fi)</b>                 | International feet [fi], storage in US feet  |
|                         | <b>Intl ft/inch (fi)</b>                     | International feet [fi], inches and 1/8 inches (0' 00 0/8 fi), storage in US feet  |
|                         | <b>US ft (ft)</b>                            | US feet [ft]   |
|                         | <b>US ft/inch (ft)</b>                       | US feet, inches and 1/8 inches (0' 00 0/8 fi) [ft]   |
|                         | <b>Kilometre (km)</b><br><b>US mile (mi)</b> | Kilometres [km]<br>US miles [mi]   |
| <b>Distance decimal</b> | From <b>0</b> to <b>4</b>                    | Available for all distance formats using decimals.<br>The number of decimal places shown for all distance and coordinate related fields. This setting is for data display and does not apply to data export or storage. The available options depend on the selected <b>Distance</b> . |
| <b>Fraction</b>         | <b>2, 4, 8, 16, 32</b><br>and <b>64</b>      | Available for <b>Distance: Intl ft/inch (fi)</b> and <b>Distance: US ft/inch (ft)</b> .<br>The fraction displayed and used for calculation, import and export.   |
| <b>Chainage format</b>  |  | Selects display format for all chainage information fields.  |
|                         | <b>+123456.789</b>                           | Default chainage display form.   |
|                         | <b>+123+456.789</b>                          | Separator between hundreds and thousands.  |
|                         | <b>+1234+56.789</b>                          | Separators between tens and hundreds.  |
|                         | <b>+123.4+56.789</b>                         | Separator between tens and hundreds with extra decimal point.  |

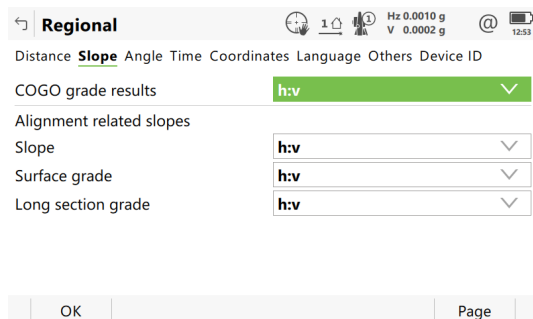


| Field         | Option   | Description  |
|---------------|--|--|
|               | <b>PegN°+10.000</b>  | In this format, a peg distance is used to calculate a peg number and to determine which value is shown next to it.<br><br>For example, at chainage of 100 m and a peg distance of 20 m, the peg number equals 5 (100/20 = 5).<br><br>Chainage 100 m = 5 + 0.000<br>Chainage 110 m = 5 + 10.000<br>Chainage -100 m = -5 - 0.000<br>Chainage -90 m = -4 - 10.000 |
| <b>Area</b>   | <b>m<sup>2</sup>, Intl acres (Ai), US acres (A), Hectares (ha), fi<sup>2</sup> or ft<sup>2</sup></b> | The units shown for all area-related fields.   |
| <b>Volume</b> | <b>m<sup>3</sup>, fi<sup>3</sup>, ft<sup>3</sup> or yd<sup>3</sup></b>                               | The units shown for all volume-related fields.   |

### Next step

**Page** changes to the **Slope** page.

### Regional, Slope page



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b> | To change to another page on this panel.                        |

### Description of fields

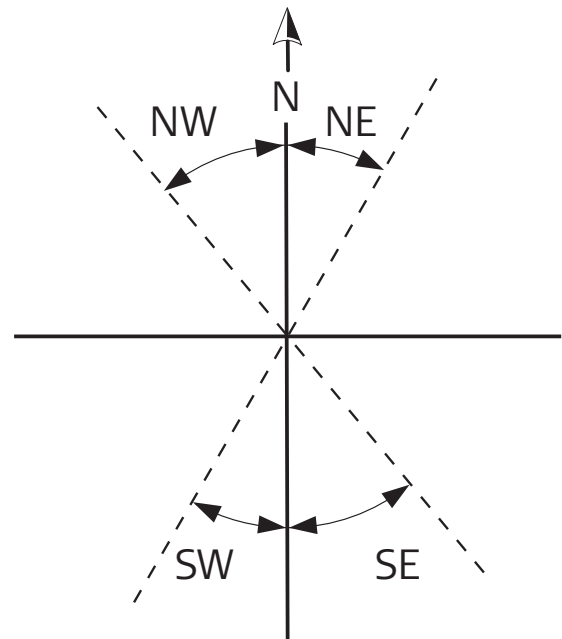
| Field      | Option                 | Description                                    |
|------------|------------------------|--|
| All fields | <b>h:v</b>             | Horizontal by vertical distance.               |
|            | <b>v:h</b>             | Vertical by horizontal distance.               |
|            | <b>%(v/h x 100)</b>    | Percentage of vertical by horizontal distance. |
|            | <b>Elevation angle</b> | Elevation angle.                               |

### Next step

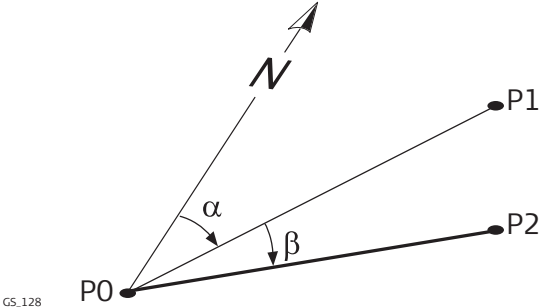
**Page** changes to the **Angle** page.


Description of fields

| Field            | Option   | Description  |
|------------------|--|--|
| Angle            | 400 gon,<br>360 <sup>0000</sup> ,<br>360° dec or<br>6400 mil | The units shown for all angular and coordinate related fields.   |
|                  | 6000 mil   | Divides a circle into 6000 milliradians.   |
|                  | Angle decimal  | The number of decimal places shown for all angular and coordinate related fields. This setting is for data display and does not apply to data export or storage. |
|                  | From 1 to 4<br>From 2 to 4                                   | Available for <b>Angle: 6400 mil.</b><br>Available for <b>Angle: 400 gon</b> and <b>Angle: 360° dec.</b>   |
|                  | 5  | Available for TS60/MS60/TM60 and <b>Angle: 400 gon</b> or <b>Angle: 360° dec.</b><br>Unavailable for remote applications.  |
|                  | 0.1", 1", 5",<br>10" or 60"                                  | Available for <b>Angle: 360<sup>0000</sup>.</b>  |
| Hz angle display | North azimuth,<br>South azimuth,<br>North anti-clockwise     | Sets the reference direction as well as the direction from where and how azimuths are computed.<br>The azimuth fields in other panels are called <b>Azimuth.</b> |
|                  | Bearing  | The azimuth fields in panels are called <b>Bearing.</b> NE, SW, SE and NW indicate the quadrant of the bearing.  |



GS 049

| Field  | Option                              | Description   |
|--|-------------------------------------|---|
|  | <b>Angle right</b>                  | Displays the horizontal angle difference between the backsight point and the current telescope position.<br>The azimuth fields in panels are called <b>Angle right</b> .  |
|  |                                     |  <p>GS.128</p> <p>P0 Instrument setup<br/>P1 Backsight point<br/>P2 Point in direction of current telescope position<br/><math>\alpha</math> Azimuth<br/><math>\beta</math> Angle right</p> |
| <b>V angle display</b>                           |                                     | For TS.   |
|  | <b>Zenith angle</b>                 | $V = 0$ in zenith.  |
|  | <b>Elevation angle</b>              | $V = 0$ horizontal elevation angle. Vertical angles are positive above the horizon and negative below it.   |
|  | <b>Elevation angle %</b>            | $V = 0$ horizontal. Vertical angles are expressed in % and are positive above the horizon and negative below it.  |
| <b>Use direction to</b>                          | <b>True north or Magnetic north</b> | Sets the North direction.   |
| <b>Declination</b>                               | Editable field                      | Available for <b>Use direction to: Magnetic north</b> .<br>The value for the magnetic declination. It is considered when computing or using any azimuth values.   |
| <b>Hold V angle after a distance measurement</b> | Check box                           | For TS.<br>If checked, the vertical angle is fixed after a distance measurement with <b>Distance</b> , whereas the horizontal angle is continuously updated with the telescope movement.  |

| Field | Option  | Description  |
|-------|---|--|
|       |   | If not checked, the vertical angle is continuously updated with the telescope movement.  |
|       |  | The active prism height is applied in the calculation of remote point elevations. The prism height must be set to zero to display and record the elevation of the targeted remote point. |

#### Next step

Page changes to the **Time** page.

### Regional, Time page

The time zone is read from WinEC.

#### Description of fields

| Field               | Option   | Description                                       |
|---------------------|--|---|
| <b>Time format</b>  | <b>24 hour</b> or <b>12 hour (am/pm)</b>                                 | How the time is shown in all time-related fields. |
| <b>Current time</b> | Display only   | Shows an example of the selected time format.     |
| <b>Date format</b>  | <b>Day.month.year,</b><br><b>Month/day/year</b> or <b>Year/month/day</b> | How the date is shown in all date-related fields. |
| <b>Current date</b> | Display only   | Shows an example of the selected date format.     |

#### Next step

Page changes to the **Coordinates** page.

### Regional, Coordinates page

#### Description of fields

| Field  | Option   | Description  |
|--|--|--|
| <b>Grid format</b>   | <b>Easting, northing</b> or <b>Northing, easting</b>     | The order in which grid coordinates are shown in all panels. The order in Measure panels depends on the user settings.   |
| <b>Geodetic format</b>   | <b>Latitude, longitude</b> or <b>Longitude, latitude</b> | The order in which geodetic coordinates are shown in all panels. The order in Measure panels depends on the user settings.   |
| <b>Switch Easting for CAD files</b> and <b>Switch Northing for CAD files</b> | Check box  | When these boxes are checked, then the signs of the Easting and Northing coordinates of CAD files are changed so that the CAD file in the 3D viewer is mirrored. The setting applies to all apps, including Roads. |

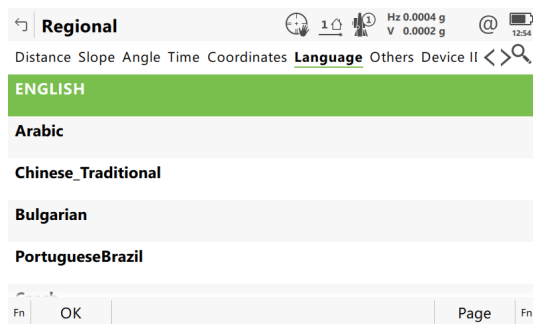
| Field | Option | Description   |
|-------|--------|---|
|       |        | The signs of the Easting/Northing coordinate only change for the display purposes. The signs are not changed in the database. |
|       |        | When importing/exporting dxf data, the signs of the data are switched according to the setting.                               |

### Next step

**Page** changes to the **Language** page.

## Regional, Language page

Languages are installed automatically within the firmware update. All available languages are listed in the current panel.



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b> | To change to another page on this panel.                        |


### Next step

**Page** changes to the **Others** page.

## Regional, Others page

### Description of fields

| Field                | Option  | Description   |
|----------------------|---|---|
| <b>Temperature</b>   | <b>Celsius (°C)</b><br>or<br><b>Fahrenheit (°F)</b>                                   | The units shown for all temperature-related fields.                               |
| <b>Pressure</b>      | <b>mbar,</b><br><b>mmHg,</b><br><b>Inch Hg (inHg),</b><br><b>hPa</b> or<br><b>psi</b> | The units shown for all pressure-related fields.<br>PSI = pounds per square inch. |
| <b>Velocity unit</b> | <b>Km/h (kph),</b><br><b>Mph (mph)</b><br>or<br><b>Knots (kn)</b>                     | The units shown for all velocity-related fields.                                  |

| Field                         | Option    | Description   |
|-------------------------------|-----------|---|
| <b>Switch<br/>WLAN driver</b> | Check box | <p>When this box is checked, an alternative WLAN configuration is loaded. Changing the WLAN configuration can improve the connection between a CS20 and a mobile hot spot. The setting is stored within the working style.</p> <p> Restart the CS20 after changing the setting. During the restart, the WLAN driver and registry key settings are applied.</p> |

#### Next step

Page changes to the **Device ID** page.

### Regional, Device ID page

#### Description of fields

| Field            | Option         | Description   |
|------------------|----------------|---|
| <b>Device ID</b> | Editable field | This number is used for the generation of the file names. Using format files, the instrument ID can be exported together with data from the instrument. By doing so, it can be identified which instrument was used for certain measurements. Sets a four-digit number as instrument identification number. By default the last four numbers of the serial number are used. |

## 29.4

### Restrict access

#### Description

By the settings on this panel, access to certain areas of the system can be locked for other users, for example restricting them from creating a new working style.

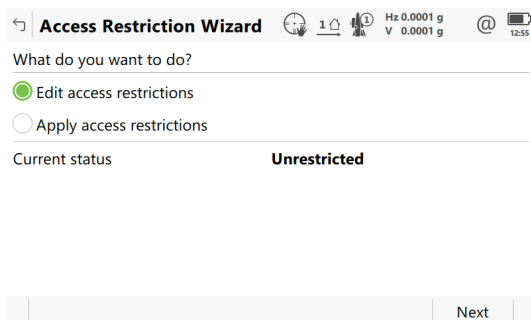
To unlock the system, a correct password must be entered. The number of attempts of password entries is not limited.

#### Access

Select **Leica Captivate - Home: Settings\System\Restrict access**.

| IF the system is | THEN  |
|------------------|---|
| locked           | the password must be typed in.  |
| not locked       | restriction settings can be set and a password can be defined. Refer to <a href="#">Access Restriction Wizard,What do you want to do?</a> |

## Access Restriction Wizard, What do you want to do?



| Key         | Description  |
|-------------|--|
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard. |

### Next step

| IF you want to     | THEN  |
|--------------------|---|
| edit lock settings | select <b>Edit access restrictions</b> , press <b>Next</b> and follow the instructions on the panel. Then continue with <a href="#">Access Restriction Wizard</a> , <a href="#">Select the settings to be available..</a> |
| lock settings      | select <b>Apply access restrictions</b> , press <b>Next</b> and continue with <a href="#">Access Restriction Wizard</a> , <a href="#">Enter new admin password..</a>  |

## Access Restriction Wizard, Enter new admin password.

### Description of fields

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| <b>Password</b>         | Editable field | Type in the password.   |
| <b>Display password</b> | Check box      | When this box is checked, the password is displayed in the <b>Password</b> field. When this box is not checked, dots are displayed in the <b>Password</b> field |

### Next step

**Next** and then **Finish** saves the password and changes the state of the system to **Restricted**.

## Access Restriction Wizard, Select the settings to be available.

| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.   |
| <b>Edit</b> | To open the panel corresponding to the highlighted field. Shows the panel that is hidden or displayed. |
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard.                         |

## Access Restriction Wizard, Do you want to apply user restrictions?

| Key         | Description                      |
|-------------|----------------------------------|
| <b>Back</b> | To return to the previous panel. |

| Key         | Description  |
|-------------|--|
| <b>Next</b> | When <b>Yes, apply user restrictions now</b> is checked and this key is pressed, a password can be typed in.<br>When <b>No, just finish the wizard</b> is checked, this key returns to the <b>Leica Captivate - Home</b> . |

## 29.5

### Calibration of Internal Sensors

#### Availability

Available for CS20. **Calibrate Disto tilt sensor** is available if the CS20 is equipped with a DISTO.

#### Access

Select **Leica Captivate - Home: Settings\System\Calibrate internal sensors** or **Calibrate Disto tilt sensor**.

#### Sensor Calibration

Calibrate the internal sensors prior to use when the compass functionality is used. The calibration wizard guides through the calibration process.

#### Disto Tilt Calibration

Re-calibrate the DISTO tilt sensor if the CS20 has been dropped or heavily bumped.

The calibration wizard guides through the calibration process.

Steps to check if a re-calibration is required:

1. Place the CS20 on a flat surface about 20 m away from a wall but aiming at the wall.
2. Access a panel where it is possible to view the tilt value: Select **Leica Captivate - Home: Measure**. Press **Fn Tools**. Select **Measure hidden point**.
3. The tilt value must be close to 0.
4. If the tilt differs from 0, then the DISTO calibrate the tilt sensor.



**Description**

This chapter describes the basic procedure for

- transferring objects between the data storage device and the internal memory.
- sending a job from the field controller to the TS and vice versa. The TS menu cannot be used when it is connected to the field controller. The commands for sending the jobs from and to the TS must be operated from the field controller only.

Refer to [B Directory Structure of the Memory Device](#) for information about file types and locations of files on the data storage device.

**Access**

Select **Leica Captivate - Home: Settings\Tools\Transfer user objects**.

OR

From the job menu select **Transfer job**.

**Transfer User Objects**

**Transfer User Objects**

Object to transfer: All objects

From: Internal memory

To device: SD card

Transfer all objects into a single AllObjects.zip file:



Do not transfer jobs:




OK



| Key | Description   |
|-----|---|
| OK  | To transfer an object and return to the panel from where this panel was accessed.<br>For transfer between TS and field controller, the job is transferred through Bluetooth, radio or cable.<br>For transfer between TS and field controller with jobs larger than 1 MB: <ul style="list-style-type: none"> <li>• The transfer time is estimated and displayed. Press <b>Yes</b> to start the transfer or <b>No</b> to cancel.</li> <li>• A progress bar indicates the progress of the transfer.</li> </ul> |


**Description of fields**

| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Object to transfer</b> | Selectable list | Listed are the objects that can be transferred. The available fields on the panel depend on the option selected. Unavailable when <b>Transfer job</b> was selected from the job menu. |

| Field                    | Option                                   | Description   |
|--------------------------|--|---|
|                          | <b>Coord sys, geoid &amp; cscs (zip)</b> | A zipped file is created in Infinity. The zip file contains a trnsf.dat file, the linked geoid files and cscs files. When the zip file is transferred to the internal memory, the geoid files and the cscs files are copied to Internal Memory\Data\Gps.  |
|                          | <b>Coordinate system</b>                 | Only the coordinate system is exported as non zipped .dat file.   |
|                          | <b>Web services list</b>                 | To transfer an entire list of configured connections, WMS and WFS, including the connection name, URL, username and password between instruments. Credentials are not encrypted.<br> When installing Captivate v5.0 or higher, all WMS/WMTS services which are already configured are overwritten to allow for this feature. |
| <b>From</b>              |  | Data storage device to transfer object from.  |
|                          | <b>SD card</b>                           | Transfer from the <b>Secure Digital</b> Memory card. Unavailable for CS30/CS35.   |
|                          | <b>USB</b>                               | Transfer from the USB.<br> The CS30/CS35 has two USB ports. The USB stick, that was inserted first, is used.   |
|                          | <b>Internal memory</b>                   | Transfer from the internal memory.  |
|                          | Display only                             | When this panel was accessed from the job menu by selecting <b>Transfer job</b> , then the data storage device of the job is displayed.   |
| <b>To device</b>         | Selectable list                          | Data storage device to transfer object to. Data storage device not selected in <b>From</b> .  |
|                          | Display only                             | For <b>From: USB</b> , the export is only possible to the internal memory.  |
| <b>Job</b>               | Selectable list                          | To select the job to be transferred. When this panel was accessed from the job menu by selecting <b>Transfer job</b> , then the job name is pre-selected.   |
| <b>Antenna</b>           | Selectable list                          | To select the antenna records to be transferred.  |
| <b>Codelist</b>          | Selectable list                          | To select the codelist to be transferred.   |
| <b>Coordinate system</b> | Selectable list                          | To select the coordinate system to be transferred.  |
| <b>CSCS field file</b>   | Selectable list                          | To select the Country Specific Coordinate System to be transferred.   |
| <b>DTM</b>               | Selectable list                          | To select the DTM job to be transferred.  |

| Field  | Option                          | Description  |
|--|---------------------------------|--|
| <b>File</b>                                      | Display only or selectable list | The dial-up list, the device list, the RTK profiles list and the server list to be transferred as binary file.<br><br>To select the user-defined templates stored on the data storage device in CONFIG\SKETCH_TEMPLATES.   |
| <b>Format file</b>                               | Selectable list                 | To select the format files to be transferred.  |
| <b>Geoid field file</b>                          | Selectable list                 | To select the Geoid Field File to be transferred.  |
| <b>Rail design</b>                               | Selectable list                 | To select the Rail job to be transferred. Available when the <b>Stake rail/Check rail</b> app is loaded.   |
| <b>Road design</b>                               | Selectable list                 | To select the Road job to be transferred. Available when the <b>Stake road/Check road</b> app is loaded.   |
| <b>Tunnel design</b>                             | Selectable list                 | To select the Tunnel job to be transferred. Available when the <b>Stake tunnel/Check tunnel</b> app is loaded.   |
| <b>Working Style</b>                             | Selectable list                 | To select the working style to be transferred.<br><br> Working styles cannot be transferred between Leica SmartWorx Viva and Leica Captivate or vice versa.   |
| <b>XSL Stylesheet</b>                            | Selectable list                 | To select the style sheets to be transferred.  |
| <b>Import image</b>                              | Selectable list                 | To select the geo-referenced map background image to be transferred.<br><br> When selecting a world file image, the *.jpg and *.jgw files must have the same file names.<br><br> The converted image file has the same name as the original .jpg file. |
| <b>Transfer all objects of the selected type</b> | Check box                       | Available for some transfer object options. To transfer all objects. Unavailable when <b>Transfer job</b> was selected from the job menu.  |

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Transfer all objects into a single AllObjects.zip file</b> | Check box | <p>Available for <b>Object to transfer: All objects</b>. To zip all objects automatically during transfer.</p> <p>Purpose:</p> <ul style="list-style-type: none"> <li>To recover a device with the exact same settings that it had, before it was formatted</li> <li>To duplicate the settings of from one device into another one</li> </ul> <p>Included are:</p> <ul style="list-style-type: none"> <li>RTK connection settings</li> <li>RTK connection profiles</li> <li>Coding settings</li> <li>Hot key and favourites configurations</li> <li>User defined pages</li> <li>App visibility</li> <li>ID templates</li> <li>Active working style settings</li> <li>GNSS raw data logging settings</li> <li>Antenna height settings</li> <li>Satellite tracking settings</li> <li>Code templates included in the transferred job</li> <li>Multiple offset settings included in the transferred job</li> <li>Coordinate systems</li> <li>Point storage settings</li> <li>Regional settings</li> <li>Software startup settings</li> <li>Screen, audio and input settings</li> <li>Restricted access settings</li> <li>TS measure and target settings</li> <li>TS target search settings</li> <li>TS automatic correction settings</li> <li>TS level and compensator settings</li> <li>TS light settings</li> <li>TS camera settings</li> <li>Cloud service settings for WFS, WMS and WMTS</li> <li>Cloud service settings for login details, LEX, FTP and so on</li> <li>User-defined templates for the sketch pad are included.</li> </ul> <p> *.jpg and *.jgw files from the \Data and from the \Data\Map_Images folder are excluded. *.archive files from the \Data\Map_Images folder are transferred.</p> <p> When <b>Do not transfer jobs</b> is checked, jobs will be excluded from the zip file.</p> |

| Field  | Option    | Description  |
|--|-----------|--|
|  |           |  The file size for the zip file is not limited. If the file size is bigger than 50 MB, a notification is displayed informing that the zipping process can take several minutes.   |
| <b>Copy all objects from AllObjects.zip file</b>   | Check box | Available for <b>Object to transfer: All objects</b> . To load an AllObjects.zip file available in the \SYSTEM folder of the selected memory device.   |
| <b>Transfer scans, Transfer images, Transfer surfaces, Transfer CAD files and Transfer XML files</b> | Check box | Available on CS when connected to TS. Available for <b>Object to transfer: Job</b> . Select the objects to transfer between CS and TS. Reduce the selection to shorten the transfer time.  |
| <b>Do not transfer jobs</b>  | Check box | Available for <b>Object to transfer: All objects</b> . To exclude jobs from the transfer.  |
| <b>Transfer linked jobs</b>  | Check box | Available for <b>Object to transfer: Job</b> with <b>Transfer all objects of the selected type</b> not checked. To transfer the selected job including the linked jobs. The transfer is possible between memory devices on one instrument. The link between the job and the linked jobs is updated with the path of the new memory device.   |
| <b>Transfer only scan area definitions</b>   | Check box | Available for <b>Object to transfer: Job</b> . When this box is checked, then an empty job is transferred which only contains the scan area definitions. To transfer the scan area definition of an MS60. The transfer is possible between memory devices on one instrument. By using the SD card in another MS60, the scan area definition can be transferred from one instrument to another. |

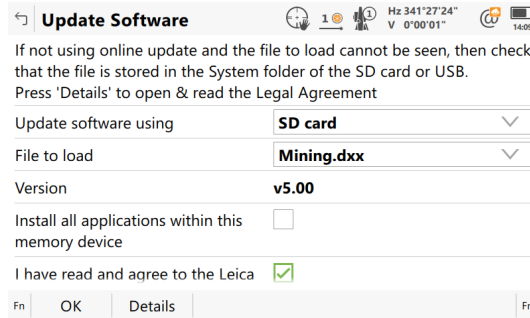
## 30.2

### Update software

#### Access


Select **Leica Captivate - Home: Settings\Tools\Update software**.





For TS60/MS60/TM60 with laser class 2




| Key     | Description  |
|---------|--|
| OK      | To upload the update and return to the panel from where this panel was accessed. Available when <b>I have read and agree to the Leica Geosystems Legal Agreement</b> is checked. |
| Details | To display the licence agreement.  |
| Delete  | To delete an app.  |

Description of fields

| Field                 | Option         | Description   |
|-----------------------|----------------|---|
| Update software using | SD card or USB | <p><b>For CS20 and TS</b></p> <p>Uploads are possible from the SD card and from the USB stick. Store the file to upload in the \SYSTEM directory of the SD card or USB stick. The upload file has the extension *.fw.</p> <p>Alternatively use myWorld to upload files.</p> <p><b>For CS30/CS35</b></p> <p>Uploading is possible from the USB stick or the internal memory.</p>   |
|                       | Online update  | <p>To download a new firmware version from myWorld to an SD card inserted into the instrument and to install the firmware from the SD card automatically.</p> <p> For CS30/CS35 the *.zip file is downloaded to the internal memory. For devices running WinEC, downloads to and installation from the USB or internal memory are not supported.</p> |

| Field               | Option          | Description   |
|---------------------|-----------------|---|
|                     |                 | <p>Availability:</p> <ul style="list-style-type: none"> <li>The instrument must be connected to the Internet.</li> <li>A software version newer than the one installed is available in myWorld. This is indicated by the  icon in the bottom right corner of the <b>Settings</b> tile. Alternatively check the About Leica Captivate, Leica Captivate page for an information message.</li> </ul> <p> The licence keys for the software maintenance must be up to date.</p> <p> Use <b>Cancel</b> to interrupt the online update. Files which have been downloaded until the key was pressed, are deleted from the SD card.</p> <p> For local apps from a Software Development Center: When such apps are installed on the instrument, they are also updated in combination with a firmware update. Checks are performed to make sure that the versions of firmware and apps match. If such apps are stored in the \SYSTEM folder, they are deleted first before installing the new versions. For the devices running WinEC: If such apps are stored in the \SYSTEM folder of the SD card, they are deleted first before installing the new versions.</p> |
| <b>File to load</b> | Selectable list | <p>Available for <b>Update software using: SD card</b> and <b>Update software using: USB</b>. List of files stored in the \SYSTEM directory of the SD card (CS20/TS) or USB stick/internal memory (CS30/CS35/TS10). Listed are files which are compatible with the expected file name and extension for the instrument in use.</p> <p>Firmware, apps, languages and WinCE are packed in one file per instrument. For CS20 Full variants, the file includes also the internal modem firmware.</p> <p>Separate upload files are available for:</p> <ul style="list-style-type: none"> <li>Special apps</li> <li>Software for peripheral devices. Peripheral devices are: RTK radio expansion pack, NovAtel GNSS ME, Cinterion 3.5 modem module</li> </ul>   |

| Field  | Option       | Description  |
|--|--------------|--|
|  |              |  The expiry date of the software maintenance contract must be the same or after the release date of the upload package. If the expiry date of the software maintenance contract is older, then any licensed Leica Captivate functionality cannot be used. Licence keys can still be loaded. Third-party software on the instrument can be used but not controlled remotely. |
| <b>Version</b>   | Display only | Available for <b>Update software using: SD card</b> and <b>Update software using: USB</b> . Version of the selected firmware/app file.   |
| <b>Install all applications within this memory device</b>            | Check box    | When this box is checked, all apps within the system folder of the currently selected memory device are installed in one go. When this box is not checked, all apps within the system folder of the currently selected memory device must be installed manually one after the other.   |
| <b>Loading this file will upgrade</b>                                | Check box    | The upgradable elements contained in the selected <b>File to load</b> . Check elements you want to upload.   |
| <b>Use the default folders for Leica Captivate installation</b>      | Check box    | Available for CS30/CS35 when <b>Update software using: Online update</b> is selected. When this box is checked, Captivate is installed in Silent mode. When this box is not checked, select in which folder the installation files should be stored.   |
| <b>I have read and agree to the Leica Geosystems Legal Agreement</b> | Check box    | Press <b>Details</b> to read the license agreement. Then check this box in order to allow installing any firmware or apps.   |



If a local app becomes available in a new language, the app must be reinstalled to become available including the language.

### 30.3

### Entitlements & licences

#### Description

A licence key can be used to activate apps and protected options and can be used to define the expiry date of the software maintenance. Refer to [32 Settings - About Leica Captivate](#) to find out how to check the expiry date of the software maintenance.



### For CS20 and TS

To upload a licence key file, the file can be in any directory of the data storage device. Licence key files use the naming convention L\_123456.key, where 123456 is the instrument serial number.

### For CS30/CS35

The equivalent to license keys on the CS30/CS35 is the entitlement ID. To activate the entitlement ID:

- Use the CLM wizard for Leica Captivate (only for CS35) or the CLM for Nodelocked licenses. In all cases, an Internet connection is required.
- Use the CLM functionality within Captivate as explained below.
- This is possible without cable connection to a computer.

## Access

Select **Leica Captivate - Home: Settings\Tools\Entitlements & licences.**

## Entitlements & Licences

 The product must be connected to the Internet.

| Key | Description               |
|-----|---------------------------|
| OK  | To confirm the selection. |

### Description of options

| Option                                 | Description   |
|--|---|
| <b>Check for licence updates</b>       | To check for updates. To trigger a licence update for the already installed Entitlements, without leaving the Leica Captivate software.<br>The software checks, if, for any installed Entitlement IDs, new licences are available on the SAP server. If yes, the licences are downloaded and installed automatically on the CS30/CS35. A user confirmation is not required. |
| <b>Activate entitlements</b>           | To activate new Entitlement IDs. Refer to <a href="#">Activate Entitlements</a> .   |
| <b>Check &amp; rehost entitlements</b> | To return Entitlement IDs.<br>To check which licences are included within the installed Entitlement IDs.  |

## Activate Entitlements

 The product must be connected to the Internet.

| Key             | Description  |
|-----------------|--|
| OK              | Available when a correct Entitlement ID has been typed into <b>Enter entitlements</b> .<br>To confirm the entry and to activate the Entitlement IDs.   |
| <b>Fn Paste</b> | Available for CS30/CS35.<br>To paste the entitlement ID which was sent via email into the <b>Enter entitlements</b> field. Use standard copy functionality to get the entitlement ID from the email. |

## Description of fields

| Field                     | Option         | Description  |
|---------------------------|----------------|--|
| <b>Enter entitlements</b> | Editable field | <p>To type in the Entitlement ID for activating licences on the product. One or more Entitlement IDs can be entered.</p> <p>When an Entitlement ID is typed in, a format check is done. The correct format consists of an alphanumeric chain formed of 5 characters groups divided by dashes.<br/>Example: 00102-22815-00017-31603-D2B56</p> <p>If multiple Entitlement IDs are typed in, they must be separated by semicolons.<br/>Example: 00102-22815-00017-31603-D2B56;99999-56987-26BA4-5c426-CDF63</p> |

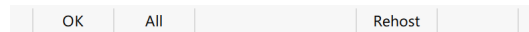
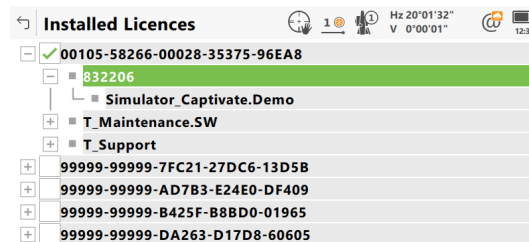
## Installed Licences


Activated Entitlement IDs for the product are displayed in a tree view.



For the tree view, no Internet connection is required.








To return an Entitlement ID, the product must be connected to the Internet.





| Key                             | Description  |
|---------------------------------|--|
| <b>OK</b>                       | To return to the panel from where this panel was accessed.   |
| <b>All</b><br>or<br><b>None</b> | To select or deselect all Entitlement IDs at once.   |
| <b>Rehost</b>                   | <p>Available when at least one Entitlement ID is selected. To return the selected Entitlement IDs.</p> <p>An entitlement ID must be returned to be able to activate it in another product.</p> <p> Only complete Entitlement IDs can be returned, not individual licences.</p> <p>When an Entitlement ID has been returned successfully, it is removed from the list.</p> |

## Description of the tree view

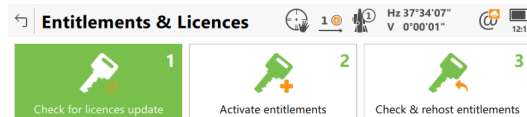
| Level   | Description   |
|---|---|
|  00106-88606-00031-03734-BB90C | <p>First level of the tree view</p> <p>Displays the Entitlement ID.</p> |

| Level   | Description  |
|---|--|
|  00100-88000-00051-05754-BB90C<br> 832206<br> Simulator_Captivate.Demo | Second level of the tree view<br>Displays the serial number of the product related to the Entitlement ID.                      |
|  832200<br> Simulator_Captivate.Demo  | Third level of the tree view<br>The feature for which the Entitlement ID is valid.   |
|  Maintenance.SW<br> Maintenance.SW  | Second level of the tree view<br>If no serial number is available for a product, then level 2 and 3 show the same information. |

### Check box status

| Icon  | Description                 |
|---|-----------------------------|
|  | Entitlement ID is selected  |
|  | Entitlement ID not selected |

## Load Licence Keys




OK

| Key              | Description   |
|------------------|---|
| OK               | To accept changes and return to <b>Leica Captivate - Home</b> or continue with the app. |
| <b>Fn Delete</b> | To delete all licence keys on the field controller.                                     |

### Description of fields

| Field                          | Option                | Description   |
|--------------------------------|-----------------------|---|
| <b>Load licence file using</b> | <b>SD card or USB</b> | <b>For CS20 and TS</b><br>The file must be on the \SYSTEM directory of the data storage device. Licence key files use the naming convention L_123456.key, where 123456 is the instrument serial number. |

| Field | Option               | Description   |
|-------|----------------------|---|
|       |                      | <p><b>For CS30/CS35</b></p> <p>The equivalent to licence keys on the CS30/CS35 is the entitlement ID. To activate the entitlement ID use the CLM wizard for Leica Captivate or the CLM for Nodelocked licences. Check, if a entitlement updates are available using Home: Settings/Tools/Entitlements &amp; licences/Check for licence updates. In all cases, an Internet connection is required.</p> |
|       | <b>Online update</b> | <p>To download a new licence key from myWorld to the internal memory and to install it automatically.</p> <p> This is possible without cable connection to a computer.</p>   |

## 30.4

### Format memory

#### Description

Allows the data storage device and the internal memory to be formatted. All data is erased.

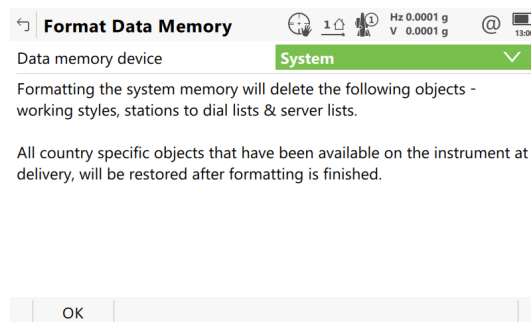


If the internal memory is formatted, all system data such as almanac, user-defined configuration sets, user-defined antennas, codelists, geoid field files and CSCS field files will be lost.

#### Access


Select **Leica Captivate - Home: Settings\Tools\Format memory**.


#### Format Data Memory



| Key       | Description   |
|-----------|---|
| <b>OK</b> | To format a data storage device and return to the panel from where this panel was accessed. |

#### Description of fields

| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Data memory device</b> | Selectable list | <p>The type of memory to be formatted.</p> <p> For GS18, use the buttons on the keyboard. Refer to the GS18 User Manual for details.</p> |

| Field | Option                 | Description   |
|-------|------------------------|---|
|       | <b>Internal memory</b> | Formatting the Internal memory will delete the following objects currently stored on the internal memory - jobs, admin settings, codelists, coordinate systems, format files, geoid & CPCS field files, RTK profiles, sketch templates & user entered antennas. All country specific objects (codelists, coordinate systems..) that have been available on the instrument at delivery, will be restored after formatting is finished. |
|       | <b>SD card</b>         | Formatting the SD card will delete all data currently stored on the SD card.  |
|       | <b>USB stick</b>       | Formatting the USB stick will delete all data currently stored on the USB stick.<br> The CS30/CS35 has two USB ports. The USB stick, that was inserted first, is used.   |
|       | <b>Apps</b>            | Formatting the Apps will delete all currently loaded apps.  |
|       | <b>System</b>          | Formatting the system memory will delete the following objects - working styles, stations to dial lists, server lists & web services lists. All country specific objects that have been available on the instrument at delivery will be restored after formatting is finished.  |

## 30.5

### Calculator

#### Access

Select **Leica Captivate - Home: Settings\Tools\Calculator**.

#### Description

The calculator can be used to perform the following arithmetic operations:

| Operation | Description   |
|-----------|---|
| +         | To add two values.  |
| -         | To subtract two values.   |
| *         | To multiply two values.   |
| /         | To divide two values.   |
| + -       | To change between positive and negative algebraic sign for a value. |
| =         | To display the result.  |
| x^2       | To calculate $x^2$ .  |
| x^y       | To calculate $x^y$ .  |
| sqrt      | To calculate $\sqrt{\quad}$ of a value.                             |
| PI        | To recall the value 3.1415926536.                                   |
| sin       | To calculate sine of a value.                                       |
| asin      | To calculate arcsine of a value.                                    |
| cos       | To calculate cosine of a value.                                     |

| Operation | Description                              |
|-----------|--|
| acos      | To calculate arccosine of a value.       |
| tan       | To calculate tangent of a value.         |
| atan      | To calculate arctangent of a value.      |
| C         | To clear the display.                    |
| <-        | To delete the last digit in the display. |
| MS        | To save a value into memory.             |
| MSR       | To recall a value in memory.             |
| done      | To quit the calculator.                  |

## 30.6

### FTP data transfer

#### Description


This functionality is to transfer jobs, codelists and other files on the data storage device with a standard and simple FTP server.

FTP protocol is used to transfer between an instrument, which has an Internet device connected, and the FTP server. The zip/unzip functionality is included.

#### Supported files

The following list shows the supported file extensions that will automatically move to the corresponding directory after downloading.

| Supported file                            | File extension | Directory          |
|---|----------------|--------------------|
| Almanac file                              | Almanac.sys    | DATA/GPS           |
| Antenna file                              | List.ant       | GPS                |
| App files                                 | *.a*           | SYSTEM             |
| ASCII files for import/export to/from job | *.txt          | DATA               |
| Coordinate system file                    | Trfset.dat     | DBX                |
| CSCS field files                          | *.csc          | DATA/GPS/<br>CSCS  |
| Cutsheets                                 | *.txt          | DATA               |
| DXF files for import/export to/from job   | *.dxf          | DATA               |
| Firmware files                            | *.fw           | SYSTEM             |
| Format files                              | *.frt          | CONVERT            |
| Geoid field files                         | *.gem          | DATA/GPS/<br>GEOID |
| GSI files                                 | *.gsi          | GSI                |
| GSM/Modem station list                    | *.fil          | GPS                |
| Job files                                 | *.dbx          | DBX                |
| Licence file                              | *.key          | SYSTEM             |
| Report sheets created from apps           | *.log          | DATA               |
| TS working style files                    | *.xfg          | CONFIG             |
| System files                              | System.ram     | SYSTEM             |
| XML files                                 | *.xml          | DATA               |

| Supported file   | File extension | Directory |
|--|----------------|-----------|
| Custom ASCII file  | *.cst          | DATA      |
|  Leica Geo Office supports the creation of *.cst files which can be used in third party applications to do traverse sheets, networks adjustments and similar. |                |           |
| Comma-separated variables, text file format (ASCII)  | *.csv          | DATA      |



Configure and connect the Internet interface before using this function.

## Access

Select **Leica Captivate - Home: Settings\Tools\FTP data transfer**.

## FTP Data Transfer

| Key            | Description                           |
|----------------|---------------------------------------|
| <b>Connect</b> | To connect to the FTP server entered. |

### Description of fields

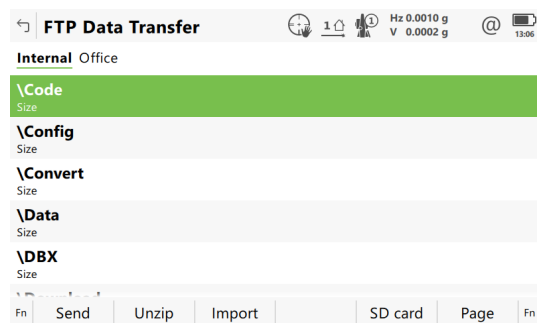
| Field                   | Option         | Description  |
|-------------------------|----------------|--|
| <b>Host</b>             | Editable field | In order to get access to the Internet, a host name is required. This host name identifies the instrument in the Internet.                                       |
| <b>TCP/IP port</b>      | Editable field | Port to be used. Any number between 0 and 65535 is valid.  |
| <b>User ID</b>          | Editable field | The User ID allows connection to the FTP site. If no value is typed in, then the instrument logs in to the FTP server anonymously.                               |
| <b>Password</b>         | Editable field | The password to get access to the FTP site.  |
| <b>Display password</b> | Check box      | When this box is checked, the password is displayed in the <b>Password</b> field. When this box is not checked, dots are displayed in the <b>Password</b> field. |


### Next step

**Connect.** Once the connection to the FTP server is established, the **FTP Data Transfer, Internal** page is displayed.

## FTP Data Transfer, Internal page

The files and folders on the selected data storage device of the instrument are displayed including their size. To get into the folders, highlight the folder and **ENTER**.



| Key                             | Description   |
|---------------------------------|---|
| <b>Send</b>                     | To copy the file or folder to its corresponding directory on the FTP server. Files or folders bigger than 100 KB are zipped before sending.   |
| <b>Unzip</b>                    | To unzip a file in the download directory. Available if a zip file is highlighted.  |
| <b>Import</b>                   | To move a file from the \Download folder to the appropriate directory folder based on its file extension type. Available in the \Download folder when a file is highlighted. Unavailable for unrecognised files in the \Download folder. These files must stay in the \Download folder. |
| <b>SD card, USB or Internal</b> | To change between the data storage devices and the internal memory.<br> The CS30/CS35 has two USB ports. The USB stick, that was inserted first, is used.  |

### Next step

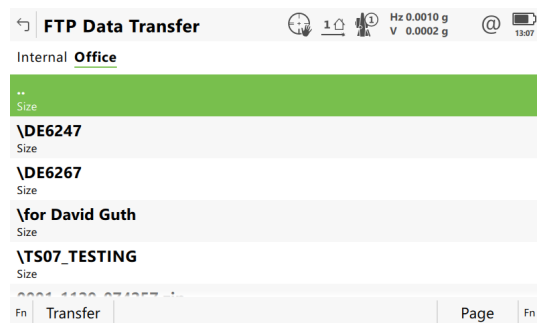
**Page** changes to the **Office** page.

## FTP Data Transfer, Office page

The files located on the FTP server are displayed.

Whenever switching to this page, if the connection to the server was disconnected, then a refresh action is done or it reconnects to the server.

The most important keys are explained.





| Key               | Description   |
|-------------------|---|
| <b>Transfer</b>   | To download the highlighted file or folder list on the FTP server to the local download folder.<br>If recognised by the system, downloaded files are moved automatically to the corresponding directories. If not, they are stored in the download folder. Zipped files are unzipped before storing in the download folder. |
| <b>Page</b>       | To change to another page on this panel.  |
| <b>Fn Refresh</b> | To refresh the FTP directory.   |

## 31 Settings - Cloud services

### 31.1 Leica Exchange

#### 31.1.1 Overview

##### Description

Leica Exchange is an online service that allows the data exchange between two users of the service. For example:

- The user in the field sends the daily measured data to the user in the office.
- The user in the field sends a codelist to a second user in the field.

##### Requirements

Valid Leica Exchange subscription

##### Creating Username and Password step-by-step

1. Order a Leica Exchange subscription. You will receive a subscription form.
2. Take the subscription ID in the subscription form and log in to your myWorld account (<https://myworld.leica-geosystems.com>).
3. Navigate to myTrustedServices.
4. On the **My Trusted Services** tab, select **Add Service** and type in the subscription ID.
5. The Leica Exchange Service is shown in the **My Trusted Services** tab. Once the Leica Exchange Service is registered, users can be assigned to the service on the **My Users** tab.
6. Click the **Add** button to define a new user and to assign services to the user.  
For each user:
  - Enter contact information
  - Define a unique user name
  - Assign a passwordThe user name and password are needed each time you access the Leica Exchange Service. The Leica Exchange Service can be accessed from Leica Captivate in the field or using Leica Exchange Office PC software.



After registering the subscription ID in your myWorld account, the subscription usage statistic is fully accessible. The total quota is shown and the consumed and remaining GB are displayed in total GB and GB/month.

##### Access

Select **Leica Captivate - Home: Settings\Cloud services\Leica Exchange**.

If a user is logged in then the **Leica Exchange** menu is accessed. If no user is logged in then the **Leica Exchange Login** panel is accessed.

##### Leica Exchange Login

###### Description of fields

| Field           | Option         | Description  |
|-----------------|----------------|--|
| <b>Username</b> | Editable field | The user ID created in MyWorld allows connection to the exchange server. |

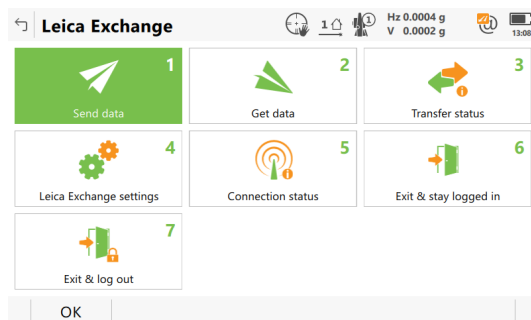
| Field                    | Option         | Description  |
|--------------------------|----------------|--|
| <b>Password</b>          | Editable field | The password created in MyWorld to get access to the exchange server.  |
| <b>Display password</b>  | Check box      | When this box is checked, the password is displayed in the <b>Password</b> field.<br>When this box is not checked, dots are displayed in the <b>Password</b> field   |
| <b>Keep me logged in</b> | Check box      | When this box is checked, user name and password are remembered. Log in is automatically.<br>The setting will be reset when quitting Leica Exchange with Exit & log out.<br><br>When this box is not checked, user name and password must be typed in each time the <b>Leica Exchange</b> service is accessed. |

### Next step

The first time you log in to **Leica Exchange** you need to accept the license agreement.

If a connection to the **Leica Exchange** server is active and if the user name and password are recognised, then **OK** accesses **Leica Exchange** menu.

## Leica Exchange



| Key       | Description                           |
|-----------|---------------------------------------|
| <b>OK</b> | To access the selected functionality. |

### Description of options

| Icon                           | Description   |
|--------------------------------|---|
| <b>Send data</b>               | To select objects to be uploaded to the server from the CS or TS and to start the upload. Access <b>Select Data to Send</b> .   |
| <b>Get data</b>                | To select objects to be downloaded from the server to the CS or TS and to start the download. Access <b>Select Data to Download</b> .<br>Data sent to a user are stored in the users "inbox" for two weeks. |
| <b>Transfer status</b>         | To check the transfer status for the last 20 transfers since log in.  |
| <b>Leica Exchange settings</b> | To access the <b>Settings</b> panel.  |

| Icon                             | Description  |
|----------------------------------|--|
| <b>Connection status</b>         | To see details about the connection. A checked box indicates an established connection to the Leica Exchange Server.   |
| <b>Exit &amp; stay logged in</b> | To remain logged in but return to the <b>Leica Captivate - Home</b> . Any transfer in progress continues in the background. You can see from anywhere inside <b>Leica Captivate</b> when new files are received. |
| <b>Exit &amp; log out</b>        | To log out and to return to the <b>Leica Captivate - Home</b> . Any transfer in progress is stopped.   |

### 31.1.2

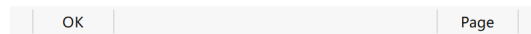
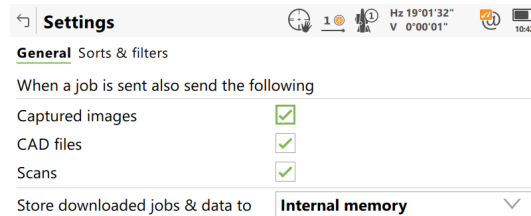
## Configuring Leica Exchange

### Access

Select **Leica Exchange settings** in **Leica Exchange** menu.

### Settings, General page

This panel consists of two pages. The explanations for the softkeys given here are valid for all pages.




| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.                                      |

### Description of fields

 The total maximum file size is 500 MB. If the file size is bigger than 50 MB, a notification is displayed informing that the transfer process can take several minutes.

| Field                                      | Option          | Description  |
|--|-----------------|--|
| <b>Captured images</b>                     | Check box       | When this box is checked, the jobs are sent with the Images folder.                      |
| <b>CAD files</b>                           | Check box       | When this box is checked, the jobs are sent with the Map files folder.                   |
| <b>Scans</b>                               | Check box       | When this box is checked, the jobs are sent with the folder, where scan data are stored. |
| <b>Store downloaded jobs &amp; data to</b> | Selectable list | The device on which the jobs and data are stored.  |

| Field | Option | Description   |
|-------|--------|---|
|       |        |  Jobs and data are stored in the internal memory when the chosen data storage device is not available. |

**Next step**

**Page** changes to the **Sorts & filters** page.

**Settings,  
Sorts & filters page**

**Description of fields**

| Field   | Option           | Description  |
|---|------------------|--|
| <b>Display objects sorted by</b>                                    |                  | The method points are sorted by.   |
|   | <b>Source</b>    | Sorts the objects by the instrument they were measured with.   |
|   | <b>Size</b>      | Sorts the objects by size in Kb.   |
|   | <b>File name</b> | Sorts the objects alphabetically by the object name.   |
|   | <b>Type</b>      | Sorts the objects in alphabetical order of the object types. After applying the alphabetical order, the time is considered for the order of the files.                               |
| <b>Display the following objects for sending or receiving files</b> | Check boxes      | When a box is checked, the filter is active for that object type.<br>The filter is valid for objects sent or received from the instrument. Objects on the server are always visible. |

**Next step**

**OK** closes the panel.

**31.1.3**

**Sending Data**

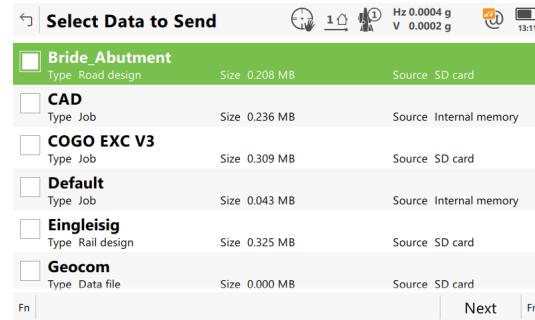
**Access**

Select **Send data** in **Leica Exchange** menu.

## Select Data to Send

Ticked objects are used for sending data.

Unticked objects are not used for sending data.



| Key                             | Description  |
|---------------------------------|--|
| <b>Next</b>                     | To confirm the settings and continue to the next panel. The Internet and server connection is checked. |
| <b>Fn All</b> or <b>Fn None</b> | To select or deselect all object for sending data.   |
| <b>Fn Filter</b>                | To sort and filter the objects listed.   |

### Description of metadata

| Metadata      | Description   |
|---------------|---|
| -             | The user-defined name of the objects.   |
| <b>Type</b>   | Supported are job, CAD files (dxf and shape files), data files, coordinate systems and codelists. |
| <b>Source</b> | The data storage device where the object is stored.   |
| <b>Size</b>   | The size of the selected object.  |

### Next step

Make a selection and press **Next**.

## Select People to Send Data

Listed are the user names of people data can be sent to. The list is downloaded from MyWorld. Refer to [Creating Username and Password step-by-step](#) for information on how to define user names.

Tick the user names to send data to. Multiple selection is possible.

| Key                             | Description  |
|---------------------------------|--|
| <b>Back</b>                     | To return to the previous panel.                           |
| <b>Next</b>                     | To confirm the settings and to continue to the next panel. |
| <b>Fn All</b> or <b>Fn None</b> | To select or deselect all users for sending data.          |

### Next step

Make a selection and press **Next**. The transfer starts.

While the transfer is in progress,

- the status can be checked by pressing **Status**. Refer to [31.1.5 Data Transfer Status](#).
- Other tasks can be done. Press **Finish** to exit the wizard.

### 31.1.4

## Getting Data

### Access

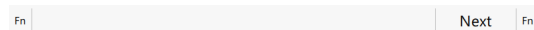
Select **Get data** in **Leica Exchange** menu.

### Select Data to Download

The information shown is derived from the list of information retrieved from the server.

Ticked objects are used for getting data.

Unticked objects are not used for getting data.



| Key                             | Description   |
|---------------------------------|---|
| <b>Next</b>                     | To confirm the settings and to continue to the next panel. The Internet and server connection is checked. |
| <b>Fn All</b> or <b>Fn None</b> | To select or deselect all object for sending data.  |
| <b>Fn Filter</b>                | To sort and filter the objects listed.  |

### Description of metadata

| Metadata      | Description   |
|---------------|---|
| -             | The user-defined name of the objects.   |
| <b>Source</b> | The user the data comes from.   |
| <b>Type</b>   | Supported are job, CAD files (dxf and shape files), data files, coordinate systems and codelists.<br>Jobs downloaded from the server are stored in a subfolder of the DBX folder of the data storage device selected in <b>Store downloaded jobs &amp; data to</b> in <b>Settings, General</b> page.<br>All files with unknown format, for example CAD or data files, are stored in the \DATA folder of the selected data storage device.<br>Coordinate systems and codelists are stored to the internal memory of the CS or TS. From the internal memory, the codelist/coordinate system can be directly selected when creating/editing a job. |
| <b>Size</b>   | The size of the selected object.  |

### Next step

Make a selection and press **Next**. The transfer starts.

While the transfer is in progress,

- the status can be checked by pressing **Status**. Refer to [31.1.5 Data Transfer Status](#).
- Other tasks can be done. Press **Finish** to exit the wizard.

## 31.1.5

### Data Transfer Status

#### Access

Select **Transfer status** in **Leica Exchange** menu.

#### Data Transfer Status

The last 20 transfers since log in are displayed.

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To return to <b>Leica Exchange</b> menu.  |
| <b>Pause</b>  | To pause all transfers.   |
| <b>Resume</b> | To restart all transfers.   |
| <b>Accept</b> | Available when a row with status <b>Conflict</b> is highlighted. To choose between replacing or discarding the downloaded file. |
| <b>Remove</b> | Available for finished or cancelled transfers. To remove the transfer from the list.  |
| <b>Cancel</b> | To cancel the highlighted transfer.   |
| <b>More</b>   | To change between user, size, date and expected time by when the transfer is finished.  |

#### Description of metadata

| Metadata      | Option | Description  |
|---------------|--------|--|
| -             | -      | The type of file transferred.  |
| <b>Name</b>   | -      | The name of the file transferred.  |
| <b>Who</b>    | -      | The user the file is transferred to or from.   |
| <b>Status</b> | -      | <b>... down/up</b> - The downloading/uploading transfer is in progress.<br><b>Sent</b> - The upload has been successfully finished.<br><b>Downloaded</b> - The download has been successfully finished.<br><b>Pending</b> - A transfer is in progress and the current transfer has not been started.<br><b>Paused</b> - The transfer has been paused.<br><b>Cancelled</b> - The transfer has been cancelled.<br><b>Conflict</b> - The transfer is finished, but there is another file with the same name in the designated folder. Press <b>Accept</b> .<br><b>Interrup.</b> - The transfer has been interrupted due to internet connection loss or other events that result in interrupting the transfer. |
| <b>Size</b>   | -      | The size of the selected object.   |



| Metadata  | Option | Description  |
|-----------|--------|--|
| Time left | -      | The estimated time until the transfer is finished. |

### 31.1.6

#### In the Office

##### In the office

1. After activating the Entitlement ID, login to Leica Exchange Office with your user name and password.
2. Click on one of the icons to define the view in the right half of the window: **Inbox**, **Status**, **History**, **Contacts**. On the left side of the window, the data on the computer are displayed. Navigate to the folder you want to place received data or to where the data to be sent are stored.
3. To get files from the inbox, click **Inbox**, select the files and drag them into the left half of the window.  
To send data, click **Contacts** and drag & drop the files from the left to the right. To send files to multiple users, select the users, drag & drop the files from the left to the right.
4. To see the status of current transfers, click **Status**.  
To see all transfers done from both field and office and also the time when the objects were sent and received, click **History**.

## 31.2

### BIM 360 Docs

#### 31.2.1

##### Overview

##### Description

BIM 360 Docs is an online service that allows the data exchange between the instrument and Autodesk BIM 360. The service includes:

- Authentication with the Autodesk ID
- Project selection within the hubs
- Download of files from a BIM 360 project
- Upload of files to a BIM 360 project

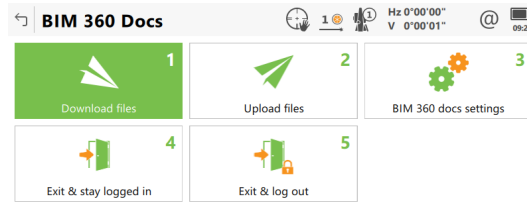
| User  | Usage of BIM 360 Docs   |
|---|---|
| Surveyors or layout specialists working in the online collaborative environment of Autodesk BIM 360 | To download the relevant files, including design files, stored online |
| Project managers  | To have an end-to-end solution from design to layout                  |

##### Requirements

- Valid Autodesk ID/login data
- A CS30/CS35 must be used.

##### Access

Select **Leica Captivate - Home: Settings\Cloud services\BIM 360 Docs**.  
If a user is logged in then the BIM 360 Docs menu is accessed. If no user is logged in then the Autodesk Login is accessed.



OK

| Key | Description                           |
|-----|---------------------------------------|
| OK  | To access the selected functionality. |

**Description of options**

| Icon                             | Description  |
|----------------------------------|--|
| <b>Download files</b>            | To select objects to be downloaded from the BIM 360 service to the CS30/CS35 and to start the download. Access <b>Download Files</b> . |
| <b>Upload files</b>              | To select objects to be uploaded to the BIM 360 service from the CS30/CS35 and to start the upload. Access <b>Upload Files</b> .       |
| <b>BIM 360 docs settings</b>     | To access the <b>BIM 360 Docs Settings</b> panel.  |
| <b>Exit &amp; stay logged in</b> | To remain logged in but return to the <b>Leica Captivate - Home</b> .  |
| <b>Exit &amp; log out</b>        | To log out and to return to the <b>Leica Captivate - Home</b> .  |

**31.2.2**

**Configuring BIM 360 Docs**


**Access**

Select **BIM 360 docs settings** in **BIM 360 Docs** menu.

**BIM 360 Docs Settings**

| Key | Description   |
|-----|---|
| OK  | To accept changes and return to the panel from where this panel was accessed. |

**Description of fields**

| Field                           | Option  | Description   |
|---------------------------------|---|---|
| <b>Store downloaded data to</b> | Selectable list   | The device on which the BIM 360 data are stored.  |
|                                 |  | Jobs and data are stored in the internal memory when the chosen data storage device is not available. |

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Show all file versions within BIM 360 docs</b> | Check box | When this box is not checked, only the latest file version is displayed for selection. |

### 31.2.3

#### Downloading Files

##### Access

Select **Download files** in **BIM 360 Docs** menu.

##### Download Files

The hub structure is displayed at the same location where files were downloaded from last, else or in the root.


Select a folder.

Ticked objects are used for downloading.

Unticked objects are not used for downloading.

| Key           | Description   |
|---------------|---|
| <b>Next</b>   | To confirm the settings and continue to the next panel. |
| <b>Return</b> | To return to the previous panel.                        |

##### Description of metadata

| Metadata         | Description   |
|------------------|---|
| -                | The user-defined name of the objects.<br>All available files in hub structure of BIM 360 are displayed.   |
| <b>Format</b>    | Supported are CAD files in various formats.   |
| <b>Version</b>   | The version of the data.<br> Check <b>Show all file versions within BIM 360 docs</b> in <b>BIM 360 Docs Settings</b> to display all versions of the files. |
| <b>Size (MB)</b> | The size of the selected file.  |

##### Next step

Make a selection and press **Next**.

### 31.2.4

#### Uploading Files

##### Access

Select **Upload files** in **BIM 360 Docs** menu.

##### Upload Files

Ticked objects are used for sending data.

Unticked objects are not used for sending data.

| Key         | Description   |
|-------------|---|
| <b>Next</b> | To confirm the settings and continue to the next panel. |

### Description of metadata

| Metadata         | Description   |
|------------------|---|
| -                | The user-defined name of the objects.<br>All available files in data folders are displayed. |
| <b>Format</b>    | Supported are CAD files in various formats.   |
| <b>Size (MB)</b> | The size of the selected file.  |
| <b>Source</b>    | The data storage device where the file is stored.   |

### Next step

Make a selection and press **Next**.

## Storage Location

The hub structure is displayed at the same location where files are downloaded from else in the root.

Select a folder as destination folder.

| Key           | Description   |
|---------------|---|
| <b>Next</b>   | To confirm the settings and continue to the next panel. |
| <b>Return</b> | To return to the previous panel.                        |

### Next step

Make a selection and press **Next**.

## 31.3

### Leica ConX

### 31.3.1

#### Overview

#### Description

Leica ConX is a cloud solution and web interface to share and visualise data. It is needed by construction companies to manage, monitor and share construction and survey data in real time everywhere.

Personnel and machines on the jobsite need to share the same data and stay in sync so work can be carried out effectively, on time and budget. Leica ConX is a web-based suite of tools that harmonises and simplifies the data handling for machine control operations, significantly reducing your downtime.

It allows to efficiently manage all connected construction projects, including third party platforms, and share job-related data with all stakeholders. Non-experienced users are able to visualise and validate localised reference models, survey data and constructed data.

- Visualise and validate data used and generated on-site in 2D and 3D localised on interactive maps to collaborate and communicate with everyone on site
- Share updates and corrections to reference model data in real-time across the project to guarantee transparency and quick reaction to design updates
- Convert formats to integrate third party platforms, increase connectivity and integrate existing workflows
- Monitor machine control operations remotely by assigning work and providing positing and reference data to operators and grade checkers ensuring you avoid costly rework and errors
- Report productivity for the work that has been performed to validate what work has been completed and that the results are to specification

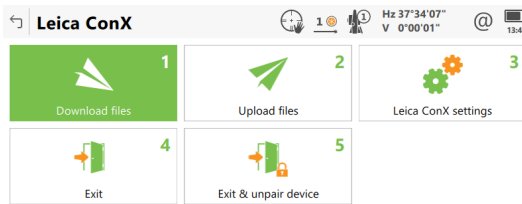
**Requirements**

Valid login data

**Access**

1. Select **Leica Captivate - Home: Settings\Cloud services\Leica ConX**.
2. The instrument must be paired to a Leica ConX project on the web-site.  
Press **Pair**.  
The pairing code is displayed.
3. Start the Leica ConX website and logging:  
<https://conx.leica-geosystems.com/frontend/login>  
Open the Unit screen under Projects > Configure > Units.  
Click the + button.  
Type in the required information.  
Click Next.  
Select device type.  
Type in the pairing code on the Leica ConX website.
4. Once the pairing is completed, the Leica ConX panel is displayed.

**Leica ConX**



OK

| Key | Description                           |
|-----|---------------------------------------|
| OK  | To access the selected functionality. |

**Description of options**

| Icon                  | Description  |
|-----------------------|--|
| <b>Download files</b> | To select files to be downloaded from the Leica ConX website to the CS or TS and to start the download. Access <b>Download Files</b> . |

| Icon                            | Description  |
|---------------------------------|--|
| <b>Upload files</b>             | To select files to be uploaded to the Leica ConX website from the CS or TS and to start the upload. Access <b>Upload Files</b> . |
| <b>Leica ConX settings</b>      | To access the <b>Leica ConX Settings</b> panel.  |
| <b>Exit</b>                     | To maintain the pairing but return to the <b>Leica Captivate - Home</b> .  |
| <b>Exit &amp; unpair device</b> | To cancel the pairing to return to the <b>Leica Captivate - Home</b> .   |

### 31.3.2

### Configuring Leica ConX


#### Access

Select **Leica ConX settings** in **Leica ConX** menu.

#### Leica ConX Settings

| Key       | Description   |
|-----------|---|
| <b>OK</b> | To accept changes and return to the panel from where this panel was accessed. |

#### Description of fields

| Field   | Option          | Description  |
|---|-----------------|--|
| <b>Store downloaded data to</b>                     | Selectable list | The device on which the data are stored.  Jobs and data are stored in the internal memory when the chosen data storage device is not available.   |
| <b>Sync measured points with Leica ConX project</b> | Check box       | When this box is checked, the measured data is backed up in the Leica ConX server. Every minute, a message is sent to the server for storing the points that were measured during that lapse of time. In this way, the measured points are useable in Leica ConX for surfacing and calculations. |



Leica ConX:



| Field   | Option    | Description  |
|---|-----------|--|
| <b>Receive notifications with project updates</b> | Check box | <p>When this box is checked, a message pops up to inform about changes in the Leica ConX project. These messages will pop up when:</p> <ul style="list-style-type: none"> <li>• A file is deleted from the project.</li> <li>• A new file is uploaded to the project.*</li> <li>• A new version of an already existing file is uploaded to the project.*</li> </ul> <p>* Additionally, from the message trigger the file download and storage directly without going to the Leica ConX menu.</p> |

### 31.3.3

### Downloading Files

#### Access

Select **Download files** in **Leica ConX** menu.

#### Download Files

All projects, which the current paired instrument has access to, are displayed.

| Key         | Description  |
|-------------|--|
| <b>Open</b> | To open the project folder and continue to the next panel. |

#### Description of metadata

| Metadata         | Description  |
|------------------|--|
| -                | The user-defined name of the projects. All projects, which the current paired instrument has access to, are displayed. |
| <b>Format</b>    | Data type as assigned in the Leica ConX server.  |
| <b>Time</b>      | The time when the file was modified in the Leica ConX server   |
| <b>Date</b>      | The date when the file was modified in the Leica ConX server   |
| <b>Size (MB)</b> | The size of the file.  |

#### Next step

Make a selection and press **Open**.

The file level of the project is displayed.

Ticked objects are used for sending data.

Unticked objects are not used for sending data.

| Key           | Description                                    |
|---------------|--|
| <b>Next</b>   | To confirm the settings and download the data. |
| <b>Return</b> | To return to the previous panel.               |

#### Next step

Make a selection and press **Next**.

File locations:

- Codelist: \CODE folder of the selected memory device
- Files: \DATA folder of the selected memory device
- Jobs: \DBX folder of the selected memory device

### 31.3.4

## Uploading Files

### Access

Select **Upload files** in **Leica ConX** menu.

### Upload Files

The \DATA, \DBX and the \Code folders from where data can be uploaded, are displayed. Coordinate system files (Trfset.dat) can be uploaded from the \DBX folder.

| Key         | Description  |
|-------------|--|
| <b>Open</b> | To open the folder and continue to the next panel. |

### Description of metadata

| Metadata         | Description   |
|------------------|---|
| -                | The name of the folder.                             |
| <b>Format</b>    | Supported are CAD files in various formats.         |
| <b>Size (MB)</b> | The size of the folder.                             |
| <b>Source</b>    | The data storage device where the folder is stored. |

### Next step

Make a selection and press **Open**.

Ticked objects are used for sending data.

Unticked objects are not used for sending data.

| Key           | Description                                  |
|---------------|--|
| <b>Next</b>   | To confirm the settings and upload the data. |
| <b>Return</b> | To return to the previous panel.             |

### Next step

Make a selection and press **Next**.

### Storage Location

All projects, which the current paired instrument has access to, are displayed. Select a folder as destination folder.

| Key           | Description               |
|---------------|---------------------------|
| <b>Open</b>   | To open a project folder. |
| <b>Upload</b> | To start the upload.      |

### Next step

Make a selection and press **Upload**.

## 31.4

## Bricsys 24/7

### 31.4.1

### Overview

### Description

Captivate supports Bricsys 24/7 cloud service for sharing project data.

It gives users easy access to their projects and to the data required to prepare for field campaigns.



Being connected also simplifies providing processed data and data deliverables to the project by uploading directly from Captivate.

## Requirements

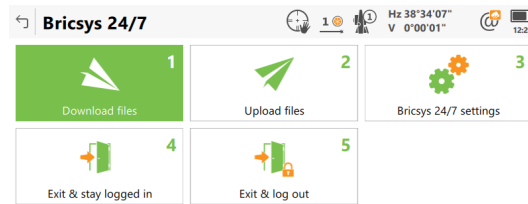
- Valid Bricsys 24/7 subscription
- Bricsys 24/7 licence key loaded on a field controller/instrument
- Leica Captivate Basic - Measure & Stakeout licence key loaded on a field controller/instrument

## Access

Select **Leica Captivate - Home: Settings\Cloud services\Bricsys 24/7**.

If a user is logged in, then the **Bricsys 24/7** menu is accessed. If no user is logged in, then the **Bricsys 24/7 Login** is accessed. The address of the server to connect to the service can be defined.

## Bricsys 24/7



OK

| Key | Description                           |
|-----|---------------------------------------|
| OK  | To access the selected functionality. |

### Description of options

| Icon                             | Description  |
|----------------------------------|--|
| <b>Download files</b>            | To select files to be downloaded from the Bricsys 24/7 service to the CS or TS and to start the download. Access <b>Download Files</b> . |
| <b>Upload files</b>              | To select files to be uploaded to the Bricsys 24/7 service from the CS or TS and to start the upload. Access <b>Upload Files</b> .       |
| <b>Bricsys 24/7 settings</b>     | To access the <b>Bricsys 24/7 Settings</b> panel.  |
| <b>Exit &amp; stay logged in</b> | To maintain the pairing but return to the <b>Leica Captivate - Home</b> .  |
| <b>Exit &amp; log out</b>        | To cancel the pairing to return to the <b>Leica Captivate - Home</b> .   |

## 31.4.2

### Configuring Bricsys 24/7

## Access

Select **Bricsys 24/7 settings** in **Bricsys 24/7** menu.

## Bricsys 24/7 Settings

| Key | Description   |
|-----|---|
| OK  | To accept changes and return to the panel from where this panel was accessed. |

### Description of fields

| Field   | Option          | Description   |
|---|-----------------|---|
| <b>Store downloaded data to</b>                   | Selectable list | The device on which the data are stored. Jobs and data are stored in the internal memory when the chosen data storage device is not available.  |
| <b>Show all file versions within Bricsys 24/7</b> | Check box       | When this box is checked, then all versions of files with the same name are listed. The difference is the time stamp. When this box is not checked, then only the last version of the file is listed. |

### 31.4.3

### Downloading Files

#### Access

Select **Download files** in **Bricsys 24/7** menu.

#### Download Files

All projects, which the current paired instrument has access to, are displayed.

| Key            | Description  |
|----------------|--|
| <b>Open</b>    | To open the project folder and continue to the next panel.                 |
| <b>Fn More</b> | To display information about the time, date, size and format of the files. |

### Description of metadata

| Metadata         | Description   |
|------------------|---|
| -                | The name of the projects. All projects, which the current paired instrument has access to, are displayed.   |
| <b>Format</b>    | Data type as assigned in the Bricsys 24/7 server.   |
| <b>Time</b>      | The time when the project was modified in the Bricsys 24/7 server.  |
| <b>Date</b>      | The date when the project was modified in the Bricsys 24/7 server.  |
| <b>Size (MB)</b> | The size of the project.  |
| <b>Version</b>   | The version of the file according to Bricsys 24/7. In the Captivate software, the version always starts from 1 to n even if the version had been changed directly in the cloud service. |

### Next step

Make a selection and press **Open**.

The file level of the project is displayed. When subfolders are available make a selection again.

The relevant folder types from where data can be downloaded are:

- Documents
- Binder
- BIM

Ticked objects are used for downloading.  
Unticked objects are not used for downloading.

| Key             | Description   |
|-----------------|---|
| <b>Download</b> | To confirm the settings and download the data. Downloaded files are stored to the \DATA folder of the selected memory device. |
| <b>More</b>     | To display information about the the time, date, size and format of the files.  |

### 31.4.4

## Uploading Files

### Access

Select **Upload files** in **Bricsys 24/7** menu.

### Upload Files

The \DATA folder from where data can be uploaded, are displayed.

| Key         | Description  |
|-------------|--|
| <b>Open</b> | To open the folder and continue to the next panel. |

### Description of metadata

| Metadata         | Description   |
|------------------|---|
| -                | The name of the folder.                             |
| <b>Format</b>    | Supported are file format.                          |
| <b>Size (MB)</b> | The size of the folder.                             |
| <b>Source</b>    | The data storage device where the folder is stored. |

### Next step

Make a selection and press **Open**.

Ticked objects are used for sending data.  
Unticked objects are not used for sending data.

| Key         | Description                                  |
|-------------|--|
| <b>Next</b> | To confirm the settings and upload the data. |

### Storage Location

All projects, which the current paired instrument has access to, are displayed.  
Select a folder as destination folder.

| Key           | Description               |
|---------------|---------------------------|
| <b>Open</b>   | To open a project folder. |
| <b>Upload</b> | To start the upload.      |

### Next step

Make a selection and press **Upload**.

**Access**

Select **Leica Captivate - Home: Settings\About Leica Captivate**.

---

**About Leica Captivate,  
CS controller page**

The information relates to the field controller. This panel shows, depending on the controller type:

- The serial number,
- The equipment number,
- The firmware version of the boot software,
- The firmware version for the **Electric Front Interface**,
- If a total station radio installed,
- If Wireless LAN is installed,
- If the internal GSM/CS modem is installed.

**Next step**

**Page** changes to the **Total station** page.

---

**About Leica Captivate,  
Total station page**

The information relates to the TS instrument. This panel shows:

- The type of instrument,
- The serial number,
- The equipment number,
- The firmware version of the boot software,
- The firmware version for the Electric Front Interface,
- System Builder (SB) version
- The version of the EDM
- The version of the Keypad Display Module (KDM)
- The version of the Overview Camera,
- Extra instrument hardware options such as EDM or PowerSearch.

**Next step**

**Page** changes to the **GS sensor** page.

---

**About Leica Captivate,  
GS sensor page**

The information relates to the GS instrument. This panel shows:

- The type of instrument,
- The serial and equipment numbers,
- The software version,
- The information about the **Measurement Engine** and tracking capability,
- The availability of instrument hardware options,
- The maintenance date (CCP end date, **Customer Care Package**),
- The availability of instrument software options

**Next step**

**Page** changes to the **AutoPole** page.

---

**About Leica Captivate,  
AutoPole page**

The information relates to the AP20. This panel shows:

- The type of instrument,
- The serial and equipment numbers,
- The firmware, MCU, CPU and IMU version,
- The availability of instrument hardware options

### Next step



**Page** changes to the **Leica Captivate** page.

---

### About Leica Captivate, Leica Captivate page

This panel shows the apps installed on the instrument, and the following information.

#### Description of fields

| Field                                     | Description  |
|---|--|
| <b>WinEC version</b>                      | Firmware version for WinCE.  |
| <b>Leica Captivate version</b>            | Firmware version for the onboard software. An information is displayed, when a new Leica Captivate version is available in myWorld. For an automatic check, the instrument must be connected to the Internet. For the installation of the new firmware, the <b>Customer Care Package</b> installed must be valid.  |
| <b>API version</b>                        | Firmware version for the app interface.  |
| <b>CCP end date</b>                       | Expiry date of the software maintenance ( <b>Customer Care Package</b> ). When the TS or CS is switched on, a reminder message appears within one month of the due date of the software maintenance or when the software maintenance has expired.<br> The message appears only once!  is displayed on the <b>Leica Captivate - Home</b> until the licence key has been updated.<br>Refer to <a href="#">30.3 Entitlements &amp; licences</a> for updating licence keys. |
| <b>mySecurity end date</b>                | If mySecurity is activated in myWorld: The date when the instrument must be connected to mySecurity in order to renew the security functionality.<br>If mySecurity is not activated in myWorld: <b>Not activated</b> is displayed.   |
| <b>Status of app related licence keys</b> | The information listed here indicates for which apps the licence keys are loaded.  |

### Next step

**Page** changes to another page on this panel.

---

## 33

## Instrument Protection (Theft Protection)

### 33.1

### Anti-Theft Alarm

#### Description

Available on TS and CS in remote mode.

The anti-theft alarm can support a protection against instrument theft while on the working site. The sound is played in highest volume.

When a CS is connected to the TS, a message is displayed on the CS.

1. Set up and level the instrument.
2. Configure a hot key or favourites to activate/deactivate the anti-theft alarm. Refer to [2.2 Configurable Keys](#) for information.
3. Use a hot key to activate the alarm.
4. Perform the survey on the site.
5. When the survey is finished, use a hot key to deactivate the alarm.

### 33.2


### mySecurity

#### Description

mySecurity is a cloud-based theft protection. A locking mechanism ensures that the instrument is disabled and can no longer be used. A Leica Geosystems service centre will inform local authorities if such an instrument turns up.

mySecurity is activated in myWorld.

#### Adding/removing instruments to/from mySecurity

1. Go to myWorld@Leica Geosystems (<https://myworld.leica-geosystems.com>).
-  You must add your instruments to **myProducts** first, before the instruments can be added to mySecurity.
2. Select **myTrustedServices/mySecurity**.  
Available information for listed instruments:
  - Activation date of the mySecurity service
  - Renewal date of the mySecurity service
  - Stolen status, in case of the instrument has been flagged as stolen
3. Click **Add** to add an instrument to mySecurity.  
Select the instrument from the selectable list.  
Click **OK**.
4. Select an instrument.  
Click **Remove** to delete the instrument from mySecurity.

#### Activating the theft protection

For an active theft protection, the instrument must be connected to myWorld within a defined time interval.

If the instrument is not connected within the defined interval, then the instrument is blocked and cannot be used. In this case, the instrument must be connected to myWorld again and the theft protection must be reactivated.

1. Click the check box to select an instrument.
2. Click **Details**.

3. For **New mySecurity Renewal**, set the start date of the theft protection.  
Click **In 3 months**, **In 6 months** or **In 12 months** to define the connection interval.

---

4. Click **Set**.

---

5. Download and install the mySecurity Online Update program.

---

6. The program scans for the instrument connection port automatically.  
In case automatic scanning fails, click **Scan** for a search of the port.  
Select the connection settings.

---

7. Click **Connect**.  
After the activation, the end date of the theft protection is displayed in the mySecurity Online Update program and on the instrument.

---

8. Press **Close**.

---

9. Click the Refresh button to update the screen information.

---

10. Check the status, the activation date and the renewal date of the theft protection.

#### Status information on the instrument

1. Select **Leica Captivate - Home: Settings>About Leica Captivate**.


---

2. Go to the **Leica Captivate** page.


---

3. **mySecurity end date:**  
Displays the date when the instrument must be connected to mySecurity. The date is transferred from myWorld to the instrument.


---

-  Several days before the **mySecurity end date**, a reminder message is displayed each time the instrument is turned on.

---

-  When the **mySecurity end date** has been exceeded, a message informs about the instrument lock. Go to myWorld to renew the theft protection.

---

-  When the instrument is locked,
  - all GeoCom commands for functionality are locked.
  - all GeoCom commands for service are locked except the commands for firmware upgrade.
  - a firmware downgrade using GeoCom is impossible.

#### Report a stolen instrument

1. Go to myWorld@Leica Geosystems (<https://myworld.leica-geosystems.com>).

---

2. Select **myTrustedServices/mySecurity**.

---

3. Click the check box to select an instrument.

---

4. Click **Details**.

---

5. In the **General** section, click **Report as Stolen**.

---

6. A warning comes up to confirm device as stolen.  
Click **OK**.

---

7. The **Status** of the instrument changes to **Stolen!**  
A Leica Geosystems service centre informs local authorities if such an instrument turns up.

## Locate a stolen instrument

If a reported, stolen instrument is registered to myWorld, then the IP address of the computer is logged. The IP address is used to locate the instrument.

In **myWorld/myTrustedServices/mySecurity**, the **Status** of the instrument changes to **Located**.

Clicking **Show Location** shows:

- The date and time when the instrument was located
- The IP address of the computer
- A link to show the location on a map

## 33.3

### LOC8 Theft Deterrence and Location Device (optional)



Refer to the TS User Manual for technical information.

Refer to the LOC8 Configuration Guide for instructions how to activate the device in the Trackimo app prior the usage.

## Description of the working principle

The LOC8 device contains GPS, A-GPS and WLAN to locate the total station in and outdoor.

The LOC8 gets operated from the Trackimo app (Desktop, iOS and Android).

LOC8 can be used for:

- Tracking the position of the total station, on demand or frequently
- Locking the total station remotely or executing an alarm in case the total station gets stolen

The functions within the Trackimo app are mentioned in the LOC8 Configuration Guide and are explained in more detail in the manual provided by Trackimo.

## LOC8 within Captivate

Within Captivate, the device ID and IMEI number required to activate the LOC8 are displayed in **About Leica Captivate, Total station** page (**Settings>About Leica Captivate**).

The total station will shut down automatically after starting up in two cases:

- If the instrument was locked from the Trackimo account.
- If the LOC8 is not attached anymore.



**Description**

Instruments can be equipped with up to two cameras:

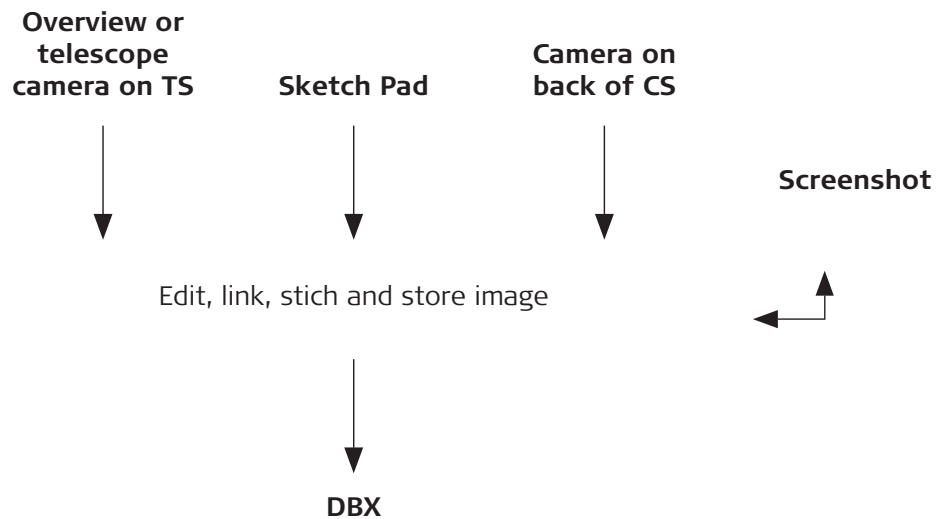
| Type             | Available on                   |
|------------------|--------------------------------|
| Overview camera  | TS16 I, MS60, TS60 I, TM60, CS |
| Telescope camera | TS60 I, TM60, MS60             |
| Camera           | GS18 I                         |

☞ All information in this chapter is related to TS and CS. Refer to [58 GS imaging](#) for information on the camera functionality on GS18 I.




The camera & imaging functionality is an interactive feature embedded in Leica Captivate but used by some apps as well as data management.

- Camera applications:
  - Taking images of survey relevant objects for documentation purposes
  - Visual aiming using the view finder and the digital crosshair
- The images can be linked to points and lines stored in the job.
- Images can be captured in a defined sequence and combined to a panoramic image.
- Screenshots can be taken from the display as additional information.
- Images, screenshots and digital sketches can be edited and sketched on. This functionality is also available on instruments which do not have a camera or an imaging licence.
- Overview and telescope camera images can be transferred from the TS to the CS.
- Images can be exported in DXF and LandXML format.
- The cameras can be switched.

Depending on where the camera & imaging functionality is accessed from, different functionality is available.



 The camera functionality on the TS must be licenced.

1. Select **Leica Captivate - Home: Tap here to create new job.** Create a job. Return to the **Leica Captivate - Home** menu.
2. Select **Leica Captivate - Home: Settings\TS instrument\Cameras.** On the **Overview camera/Telescope camera** page, check **Use TS overview camera/Use TS overview & telescope cameras.** Return to the **Leica Captivate - Home.**
3. Select **Leica Captivate - Home: Setup.** Define the setup. Return to the **Leica Captivate - Home.**
4. Select **Leica Captivate - Home: Measure.** Measure a point.
5. Tap  in the 3D viewer, to switch to the camera view. Tap  to take an image on demand.
6. The image is only displayed, not stored yet.
7. To draw on the image, tap .
8. To store the image, press **Store.**
9. Decide how to link the image:
  - With the last measured point
  - With any point or line
  - No link at all
  - Cancel

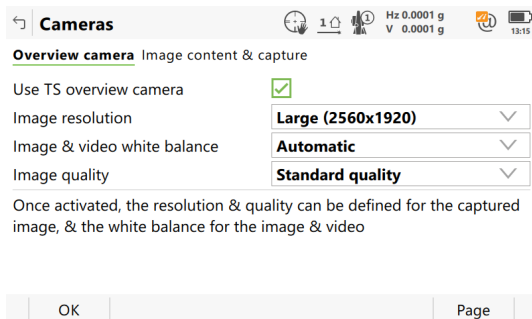
## 34.2

### Camera Settings

#### Access

Select **Leica Captivate - Home: Settings\TS instrument\Cameras.**

#### Cameras, Overview camera/ Telescope camera (for TS60/TM60) page



| Key  | Description  |
|------|--|
| OK   | To accept changes and return to <b>Leica Captivate - Home.</b> |
| Page | To change to another page on this panel.                       |

#### Description of fields

| Field                         | Option    | Description  |
|-------------------------------|-----------|--|
| <b>Use TS overview camera</b> | Check box | Available for TS16 I/MS60/TS60 I/TM60. The overview camera can be physically switched on and off. When this box is checked, the camera is switched on. |

| Field  | Option                  | Description  |
|--|-------------------------|--|
| <b>Use TS overview &amp; telescope cameras</b> | Check box               | Available for MS60/TS60 I/TM60. The overview AND the telescope camera can be physically switched on and off. When this box is checked, the cameras are switched on.                              |
| <b>Image resolution</b>                        | Selectable list         | The resolution has a direct influence on the file size. When images are transferred between TS and CS, select <b>Medium</b> or <b>Small</b> . <b>Small</b> is recommended to save transfer time. |
| <b>Image &amp; video white balance</b>         | Selectable list         | This setting defines the colour impression. If <b>Automatic</b> does not provide satisfying results, select <b>Indoor</b> or <b>Outdoor</b> depending on the surveying environment.              |
| <b>Image quality</b>                           |                         | The grade of compression of the image.   |
|  | <b>Highest quality</b>  | Low jpg compression, better image quality, larger file size  |
|  | <b>Standard quality</b> | Higher jpg compression, standard image quality, smaller file size  |


#### Next step



**Page** to change to the **Image content & capture** page.

#### Cameras, Image content & capture page

| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b> | To change to another page on this panel.                        |

#### Description of fields

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Capture image from overview camera for every measured point</b><br>For MS60/TS60 I/TM60 also:<br><b>Capture image from telescope camera for every measured point</b> | Check box | When this box is checked, an image is taken automatically with every measurement. The order of images taken is: 1. telescope camera, 2. overview camera.<br><br>When this box is not checked, pictures can be taken on demand. Use this option to save power. The active view finder defines the camera source.<br><br>In apps, use the  icon in the 3D viewer page to take pictures.<br><br>Outside of apps, tap the <b>Camera</b> bubble icon in the Battery and Time icon pop-up bubble. Then press <b>Capture</b> . |

| Field  | Option    | Description  |
|--|-----------|--|
|  |           |  Images taken with the camera are always stored related to the active job. The images are stored in a subfolder of the active job. The images can be viewed in the Data Management.   |
| <b>Automatic-ly link captured image to measured point</b>      | Check box | <p>Available when <b>Capture image from overview camera for every measured point</b> or <b>Capture image from telescope camera for every measured point</b> is checked.</p> <p>When this box is checked, the image taken with a measurement is automatically linked to the last measurement taken.</p>  Several images can be linked with one point. One image can be linked to several measured points. <p>When this box is not checked, the image taken with a measurement is not automatically linked to a measurement. The image can be linked manually in data management.</p> |
| <b>Store crosshairs on all captured images</b>                 | Check box | When this box is checked, the crosshair is stored on the picture.  |
| <b>Store data shown in camera view when pressing 'Capture'</b> | Check box | When this box is checked, point and line information is stored on images taken with <b>Capture</b> . The information stored on the image depends on the distance slider and the settings defined in <b>Object Display</b> and <b>Sort &amp; Filter</b> .   |
| <b>Store second image without overlay data</b>                 | Check box | When this box is checked, the image without points and lines is saved additionally.  |

## 34.3

## Taking an Image

### 34.3.1

### Overview

#### Description

- The camera can be used to take images of survey relevant objects.
- The images can be linked to points and lines stored in the job.
- Screenshots can be taken from the display as additional information in support cases.

Functionality is provided by icons in a groupbar. Some of the functions performed by the icons can also be replicated using a key on the keyboard.

## Requirements

- A TS16 I/MS60/TS60 I/TM60 must be used.
- The camera settings must be active. Refer to [34.2 Camera Settings](#).
- The documentation settings must be set. Refer to [34.2 Camera Settings](#).

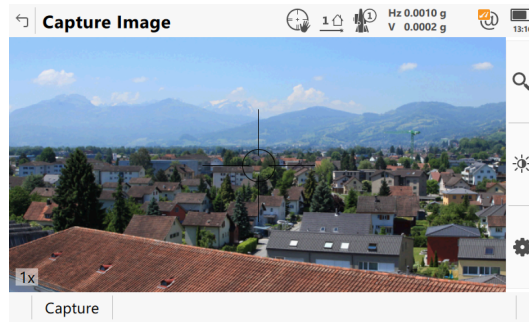
## 34.3.2

### Outside of Apps

#### Access

Tap the **Camera** bubble icon in the Battery and Time icon pop-up bubble. Then press **Capture**.


#### Capture Image

















| Key            | Description  |
|----------------|--|
| <b>Capture</b> | To take an image with the current pixel resolution. The image is then displayed but not stored on the data storage device yet. |










#### Tools

Tools are available in groups. The groups available depend on the active app. Click an icon to display the group of related tools.

 To use the hardware keys, close the split panel so that only the 3D viewer is visible.

| Icon  | Hardware keys   | Description   |
|---|-----------------|---|
|  |                 | Camera view<br>To switch to the telescope camera. The style of the crosshairs changes with the camera in use. |
|  |                 | Camera view<br>To switch to the overview camera. The style of the crosshairs changes with the camera in use.  |
|  | <b>NAVIGATE</b> |   |

| Icon  | Hardware keys     | Description   |
|---|-------------------|---|
|    |                   | <p>Single autofocus<br/>To activate a single autofocus. Single autofocus deactivates continuous autofocus. Same functionality as pressing the autofocus button on the side cover of the instrument.</p> <p> While continuous autofocus is active, any manually measured distance updates the focus position.</p> |
|    |                   | <p>Continuous focus on<br/>To switch on continuous autofocus.</p>   |
|    | 2                 | <p>Zoom +<br/>To zoom into the image.</p>   |
|    | 3                 | <p>Zoom -<br/>To zoom out of the image.</p>   |
|   | <b>BRIGHTNESS</b> |   |
|  |                   | <p>Auto Bright<br/>To turn on automatic brightness.</p>   |
|  |                   | <p>Bright +<br/>To increase the brightness from the current value.</p>  |
|  |                   | <p>Bright -<br/>To decrease the brightness from the current value.</p>  |
|  | <b>SET</b>        |   |
|  |                   | <p>CAD layers<br/>To turn layers of background maps (CAD files) on and off. Refer to <a href="#">6.2 Creating a New Job</a> for information on CAD files.</p>   |

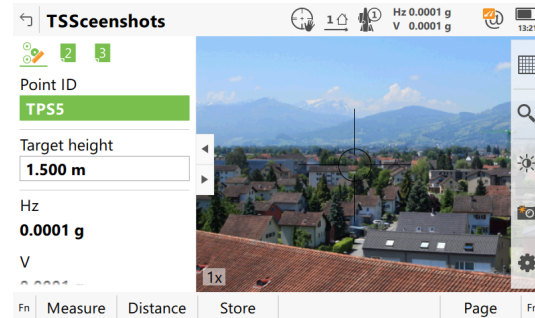
| Icon  | Hardware keys | Description  |
|---|---------------|--|
|    |               | <p>Settings</p> <p>To define the display settings. Change the crosshair colour, what is displayed in the 3D viewer, separately to the plan or orbital views.</p>   |
|    |               | <p>Data range</p> <p>To define a range from the eye point by a minimum and maximum distance. Only data within the range is displayed.</p> <p>Top slider</p> <p>The maximum distance from the eyepoint, for example set to 400.</p> <p>Bottom slider</p> <p>The minimum distance from the eyepoint, for example set to 10.</p> <p>Result</p> <p>Points between 10 m and 400 m from the eyepoint are displayed on the image.</p> <p> To move the slider, tap on the slider, hold and drag it.</p> |
|    | <b>SKETCH</b> |  |
|  |               | <p>Erase</p> <p>To remove sketched lines by moving the stylus over the area.</p>   |
|  |               | <p>On/off</p> <p>To activate sketching.</p>  |
|  |               | <p>Line colour</p> <p>To change the line colour.</p> <p>Tap the icon to open a window displaying line colours for selection. Move the stylus over the window to display more colours.</p> <p>The selected line colour is remembered.</p>   |
|  |               | <p>Line weight</p> <p>To change the line width.</p> <p>Tap the icon to open a window displaying line widths for selection.</p> <p>The selected line width is remembered.</p>   |
|  |               | <p>Text mode on/off</p> <p>To type text into the image. Use the keys on the keypad. Tap the screen to specify the insertion point of the text.</p>   |



## Access

In apps, the map is displayed by default.

## In Measure

The style of the crosshairs changes with the camera in use. Refer to [Tools](#) for information on the toolbar.




| Key               | Description   |
|-------------------|---|
| <b>Measure</b>    | To measure and store distances and angles. If configured, an image is taken automatically. If configured, the image is linked to the point measurement automatically.   |
| <b>Stop</b>       | Available if <b>Measure distance: Continuously</b> and <b>Distance</b> was pressed. Stops the distance measurements. The key changes back to <b>Measure</b> .   |
| <b>Distance</b>   | To measure and display distances.   |
| <b>Store</b>      | To record data. If <b>Measure distance: Continuously</b> and/or <b>Automatically measure points</b> is checked, measured points are recorded and tracking continues. If configured, an image is taken automatically. <ul style="list-style-type: none"> <li> Depending on the setting, crosshairs are stored on top of the image.</li> <li> For the overview camera: If a valid distance measurement is available, then the parallax is corrected and the crosshairs are overlaid on the image on their true position.</li> </ul> |
| <b>Page</b>       | To change to another page on this panel.  |
| <b>Fn Display</b> | To configure what is displayed in 3D viewer. Refer to <a href="#">Object Display, General page</a> .  |
| <b>Fn 2 Face</b>  | Available for <b>Measure distance: Once</b> and <b>Measure distance: Once &amp; fast</b> . To take an angle and distance measurement in Face I and Face II. The point stored is an average of the two measurements. Using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face.   |
| <b>Fn Tools</b>   | Refer to <a href="#">39 Apps - The Toolbox</a> .  |



## In Total Station Setup

In the Setup app, points can be linked with images. Depending on the setting, the images are linked either automatically or manually.

A **Camera** page is displayed. Depending on the panel, the available keys differ. The style of the crosshairs changes with the camera in use.

Click  to take an image with the current pixel resolution. The image is then displayed but not stored on the data storage device yet. In case of multiple backsight setups, link the image with the next or the previous target.

| Key               | Description  |
|-------------------|--|
| <b>OK</b>         | For <b>Setup method: Set orientation</b> : To set the setup and orientation and exit the Setup app.<br>If configured, an image is taken automatically, also for two face measurements.<br>If configured, the image is linked to the point measurement automatically.   |
| <b>Measure</b>    | For <b>Setup method: Multiple backsights</b> : To measure and store the distances and angles made to the control points.<br>If configured, an image is taken automatically, also for two face measurements.<br>If configured, the image is linked to the point measurement automatically.<br>For measurements in two faces, two images are linked with one point.  |
| <b>Distance</b>   | To measure and display distances.  |
| <b>Store</b>      | For <b>Setup method: Set orientation</b> : To store the measurement with or without a distance.<br>For <b>Setup method: Multiple backsights</b> : To record display values temporarily. The target measurements are not stored to the current job until the setup is set.<br>If configured, an image is taken automatically, also for two face measurements.<br>If configured, the image is linked to the point measurement automatically.<br>For measurements in two faces, two images are linked with one point. |
| <b>Page</b>       | To change to another page on this panel.   |
| <b>Fn Display</b> | To configure what is displayed in 3D viewer. Refer to <a href="#">37.3 Configuring 3D viewer</a> .   |

## Object Display, General page

### Description of fields

| Field                     | Option    | Description  |
|---------------------------|-----------|--|
| <b>Display crosshairs</b> | Check box | For TS: If no distance is measured, then the coarse-style crosshair is indicated which is approximately the field of view. |

| Field                    | Option          | Description   |
|--------------------------|-----------------|---|
|                          |                 | <p>If a valid distance is measured and the parallax can be resolved, then the fine-style crosshair is indicated as two intersecting lines on the true position. When the instrument turns about three gon in horizontal or vertical direction after measuring a distance, then the crosshair style changes back to the field of view variant.</p> <p>In tracking mode, the crosshairs are always on the correct position and displayed as two intersecting lines.</p> <p>When locked onto a prism, the crosshair style adapts with distance measurements.</p> |
| <b>Crosshairs colour</b> | Selectable list | Available if <b>Display crosshairs</b> is checked. Defines the colour of the crosshairs.  |

#### Next step

Page to change to the **Points** page.

## Object Display, Points page

#### Description of fields


| Field   | Option    | Description   |
|---|-----------|---|
| <b>Points</b>                                       | Check box | <p>When this box is checked, points from the job with 3D local grid coordinates are displayed on the view finder. Use the display of points to check completeness and reliability of the survey.</p> <p>Points are displayed with a visual 3D effect: Points further away from the instrument are displayed smaller than points closer to the instrument.</p> |
| <b>Point IDs, Point codes, Height of points</b>     | Check box | When this box is checked, the relevant information of a measured point is displayed next to the point symbol.   |
| <b>Only show points measured from current setup</b> | Check box | In addition to the selected number of points, the points displayed can be restricted further by showing only points measured from the current setup.  |

#### Next step

Page changes to the **Lines & alignments** page.

**Object Display,  
Lines & alignments  
page**

**Description of fields**

| Field                              | Option             | Description  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
|------------------------------------|--------------------|--|--|--------------------|----------------|-----------------|----------|----------|-----------------|----------|----------|----------------|----------|----------|
| <b>Lines</b>                       | Check box          | <p>When this box is checked, lines from the job with 3D local grid coordinates are displayed on the view finder. Use the display of points to check completeness and reliability of the survey.</p> <p>Points are displayed with a visual 3D effect: Points further away from the instrument are displayed smaller than points closer to the instrument.</p> <p> Points are only displayed on the image. They are not saved with the image.</p> |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Line IDs</b>                    | Check box          | When this box is checked, then the line IDs are displayed with the lines.  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Alignments</b>                  | Check box          | When this box is checked, then the active alignment of the active Rail, Road or Tunnel job is displayed.   |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Alignment ID</b>                | Check box          | When this box is checked, then the line IDs for all shown alignments are displayed in.   |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Lines &amp; alignments size</b> |                    | <p>Determines the thickness of selected and non-selected lines.</p> <table border="1"> <thead> <tr> <th></th> <th>Non-selected lines</th> <th>Selected lines</th> </tr> </thead> <tbody> <tr> <td><b>3 pixels</b></td> <td>3 pixels</td> <td>6 pixels</td> </tr> <tr> <td><b>2 pixels</b></td> <td>2 pixels</td> <td>4 pixels</td> </tr> <tr> <td><b>1 pixel</b></td> <td>1 pixels</td> <td>3 pixels</td> </tr> </tbody> </table>  |  | Non-selected lines | Selected lines | <b>3 pixels</b> | 3 pixels | 6 pixels | <b>2 pixels</b> | 2 pixels | 4 pixels | <b>1 pixel</b> | 1 pixels | 3 pixels |
|                                    | Non-selected lines | Selected lines   |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>3 pixels</b>                    | 3 pixels           | 6 pixels   |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>2 pixels</b>                    | 2 pixels           | 4 pixels   |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>1 pixel</b>                     | 1 pixels           | 3 pixels   |  |                    |                |                 |          |          |                 |          |          |                |          |          |

**Next step**

**Page** changes to the **Scans** page.

**Object Display,  
Scans page**

**Description of fields**

| Field                         | Option          | Description  |
|-------------------------------|-----------------|--|
| <b>Scans</b>                  | Check box       | When this box is checked, then scan areas previously defined are displayed in 3D viewer. |
| <b>Colour scans using</b>     | Selectable list | This colour is used for the previously defined scan areas.                               |
| <b>Point cloud point size</b> | Selectable list | This size is used for the points of the scan areas.                                      |

**Next step**

**Page** changes to the **DTM** page.

## Object Display, DTM page

### Description of fields

| Field      | Option          | Description   |
|------------|-----------------|---|
| DTMs       | Check box       | When this box is checked, then the active DTM of the DTM job is displayed in 3D viewer. |
| DTM colour | Selectable list | This colour is used for the DTM and for the text related to the DTM.                    |

### Next step

Page changes to the **Background map** page.

## Object Display, Background map page

| Key    | Description   |
|--------|---|
| OK     | To confirm the selections and to return to the panel from where this panel was accessed.  |
| Images | Available for <b>Display map: From files</b> . To select the geo-referenced aerial photograph as background image to be used. Opens <b>Map Images</b> . Refer to <a href="#">Map Images</a> . |
| Page   | To change to another page on this panel.  |

### Description of fields

| Field       | Option           | Description  |
|-------------|------------------|--|
| Display map | None             | When this box is checked, then no background images are displayed in 3D viewer.  |
|             | From web service | A geo-referenced imaged streamed by a Web map service is displayed in 3D viewer.   |
|             | From files       | Geo-referenced aerial photographs are displayed in 3D viewer. <b>Images</b> to select the photo.   |
| Web service | Selectable list  | Available for <b>Display map: From web service</b> . To select the Web Map service to be used. Open the selectable list to access the <b>Web Services</b> panel. Refer to <a href="#">Web Services</a> . |

## 34.3.4

### Screenshot

#### Description

Press  and .

The screenshot is displayed and can be edited by sketching.

The screenshot can be linked with points manually. Sketching on the screenshot is possible.

The screenshot is stored as jpg with a predefined compression rate. The resolution is 640 x 480. Screenshots can be georeferenced by linking to a point. Screenshots cannot be orientated and calibrated.

**Description**

A panoramic image is a combination of single images. Panorama images show the area of what can be seen from the instrument setup. Panorama images are used for documentation purposes and support the evaluation of the surveying data directly in the field or in the office. Panorama images can be imported into Infinity.

Panoramic images can be generated independent of any app.

A panorama is organised with a panorama instance within the DBX. The single images are stored in the DBX\JOB\IMAGES folder of the data storage device. The single images are named `Img_Pano_x_y_date_time.jpg`.

| Field | Description   |
|-------|---|
| x     | Number of the row, starts with upper left corner      |
| y     | Number of columns, starts with upper left corner data |
| Date  | Same as with normal images                            |
| Time  | Same as with normal images                            |



Panoramic images can only be generated with motorised instruments with overview camera (TS16 I/MS60/TS60 I/TM60).

**Access**

In **Leica TS Favourites** click **Panoramic image**.

OR

Press a function key configured with the option **User - Capture panoramic image**.

OR

At the end of Setup, a panoramic image can be taken.

**Define Panoramic Image****Description of fields**

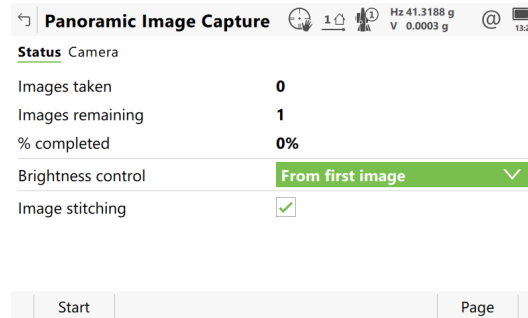
| Field             | Option                       | Description   |
|-------------------|------------------------------|---|
| <b>Image type</b> | <b>Rectangular area</b>      | Area defined by upper left and lower right corner             |
|                   | <b>Multi-row 360° image</b>  | 360° with one or more rows above each other                   |
|                   | <b>Single row 360° image</b> | 360° in one row   |
|                   | <b>Polygonal area</b>        | Area defined by three or more corners in clockwise direction. |

**Next step**

**OK** and follow the instructions on the panel to define the area.

Once the panoramic image area is defined then the **Panoramic Image Capture** panel opens.

## Panoramic Image Capture



| Key            | Description   |
|----------------|---|
| <b>Start</b>   | To start taking the panorama images.                                    |
| <b>Stop</b>    | To end taking the panorama images.                                      |
| <b>Pause</b>   | To pause taking the panorama images.                                    |
| <b>Resume</b>  | To continue taking panorama images after <b>Pause</b> has been pressed. |
| <b>Fn Exit</b> | To exit the panel.  |

### Description of fields

| Field                     | Option   | Description  |
|---------------------------|--|--|
| <b>Images taken</b>       | Display only   | The number of captured images.   |
| <b>Images remaining</b>   | Display only   | The number of images remaining to be taken.  |
| <b>% completed</b>        | Display only   | In percent, the number of images taken against the total number of images which must be taken.   |
| <b>Image file name</b>    | Display only   | The name of the file where the image is stored to.   |
| <b>Brightness control</b> | <p><b>From first image</b></p> <p><b>From each image</b></p> | <p>To control the brightness of each tile of the panorama image.</p> <p>The brightness is measured for first image of the panorama. The value is applied to all further tiles. Recommended for panorama images taken under normal conditions</p> <p>The brightness is measured for each image of the panorama. Recommended for panorama images with diverse brightness.</p>                                    |
| <b>Image stitching</b>    | Check box  | <p>When this box is checked, a stitched panoramic image is created and stored.</p> <p>Possibilities:</p> <ul style="list-style-type: none"> <li>• Colouring of any related scan</li> <li>• Panoramic image is exported to any export</li> <li>• Documentation onboard</li> </ul> <p>Stitching combines multiple images with overlapping fields of view to one segmented panorama or high-resolution image.</p> |

| Field | Option | Description  |
|-------|--------|--|
|       |        | When this box is not checked, the image is not stitched. No name of the panoramic image is added to the DBX. |

### Next step

The panorama and the images are stored in the images folder of the job, either with or without link to the reference triplet of the current setup.



An image belonging to a panorama image can be linked manually with another object without affecting the panorama image.

## 34.4

### Image Management



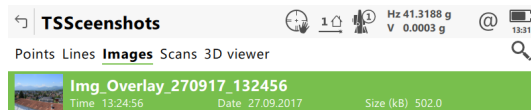
Image Management is available on instruments which have a camera.

#### Access

1. Select **View & edit data** from the job menu.
2. **Page** until the **Images** page is active.

#### Job name, Images page

Listed are all images in the job with information about the image size and the time and the date of when the image was stored.



Fn OK Link Sketch Delete Page Fn

| Key              | Description   |
|------------------|---|
| <b>OK</b>        | To close the panel and return to the panel from where this panel was accessed.                |
| <b>Link</b>      | To display a points list and to link the image to a point.                                    |
| <b>Sketch</b>    | To display an image and to draw on the image. Refer to <a href="#">Image Viewer</a> .         |
| <b>Delete</b>    | To delete the highlighted image and all its links.  |
| <b>Page</b>      | To change to another page on this panel.  |
| <b>Fn Filter</b> | To define sort and filter settings. Refer to <a href="#">Sort &amp; Filter, Images page</a> . |

#### Image Viewer

Use the arrow keys on the keypad to move the image on the panel.

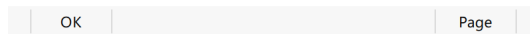
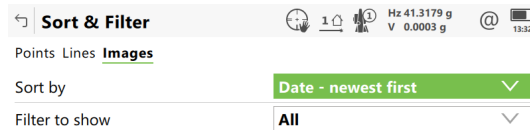
| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store the image with the added link or a sketch created. If no sketch was created, then the image is not stored a second time to avoid a loss of quality. |

| Key             | Description   |
|-----------------|---|
| <b>Previous</b> | To display the previous image in the list of images. Available unless the beginning of the list is reached. |
| <b>Next</b>     | To display the next image in the list of images. Available unless the end of the list is reached.           |

### Next step

**Store** returns to **Job name, Images** page.

## Sort & Filter, Images page



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To close the panel and return to the panel from where this panel was accessed. The selected sort and filter settings are applied. |
| <b>Page</b> | To change to another page on this panel.  |

### Description of fields

| Field                 | Option                         | Description   |
|-----------------------|--------------------------------|---|
| <b>Sort by</b>        | <b>File name - ascending,</b>  | Always available. The method the images are sorted by.  |
|                       | <b>File name - descending,</b> |   |
|                       | <b>Date - oldest first</b> and |   |
|                       | <b>Date - newest first</b>     |   |
| <b>Filter to show</b> | <b>All</b>                     | Always available. The method by which the images are filtered.  |
|                       | <b>Image source</b>            | Shows all images.   |
|                       | <b>Camera type</b>             | Shows photos taken with the camera or screenshots. Make the selection in the <b>Image source</b> field. |
|                       | <b>Linked / unlinked</b>       | Shows images taken with the TS13/TS16 or CS camera. Make the selection in the <b>Camera type</b> field. |
| <b>Image source</b>   |                                | Shows linked or unlinked images. Make the selection in the <b>Image</b> field.                          |
|                       |                                | Available for <b>Filter to show: Image source</b> .   |



| Field              | Option                  | Description  |
|--------------------|-------------------------|--|
|                    | <b>Camera</b>           | Shows images taken with the camera on the TS13/TS16 or CS.   |
|                    | <b>Screenshot</b>       | Shows pictures taken from the instrument panel.  |
|                    | <b>Field sketch</b>     | Shows field sketches created.  |
| <b>Camera type</b> |                         | Available for <b>Filter to show: Camera type</b> .   |
|                    | <b>Overview camera</b>  | Shows images taken with the overview camera on the instrument.   |
|                    | <b>CS camera</b>        | Shows images taken with the camera on the CS.  |
|                    | <b>Telescope camera</b> | Shows images taken with the telescope camera on the instrument.  |
| <b>Image</b>       | Selectable list         | Available for <b>Filter to show: Linked / unlinked</b> . Either linked or unlinked images are displayed. |

#### Next step

**OK** returns to **Job name, Images** page.

## 34.5

### Sketching on Images

#### Description

A sketch can be overlaid on an image taken with a camera.


A sketch can be made on every jpg file stored in the DBX\JOB\IMAGES folder of the job.

The sketch is stored together with the image in jpg format. The compression rate is specified in the **Cameras** panel.



#### Access step-by-step

##### In data management

The image is already stored and possibly linked.

1. Select **View & edit data** from the job menu.
2. **Page** until the **Images** page is active.
3. Press **Sketch**.
4. Click the  icon in the toolbar.  
Refer to [Tools](#) for a description of icons.

##### For images

1. Start the Measure or Setup app and go to 3D viewer.
2. Click the  icon. The image is taken as with a digital camera.
3. Click the  icon in the toolbar.  
Refer to [Tools](#) for a description of icons.

##### For screenshots



1. Press  and .
2. The screenshot is displayed and can be edited by sketching.

## 34.6


## Exporting Images

---

### Exporting images in DXF format

1. Select **Export data\DXF** from the job menu.
  2. **Fn Settings** goes to **Settings, Objects to be exported** page.
  3. Checking **Images** activates the export of images linked with any point or line.
-  If multiple images are linked with one point or one line, then all images linked are exported.
-  Images are exported according to the filter settings. Press **Filter** to check the settings.
- 

### Exporting images in XML format

1. Select **Export data/XML** from the job menu.
  2. **Fn Settings** accesses **Settings, Export** page.
  3. Checking **Images** activates the export of images linked with any point or line.
-  Images are exported according to the filter settings. Press **Filter** to check the settings.
-

## 35

## TS Functions

### 35.1

### EDM

#### Description

Electronic **D**istance **M**easurement **EDM** is the function used for distance measurements.

There are different modes the instrument can work in. Refer to [23.1.1 Measure & Target](#).

### 35.2

### Prism Search Methods

#### 35.2.1

#### Automatic aiming

#### Description

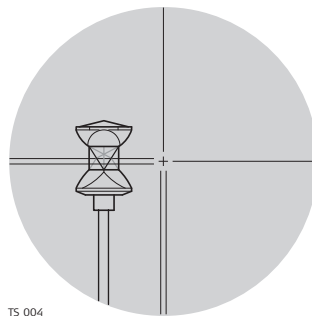
Automatic aiming is the function which recognises and measures the position of a prism using a CCD array. A laser beam is transmitted and the built-in CCD array receives the reflected beam. The position of the reflected spot is computed regarding the centre of the CCD. These automatic aiming offsets are used to correct the horizontal and vertical angles. The automatic aiming offsets are also used to control the motors which turn the instrument to centre the crosshairs to the prism. In order to minimise the time for measuring, the crosshairs are not moved to the exact centre of the prism. The automatic aiming offset can be up to 500 cc depending on selected **Measure distance**. The automatic aiming function measures the offsets between the crosshairs and prism centre and corrects the horizontal and vertical angles accordingly. Therefore the horizontal and vertical angles are measured to the prism-centre, even if the crosshairs are not aimed precisely at the centre of the prism.

Motorised instruments can be equipped with automatic aiming. For **Aim at target: Automatic** the instrument can find a static prism and measure a distance once **Measure** or **Distance** is pressed. The instrument does not follow a moving prism.

#### Field of view

The telescope field of view is the region seen when looking through the telescope. The automatic aiming field of view is the region seen by the automatic aiming. Both are identical on TS instruments.

#### Automatic aiming measurement



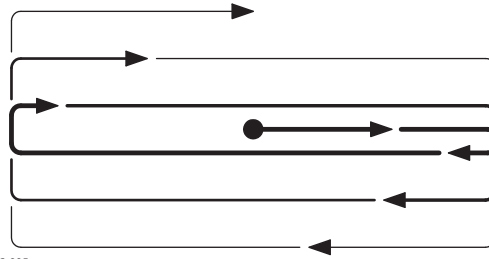
If the prism is in the field of view with **Aim at target: Automatic** the crosshairs are automatically positioned to the prism when, for example **Measure** or **Distance** is pressed. No automatic aiming search is started.



The displayed values are always related to the centre of the prism after **Measure** or **Distance** is pressed. For **Measure**, these values are displayed only shortly after the key press.

The crosshairs of the telescope may not fully coincide with the centre of the prism when viewed through the telescope. The remaining automatic aiming offsets for the horizontal and vertical angles are measured by the automatic aiming function and applied to the measured and displayed angles.

## Automatic aiming search



If the prism is not in the field of view when **Measure** or **Distance** is pressed, an automatic aiming search is started. For the automatic aiming search the automatic aiming window is scanned line by line starting at the current telescope position.

### If the prism was not found

- **Search** can be pressed to search for the prism in an increased area. The telescope move automatically.
- **Retry** can be pressed to search for the prism under unfavourable conditions. The telescope does not move. Make sure that the prism is within the field of view.

### If the prism was found

The automatic aiming measurement is performed to position the telescope to the centre of the prism.

## Automatic aiming window

The automatic aiming window is a relative window based on the current telescope position. The horizontal and vertical extent can be defined.

## Fine search window

If no target is found after the prediction time and **If no target found after prediction then: Start fine search** is set, then the prism is searched for with automatic aiming using a dynamic automatic aiming window. This window covers a horizontal region from the position of loss of lock to the current telescope position, and the same extent on the other side. The vertical dimension of the dynamic window is one third of the horizontal expansion.

## Targeting modes

Refer to [23.1.1 Measure & Target](#).

## 35.2.2

### PowerSearch

## Description

The PowerSearch module allows an automatic prism detection within a short time period. The PowerSearch function can be started in the icon bar and configured in **Settings\TS instrument\Target search, PowerSearch window** page.

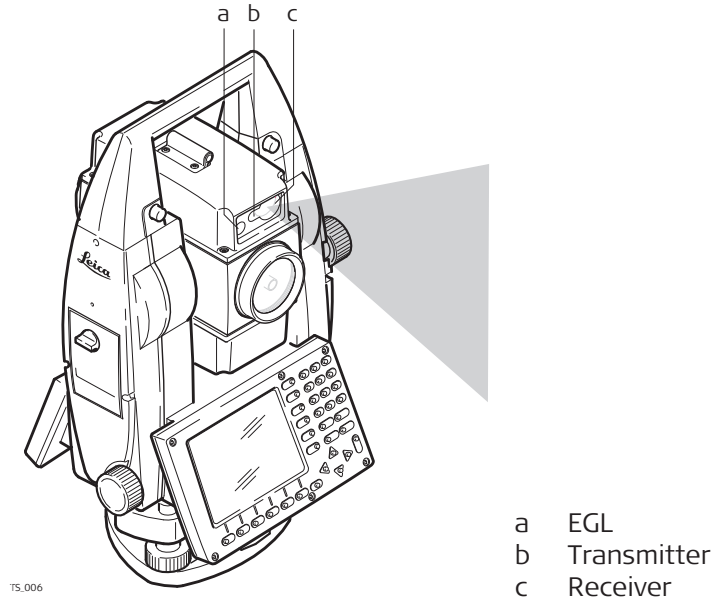


TS13 is equipped with SpeedSearch. SpeedSearch differs in performance compared to PowerSearch.

## Functionality

The PowerSearch function consists of a transmitter (a) and a receiver (b). Both are installed in the telescope.

When PowerSearch is activated, the instrument starts to rotate around its standing axis. The transmitter emits a vertical laser swath. If the laser swath detects a prism, the rotation of the instrument is stopped. Afterwards an automatic aiming measurement in the vertical direction is performed.



If a PS filter is active, PowerSearch ignores the prisms defined in the filter.



If a PS window is defined and active, PowerSearch is executed within the defined limits.

## 360° search

If the search window is not defined and PowerSearch is started, the prism is searched for with PowerSearch in the 360° window. The default search with PowerSearch consists of a short swing in anti-clockwise direction followed by a complete 360° turn in clockwise direction. If a prism is detected the movement is stopped and an automatic aiming search is performed.

## PowerSearch filter

A PowerSearch filter can be applied to exclude disturbing prisms from PowerSearch.

The PowerSearch filter can be defined in two ways:

1. Performing a PowerSearch scan:  
Select the **Filter learn** bubble icon in the **Aim & Search** icon pop-up bubble.
2. Adding setup points to the PowerSearch filter:  
In the **Setup** app, check **Add target points to the PowerSearch filter** in the **Settings, General** page.

The PowerSearch scan finds prisms and other reflective spots in the surrounding of the instrument. Around each found prism or reflective spot, an exclusion area is defined. The exclusion area has the dimension of  $H_z = \pm 1$  gon,  $V = \pm 50$  gon and  $d = \pm 12$  m.

After defining the filter, the filter is switched on: **Filter on** is displayed in the **Aim & Search** icon pop-up bubble.

The PowerSearch filter can be switched on and switched off in the **Aim & Search** icon pop-up bubble.

After clicking the **Filter off** bubble icon, the filter is deactivated, but not deleted. The filter can be switched on again using **Filter on**.

When no filter is learned, the bubble icons **Filter on** and **Filter off** are not shown.

When pressing the **Filter learn** bubble icon, the instrument performs a PowerSearch scan. The scan order is:

- 400 gon PowerSearch rotation around Hz with a V angle of 100 gon
- 400 gon PowerSearch rotation around Hz with a V angle of 60 gon
- 400 gon PowerSearch rotation around Hz with a V angle of 140 gon

When learning the filter, a previous filter is deleted.

When measuring new points for a setup, the current filter is updated.

The PowerSearch filter is reset after a new setup.

The PowerSearch filter is kept when shutting down and restarting the instrument.

---

#### PowerSearch window

The PowerSearch window can be defined individually. It is specified by absolute angle values and does not change its position. The PowerSearch window can be set in the **Target Search, PowerSearch window** page by aiming at two opposite points of the PowerSearch window. When **Use PowerSearch window** is checked and a PowerSearch is started, a prism is searched for within the defined window.

---

#### Dynamic PowerSearch window

When **Use PowerSearch window** is not checked and the instrument has lost lock, after the prediction time, the prism is searched for in a dynamic PowerSearch window. This window covers a region at the position after prediction of horizontal 100 gon by vertical 40 gon.

---

#### Direction of search

The PowerSearch routine can be activated clockwise or anticlockwise by using hotkeys. This action will have no influence on the prism search settings.

---

### 35.3

---

#### Follow Moving Prisms - Lock

---

#### Description

Lock enables instruments equipped with automatic aiming to follow a moving prism. The automatic aiming sensor is active when Lock is active. When **Target lock on** is selected in the icon bar, an automatic aiming search is executed. The instrument locks onto the prism and follows its movements. Automatic aiming offsets are continuously applied to the angle measurements. When the instrument loses lock to the prism, a PowerSearch or fine search (auto aiming search) can be executed depending on the prism search settings.

Lock is unavailable for SmartStation.



If the speed of the prism is too fast, the target may be lost. Make sure that the speed does not exceed the figure given in the technical data.

---

## Enable lock

Selecting **Target lock on** in the icon menu, will immediately activate an automatic aiming search to find the prism. Alternatively, as long as **Aim at target** is set to **With lock** in **Measure & Target**, then pressing **Measure, Distance, PowerSearch, OK** in **Check Point** and **Turn Using Arrow Keys, Turn Instrument to Hz/V** and starts a PowerSearch or automatic aiming search to find the prism. When the prism is found, the instrument locks onto the prism. The instrument follows the moving prism and the automatic aiming function remains active.

## Loss of lock

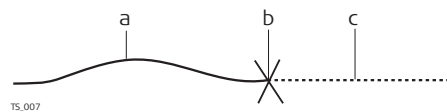
When the instrument is locked onto a prism, lock may be lost if the movement of the prism is too fast for the instrument to follow or the prism is hidden behind an object. After lock is lost, the prediction, as set in **Target Search** is used to find the prism again.

The automatic aiming function is still active.



Whenever the prism is moved in the field of view during the prediction and any other search periods, the instrument locks automatically to the prism.

## Prediction



- a Moving prism locked onto by the instrument
- b Loss of lock
- c Prediction

As long as the prism is being tracked by the instrument a mathematical filter continuously calculates the average speed and direction of the prism. If the line of sight between instrument and prism is disturbed, the instrument keeps on moving using these calculated values. This behaviour is called prediction. The prediction time can be configured. During prediction, the LOCK icon is displayed and if the prism comes into the instruments field of view again the automatic aiming will lock to the prism.

## Prism search after prediction

After prediction, the prism is searched for depending on the settings in **Target Search**.

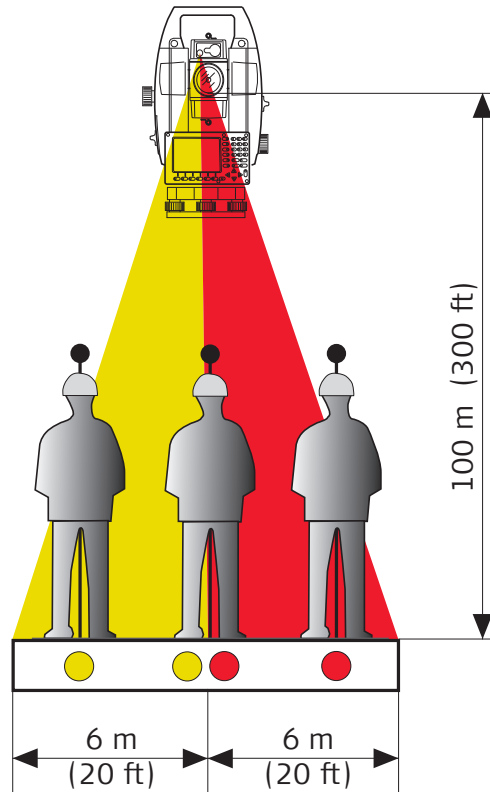
- **If no target found after prediction then: Wait & lock.** If the prism moves into the field of view, the prism is not searched for until **Measure, Distance, Target lock on** is pressed.
- **If no target found after prediction then: Start fine search:** prism is searched for in the dynamic automatic aiming window with automatic aiming.
- **If no target found after prediction then: Start CubeSearch** and **Use PowerSearch window** is checked: prism is searched for in the PS window with PowerSearch.
- **If no target found after prediction then: Start CubeSearch** and **Use PowerSearch window** is NOT checked: prism is searched for in the dynamic PowerSearch window.

## Relock

Independent of the setting for **If no target found after prediction then** the instrument can relock to the prism. Refer to paragraph [Enable lock](#).

**Description**

The **Emitting Guide Light**, EGL, consists of two differently coloured flashing lights in the telescope housing of the TS. The EGL is used for guidance into the line of sight. If the left light is seen, the prism must be moved right and vice versa. If both flashing lights can be seen, the prism is in the line of sight of the instrument.

**Functionality**

TS.008

The EGL can be used

- to help guide the prism into the telescope line of sight when the instrument is controlled remotely and **Aim at target: With lock**.
- to stake out points.

The instrument emits two differently coloured flashing cones of light. At a target distance of 100 m, the cones have a width of 6 m. Between the two cones of light, a sector with a width of 30 mm is created where both guide lights are visible simultaneously. In this position, the prism is in the line of sight of the instrument.

**Using the EGL step-by-step**

1. Check **Use the instrument guide lights (EGL)** in the **Instrument Lights** panel.  
OR  
Set **Aim at target: With lock** and press **Turn to Hz/V** in the icons menu.
2. Align instrument line of sight and prism, where both flashing EGL lights can be seen simultaneously.
3. **OK** to lock onto the prism.



4. If the instrument has locked onto the prism the EGL is turned off automatically.



If the EGL was turned on in **Instrument Lights**, it must be turned off by unchecking the check box.

## 35.5

### Illumination

#### Description

There are several different illumination types built into the instrument that all fulfil different functions. Some are to support measurements, for example the visible red laser pointer. Others, such as the screen illumination, are for more convenient work with the instrument. These different types of illumination are described in this chapter.

#### Laser plummet

The laser plummet allows setting up the instrument over a marked point. The laser beam is emitted from the bottom of the instrument, pointing to the ground. When the instrument is levelled and the laser beam points exactly at the ground point, the instrument is set up correctly.

The laser plummet can be turned on and off. It is turned on automatically when opening **Settings\TS instrument\Level & compensator**.

#### Visible red laser pointer

The visible red laser pointer is used to measure to any surface. The visible red laser pointer is arranged coaxially with the line of sight of the telescope and emitted through the objective. If the instrument is correctly adjusted, the visible red laser beam coincides with the line of sight.



The direction of the beam should be inspected before precise distance measurements are executed. An excessive deviation of the laser beam from the line of sight can cause inaccurate results.

## 35.6

### Connection to Other Total Stations

#### 35.6.1

#### Leica Legacy Total Stations

#### Supported functions

| Function             | TPS300<br>TPS400<br>TPS700 | TPS700A        | TPS800 | TPS1000<br>TPS1100 |
|----------------------|----------------------------|----------------|--------|--------------------|
| Robotic control      | -                          | -              | -      | -                  |
| Auto aiming          | -                          | ✓              | -      | ✓                  |
| Level bubble         | -                          | -              | -      | -                  |
| Auto aiming in setup | -                          | ✓ <sup>1</sup> | -      | ✓ <sup>1</sup>     |
| Compensator on/off   | ✓                          | ✓              | ✓      | ✓                  |
| Laser plummet on/off | ✓                          | ✓              | ✓      | -                  |
| Laser pointer on/off | ✓                          | ✓              | ✓      | -                  |
| EGL on/off           | ✓                          | ✓              | ✓      | ✓                  |
| Connection status    | ✓                          | ✓              | ✓      | ✓                  |
| TS battery status    | -                          | -              | -      | -                  |

| Function  | TPS300<br>TPS400<br>TPS700   | TPS700A | TPS800 | TPS1000<br>TPS1100 |
|---|--|---------|--------|--------------------|
| Move between measurements to any surface or prism | ✓  | ✓       | ✓      | ✓                  |
| Measure distances continuously                    | ✓  | ✓       | ✓      | ✓                  |
| Auto logged points                                | ✓  | ✓       | ✓      | ✓                  |
| ✓   | Supported  |         |        |                    |
| -   | Not supported  |         |        |                    |
| 1   | The auto aiming function when doing a setup only works if a distance is measured. The <b>Meas</b> or <b>Dist</b> key must be used. When using the <b>Store</b> key only, the auto aiming function in setup is unavailable. |         |        |                    |



SmartPole and SmartStation are not supported with Leica Legacy instruments.



Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

## 35.6.2

### Topcon

#### Supported functions

| Function  | GTS<br>GPT<br>GPT-L | GTS800<br>GTS820<br>GTS900 | GPT8000<br>GPT8200<br>GPT9000 |
|---|---------------------|----------------------------|-------------------------------|
| Robotic control                                   | -                   | -                          | -                             |
| Auto aiming                                       | -                   | -                          | -                             |
| Level bubble                                      | -                   | -                          | -                             |
| Compensator on/off                                | -                   | -                          | -                             |
| Laser plummet on/off                              | -                   | -                          | -                             |
| Laser pointer on/off                              | -                   | -                          | -                             |
| EGL on/off  | ✓                   | ✓                          | ✓                             |
| Connection status                                 | ✓                   | ✓                          | ✓                             |
| TS battery status                                 | -                   | -                          | -                             |
| Move between measurements to any surface or prism | ✓                   | ✓                          | ✓                             |
| Measure distances continuously                    | -                   | -                          | -                             |
| Auto logged points                                | -                   | -                          | -                             |
| ✓   | Supported           |                            |                               |
| -   | Not supported       |                            |                               |



Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

### 35.6.3

### Sokkia

#### Supported functions

| Function  | Sokkia Set030R/220/010 | Sokkia Set10/10K Series<br>Sokkia Set 20/20K Series<br>Sokkia Set 30R/30RK/130R | Sokkia Set 110 Series<br>Sokkia Set110R<br>Sokkia Set 120 Series | Sokkia Set 110M Series | Sokkia Set 230RM Series | Sokkia Set300/500/600<br>Sokkia SRX Series | Sokkia Set X Series<br>Sokkia Set SCT6 |
|---|------------------------|---|--|------------------------|-------------------------|--|--|
| Robotic control                                   | -                      | -   | -  | -                      | -                       | -  | -                                      |
| Auto aiming                                       | -                      | -   | -  | -                      | -                       | -  | -                                      |
| Level bubble                                      | -                      | -   | -  | -                      | -                       | -  | -                                      |
| Compensator on/off                                | -                      | -   | -  | -                      | -                       | -  | -                                      |
| Laser plummet on/off                              | -                      | -   | -  | -                      | -                       | -  | -                                      |
| Laser pointer on/off                              | -                      | -   | -  | -                      | -                       | -  | ✓                                      |
| EGL on/off  | -                      | -   | -  | ✓                      | -                       | ✓  | -                                      |
| Connection status                                 | ✓                      | ✓   | ✓  | ✓                      | ✓                       | ✓  | ✓                                      |
| TS battery status                                 | -                      | -   | -  | -                      | -                       | -  | -                                      |
| Move between measurements to any surface or prism | 1                      | -   | -  | -                      | ✓                       | ✓  | ✓                                      |
| Measure distances continuously                    | ✓                      | ✓   |  |                        |                         | ✓  | ✓                                      |
| Auto logged points                                | ✓                      | ✓   | n/a  | n/a                    | n/a                     | ✓  | ✓                                      |
| Others  | 2                      | -   | -  | -                      | -                       | -  | -                                      |

✓ Supported

- Not supported

n/a Not available

1 Set **Prism** or **Any surface** distance measurements at the instrument.

Set the correct prism constant at the controller.

2 Setup not available. Set horizontal angle at instrument.



Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.

## Supported functions

| Function  | Nikon 800 Series | Nikon A Series | Nikon DTM300 Series | Nikon DTM330 Series<br>Nikon NPL330 Series | Nikon DTM500 Series | Nikon Nivo C<br>Nikon Nivo M |
|---|------------------|----------------|---------------------|--|---------------------|------------------------------|
| Robotic control                                   | -                | -              | -                   | -  | -                   | -                            |
| Auto aiming                                       | -                | -              | -                   | -  | -                   | -                            |
| Level bubble                                      | -                | -              | -                   | -  | -                   | -                            |
| Compensator on/off                                | -                | -              | -                   | -  | -                   | ✓                            |
| Laser plummet on/off                              | -                | -              | -                   | -  | -                   | -                            |
| Laser pointer on/off                              | -                | -              | -                   | -  | -                   | -                            |
| EGL on/off  | -                | -              | -                   | -  | ✓                   | -                            |
| Connection status                                 | ✓                | ✓              | ✓                   | ✓  | ✓                   | ✓                            |
| TS battery status                                 | -                | -              | -                   | -  | -                   | -                            |
| Move between measurements to any surface or prism | -                | -              | -                   | ✓  | -                   | ✓                            |
| Measure distances continuously                    | n/a              | ✓              | -                   | ✓  | ✓                   | ✓                            |
| Auto logged points                                | n/a              | n/a            | -                   | ✓  | ✓                   | ✓                            |
| Others  | -                | 1              | -                   | -  | -                   | -                            |

✓ Supported

- Not supported

n/a Not available

1 Setup not available. Set horizontal angle at instrument.



Prism constants and correction values set at the CS are applied to the raw measurement data taken from the total station.



Configure an Ntrip connection using the **RTK Rover Wizard**. Select **Leica Captivate - Home: Settings\Connections\RTK rover wizard** and follow the on-panel instructions.

The remainder of this chapter describes each of the steps and panels when configuring without the use of the **RTK Rover Wizard**.



For TS: One Internet interface is available - the **CS internet**.

For GS: Two Internet interfaces are available - the **CS internet** and the **GS internet**.

The **CS internet** is used as an example. The explanations are also valid for the **GS internet**.



To access the Internet with a GS or TS instrument, **General Packet Radio System** devices are normally used. GPRS is a telecommunication standard for transmitting data packages using the Internet Protocol (IP).

### Select the Internet interface

Select **Leica Captivate - Home: Settings\Connections\All other connections**.

On the **CS connections** page highlight **CS internet**.

Press **Edit**.

### Configure the Internet interface

Internet Connection

Use Internet connection on CS

Connect using **CS Bluetooth 1**

Device **Nokia Phone**

Bluetooth ID -----

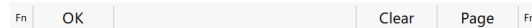
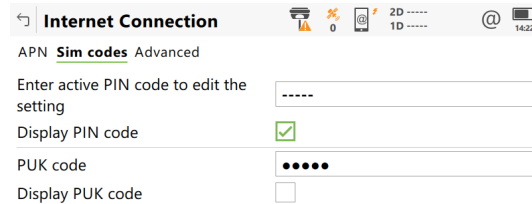
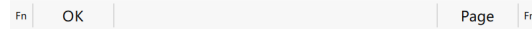
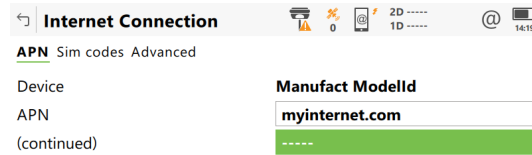
Connect to internet using **Mobile data**

Use user ID & password

|    |        |        |
|----|--------|--------|
| OK | Search | Device |
|----|--------|--------|

1. Select a port (**Connect using**).
2. Select a device (**Device**).
3. If necessary, enter **User ID** and **Password**. Some providers ask for a **User ID** and a **Password** to allow connecting to the Internet using GPRS. Contact your provider if user ID and password are required.
4. **OK** to return to **Connection Settings**.
5. In **Connection Settings** press **Control**. Continue with the next paragraph.

## Configure the Internet Connection



1. On the **APN** page, type in the **APN (Access Point Name)** of a server from the network provider). Contact your provider to get the correct APN.

---

2. On the **Sim codes** page, type in the **Enter active PIN code to edit the setting** for the SIM card.  
If the PIN is locked for any reason, for example the wrong PIN was entered, input the **Personal Unblock**ing code for access to the PIN.

---

3. **OK** twice to return to the **Leica Captivate - Home**.  
The instrument is now online to the Internet. The Internet online status icon is displayed. But because GPRS is being used, no charges are yet made since no data transfer from the Internet has yet taken place.

## Check the status of the Internet connection

### For CS

1. Tap on @ in the icon bar.

---

2. Select **Internet status**. This icon is only available if an Internet connection is configured.


---

3. Check the Internet online status.

---

4. **OK** to return to the **Leica Captivate - Home**.

### For GS

 Configure the **RTK rover**, if you have configured the **GS internet**.

1. Tap on ⚡ in the icon bar. This icon is only available if an Internet connection is configured.

---

2. Select **RTK data link stat**.

---

3. Check the Internet online status on the **Connectivity** page.

---

4. **OK** to return to the **Leica Captivate - Home**.

## 36.2

## Using the NTRIP Service with a Real-Time Rover

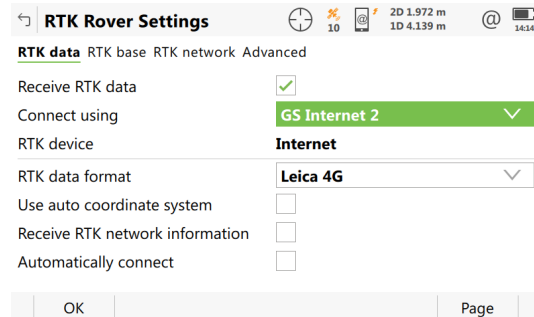
Select the Internet interface

Select **Leica Captivate - Home: Settings\Connections\All other connections**.

On the **GS connections** page highlight **RTK rover**.

Press **Edit**.

Settings for the RTK rover



RTK data RTK base RTK network Advanced

Receive RTK data

Connect using **GS Internet 2** ▼

RTK device **Internet**

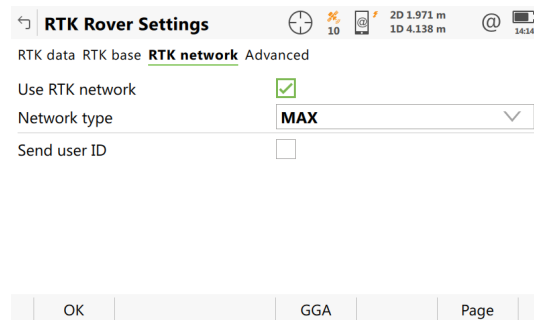
RTK data format **Leica 4G** ▼

Use auto coordinate system

Receive RTK network information

Automatically connect

OK Page



RTK data RTK base **RTK network** Advanced

Use RTK network

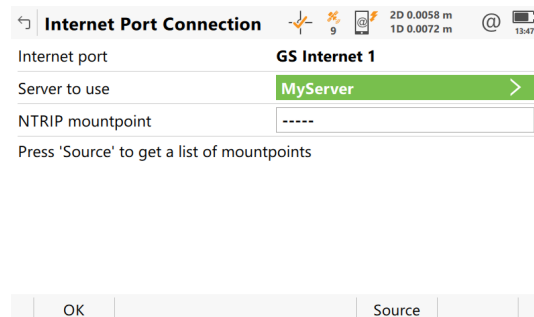
Network type **MAX** ▼

Send user ID

OK GGA Page

1. On the **General** page, make sure that an Internet port is selected for **Connect using**.
2. On the **RTK network** page, enable **Use RTK network**.
3. Press **OK** to return to **Connection Settings, GS connections** page.
4. Press **Control** to access **Internet Port Connection**. Continue with the next paragraph.

Select the server to be accessed in the Internet



Internet port **GS Internet 1**

Server to use **MyServer** >

NTRIP mountpoint -----

Press 'Source' to get a list of mountpoints

OK Source

**New Server**

General **NTRIP**

Server name: MyServer

Address: www.myserver.com

Port: 1000

Store Page

**New Server**

General **NTRIP**

Use NTRIP with this server: With user account

NTRIP user ID: NTRIP User

NTRIP password: .....

Display password:

Store Page

1. The **Server to use**, must be Use NTRIP with this server enabled. To create a server click into the selectable list.

---

2. In **New Server, General** page, type in the address and the port of the server through which the data is provided. Each server has several ports for various services.

---

3. In **New Server, NTRIP** page, activate the use of Ntrip.
  - For **Use NTRIP with this server: With user account:** Ntrip is being used with this server. Enter a username and a password.
  - For **Use NTRIP with this server: With sensor ID:** Ntrip is being used with this server. The login is managed automatically. Available for connecting registered GS sensors with active HxGN SmartNet subscription only.
  - For **Use NTRIP with this server: No:** Use NTRIP with this server is not being used with this server.

---

4. Type in the **NTRIP user ID** and the **NTRIP password**. A user ID and the password are required to receive data from the Use NTRIP with this server Caster. Contact the Use NTRIP with this server administrator for information.

---

5. **Store** followed by **OK** to return to **Internet Port Connection**.

## Select the Ntrip mountpoint

**Internet Port Connection**

Internet port: GS Internet 1

Server to use: MyServer

NTRIP mountpoint: -----



Press 'Source' to get a list of mountpoints

OK Source



← **NTRIP Source Table**

|                       |                       |      |      |    |
|-----------------------|-----------------------|------|------|----|
| <b>MAX-RTCM3</b>      |                       |      |      |    |
| Identifier MAX-RTCM3  | Distance 12867.8289 m |      |      |    |
| <b>iMAX-RTCM3</b>     |                       |      |      |    |
| Identifier iMAX-RTCM3 | Distance 12867.8289 m |      |      |    |
| <b>iMAX-CMR</b>       |                       |      |      |    |
| Identifier iMAX-CMR   | Distance 12867.8289 m |      |      |    |
| <b>iMAX-LEICA</b>     |                       |      |      |    |
| Identifier iMAX-LEICA | Distance 12867.8289 m |      |      |    |
| <b>iMAX-2021</b>      |                       |      |      |    |
| Identifier iMAX-2021  | Distance 12867.8289 m |      |      |    |
| <b>iMAX-1819</b>      |                       |      |      |    |
| Identifier iMAX-1819  | Distance 12867.8289 m |      |      |    |
| Fn                    | OK                    | Info | Sort | Fn |

1. If the selected server is Ntrip enabled, Ntrip mountpoint is available.
2. Press **Source** to access **NTRIP Source Table**.
3. All mountpoints are listed with their name, their identifier and the distance. Mountpoints are the Ntrip servers sending out real-time data.
4. Highlight a mountpoint.
  -  **Sort** To define the criteria for sorting the list of available points. The distance is updated when pressing **OK**. Mountpoints without distance information appear at the bottom of the list.
  -  **Info** To see all information for the highlighted mountpoint, including the authentication, compression and encryption entries.
5. Press **OK** twice to return to **Connection Settings, GS connections** page.
6. **Fn Connect** and **Fn Disconnect** are now available in all apps to connect to and disconnect from the NTRIP server.

**Description**

3D viewer is an interactive display feature embedded in the firmware. 3D viewer provides a graphical display of the survey elements and maps. 3D viewer allows for a better overall understanding of how the data being used and measured relates to each other. Several view modes are supported. Depending on the app, different functionality is available.



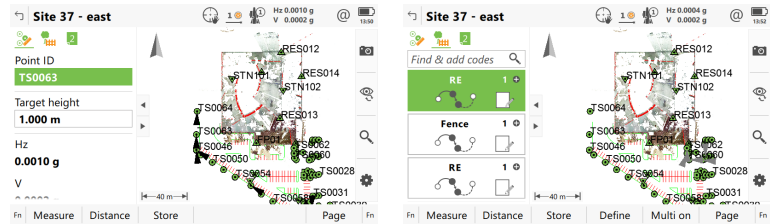
In order to view the data, it must be stored in a local coordinate system. Data in WGS 1984 only is not displayed.



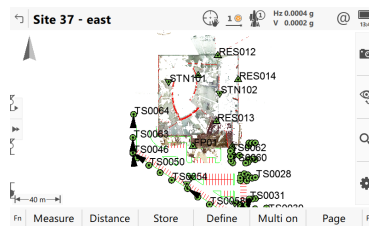
If negative coordinates are used in CAD files to suit projections with the origin in North-East and the axes going South and West, use the setting **Switch Easting for CAD files** and **Switch Northing for CAD files** in **Regional, Coordinates** page to mirror the CAD file.

**Terms**

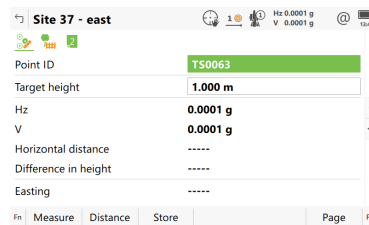
| Term               | Description  |
|--------------------|--|
| <b>Split panel</b> | The panel shows 3D viewer on the right and fields on the left. |



**Full screen mode** For the 3D viewer

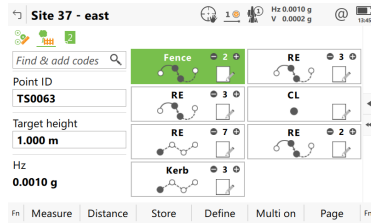


For the surveying prompts area Available for Measure.



For the advanced coding area

| Term | Description |
|------|-------------|
|------|-------------|



## Views

| View | Description |
|------|-------------|
|------|-------------|

### Camera view

A 3D perspective view of 3D data. The camera of the instrument delivers the 3D data as live video stream. The current position of the TS defines the eye point of the camera view.



### Image view

A view of images stored on the instrument. The images are captured previously. The images can have 3D data overlay. The 3D data overlay is done when taking the image. The 3D data is not live data and is not updated.





| View                | Description  |
|---------------------|--|
| <b>Profile view</b> | <p>A 2D view representing a cut or intersection with 1D, 2D or 3D data.</p> <p>Example: A long section of a road, with the height axis pointing upwards, and the axis pointing to the right representing the distance along the road.</p> <p>Example: A cross section of a road at a defined distance along the road, with the height axis pointing upwards and the axis pointing to the right representing the distance from the centreline.</p> <p>A profile view can be panned and zoomed.</p> <p>Vertical exaggerations can be adjusted in some profile views.</p> |

|                   |   |
|-------------------|---|
| <b>Stake view</b> | <p>A graphical view with instructions to aid staking out points and lines. Available in Stake apps.</p> |
|-------------------|---|

### Displayable data

The data displayed is defined by:

- the app
- filters set
- settings made for 3D viewer
- the coordinates. Position only (2D) data is automatically reduced to zero height. Height only (1D) data is not displayed.

The way the data look depends on the state.

| State  | Description                          |
|--------|--------------------------------------|
| Normal | This is the standard state for data. |

| State      | Description  |
|------------|--|
| Greyed out | This is used to distinguish non-active data.<br>Example: If design data was selected to be used, it would be displayed greyed-out in the Measure app.    |
| Selected   | This is the state for when a selectable object is marked as selected.  |
| In use     | This is the state for when an object is used by an app and should be indicated as such. Example: The alignments used for some calculations in Road apps. |

## 37.2

### Accessing 3D viewer

#### Description

The 3D viewer is provided as separate feature, within all apps and in data management.

#### Access step-by-step

##### Example for Leica Captivate - Home

1. Select **Leica Captivate - Home: 3D viewer**.

##### Example for data management

1. Select **View & edit job properties** from the job menu.
2. **Page** until the **3D viewer** page is active.

##### Example for an app

1. Select **Leica Captivate - Home: Measure**.

## 37.3

### Configuring 3D viewer

#### Description

Allows options to be set which are used as default. These settings are stored within the working style and apply, regardless of how 3D viewer is accessed.




Any changes made in **Object Display** affect the appearance of **3D viewer**, not just the active app.

#### Access step-by-step

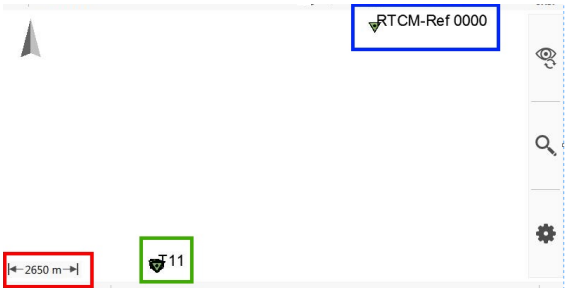
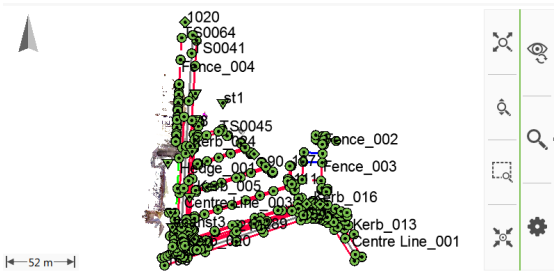
Press **Fn Display** on any **3D viewer** panel.

#### Object Display, General page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To confirm the selections and to return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.   |

| Key              | Description   |
|------------------|---|
| <b>Fn Filter</b> | <p>To define sort and filter settings. Refer to <a href="#">7.6 Point Sorting and Filters</a>.</p> <p> Instead of using this setting, select a range of points graphically in the <b>3D viewer</b>. Tap on the object or use the window selection to select multiple objects at the same time. The resulting list of points includes all points falling within the selection. The points list and the map are updated. If the selected points come from different sources such as working job or control job, the selection can be applied to either one or both sources. To remove a graphically selected filter, define another filter manually or use <b>Revert graphic filter</b> from the context menu in the <b>3D viewer</b>.</p> |

### Description of fields

| Field  | Option    | Description  |
|--|-----------|--|
| <b>Include RTK Base station within the zoom extent</b> | Check box | <p>The distance between the working area and the GPS base points influence the calculation of the zoom factor in 3D viewer.</p> <p>When this box is checked, the GPS base points are included in the calculation of the zoom extent. The working area is displayed smaller.</p>  <p>When this box is not checked, the GPS base points are excluded from the calculation of the zoom factor. The working area is displayed larger.</p>  |
| <b>Rotate data in 2D map by 180°</b>                   | Check box | When this box is checked, the map is rotated by 180°.  |

## Next step

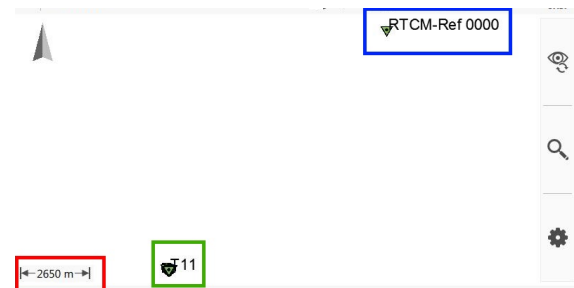
Page changes to the **Points** page.

## Object Display, Points page

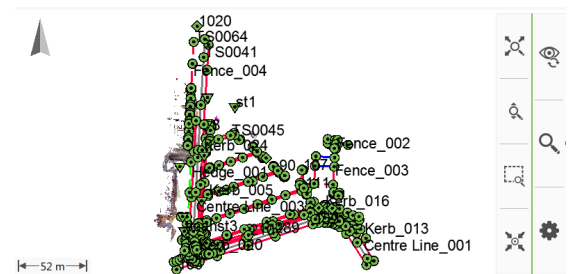
### Description of fields

| Field  | Option    | Description   |
|--|-----------|---|
| <b>Points</b>  | Check box | Determines if points are displayed.   |
| <b>Points on lines</b>                                 | Check box | Available if <b>Points</b> is checked. Determines if the points creating the linework are displayed in the map. In stake apps, these points are not displayed in the map. |
| <b>Point IDs</b>                                       | Check box | Available if <b>Points</b> is checked. Determines if the ID of a point is displayed.  |
| <b>Point codes</b>                                     | Check box | Available if <b>Points</b> is checked. Determines if the code of a point is displayed.  |
| <b>Height of points</b>                                | Check box | Available if <b>Points</b> is checked. Determines if the height of a point is displayed.  |
| <b>Include RTK Base station within the zoom extent</b> | Check box | The distance between the working area and the GPS base points influence the calculation of the zoom factor in 3D viewer.  |

When this box is checked, the GPS base points are included in the calculation of the zoom extent. The working area is displayed smaller.



When this box is not checked, the GPS base points are excluded from the calculation of the zoom factor. The working area is displayed larger.







**Next step**

Page changes to the **Lines & alignments** page.

**Object Display,  
Lines & alignments  
page**

**Description of fields**

| Field                                    | Option             | Description   |  |                    |                |                 |          |          |                 |          |          |                |          |          |
|--|--------------------|---|--|--------------------|----------------|-----------------|----------|----------|-----------------|----------|----------|----------------|----------|----------|
| <b>Lines</b>                             | Check box          | <p>When this box is checked, open lines from the job with 3D local grid coordinates are displayed on the view finder. Use the display of points to check completeness and reliability of the survey.</p> <p>Points are displayed with a visual 3D effect: Points further away from the instrument are displayed smaller than points closer to the instrument.</p> <p> Points are only displayed on the image. They are not saved with the image.</p> |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Line IDs</b>                          | Check box          | When this box is checked, then the line IDs are displayed with the open lines.  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Closed lines</b>                      | Check box          | When this box is checked, closed lines from the job with 3D local grid coordinates are displayed on the view finder.  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Closed line IDs</b>                   | Check box          | When this box is checked, then the area IDs are displayed with the closed lines.  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Alignments</b>                        | Check box          | When this box is checked, then the active alignment of the active Rail, Road or Tunnel job is displayed.  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Alignment ID</b>                      | Check box          | When this box is checked, then the line IDs for all shown alignments are displayed in.  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Lines &amp; alignments size</b>       |                    | <p>Determines the thickness of selected and non-selected lines.</p> <table border="1"> <thead> <tr> <th></th> <th>Non-selected lines</th> <th>Selected lines</th> </tr> </thead> <tbody> <tr> <td><b>3 pixels</b></td> <td>3 pixels</td> <td>6 pixels</td> </tr> <tr> <td><b>2 pixels</b></td> <td>2 pixels</td> <td>4 pixels</td> </tr> <tr> <td><b>1 pixel</b></td> <td>1 pixels</td> <td>3 pixels</td> </tr> </tbody> </table>   |  | Non-selected lines | Selected lines | <b>3 pixels</b> | 3 pixels | 6 pixels | <b>2 pixels</b> | 2 pixels | 4 pixels | <b>1 pixel</b> | 1 pixels | 3 pixels |
|  | Non-selected lines | Selected lines  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>3 pixels</b>                          | 3 pixels           | 6 pixels  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>2 pixels</b>                          | 2 pixels           | 4 pixels  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>1 pixel</b>                           | 1 pixels           | 3 pixels  |  |                    |                |                 |          |          |                 |          |          |                |          |          |
| <b>Vertical exaggeration of profiles</b> | Editable field     | <p>A scale factor to be applied over the vertical axis. A profile will be exaggerated in the vertical direction, but it will remain the same for the horizontal. The value can be between 0.1 and 50.</p> <p> This setting only has an effect in applications where cross-section views are displayed.</p>   |  |                    |                |                 |          |          |                 |          |          |                |          |          |

| Field  | Option    | Description   |
|--|-----------|---|
| <b>Display additional layers in cross section view</b> | Check box | When this box is checked, all layers of an alignment are displayed in a cross section view.<br>When this box is not checked, only the active layer will be displayed. |

#### Next step

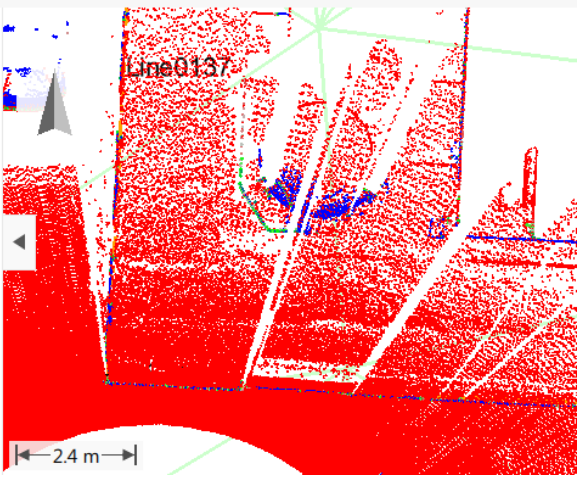
Page changes to the **Scans** page.

#### Object Display, Scans page

#### Description of fields

| Field                         | Option                     | Description  |
|-------------------------------|----------------------------|--|
| <b>Scans</b>                  | Check box                  | Determines if point clouds from scan are displayed.<br>When this box is checked, the 3D point clouds are displayed.  |
| <b>Colour scans using</b>     |                            | Available if <b>Scans</b> is ticked.   |
|                               | <b>True colour</b>         | The point cloud is coloured according to the RGB (red, green, blue) values from the panoramic image. If a panoramic image has been taken when defining a scan, the RGB values are available.                       |
|                               | <b>Intensity</b>           | The point cloud is coloured according to the intensity value of the received EDM signal.   |
|                               | <b>One colour per scan</b> | A point cloud gets a single colour. If several scans are available, each point cloud gets a different colour. A colour table is defined in the background, from which the colours are picked for each point cloud. |
| <b>Point cloud point size</b> |                            | Available if <b>Scans</b> is ticked.<br>To change the pixel size of a single scan point displayed in the viewer. To best view the scan points in different areas.  |
|                               | <b>Small</b>               | A small point represent each scan point.   |

| Field | Option | Description                              |
|-------|--------|--|
|       | Large  | A small point represent each scan point. |



#### Next step

Page changes to the **DTM** page.

#### Object Display, DTM page

##### Description of fields

| Field      | Option          | Description  |
|------------|-----------------|--|
| DTMs       | Check box       | When this box is checked, DTM triangles from the active DTM or the active DTM job are displayed. |
| DTM colour | Selectable list | Defines the colour of the active DTM layer.  |

#### Next step

Page changes to the **Background map** page.

#### Object Display, Background map page

| Key    | Description  |
|--------|--|
| OK     | To confirm the selections and to return to the panel from where this panel was accessed.   |
| Images | Available for <b>Display map: From files</b> .<br>To select the geo-referenced aerial photograph as background image to be used. Opens <b>Map Images</b> . Refer to <a href="#">Map Images</a> . |
| Page   | To change to another page on this panel.   |

##### Description of fields

| Field       | Option           | Description  |
|-------------|------------------|--|
| Display map | None             | When this box is checked, then no background images are displayed in 3D viewer.  |
|             | From web service | A geo-referenced imaged streamed by a Web map service is displayed in 3D viewer. |

| Field              | Option            | Description   |
|--------------------|-------------------|---|
|                    | <b>From files</b> | Geo-referenced aerial photographs are displayed in 3D viewer.<br><b>Images</b> to select the photo.   |
| <b>Web service</b> | Selectable list   | Available for <b>Display map: From web service</b> .<br>To select the Web Map service to be used. Open the selectable list to access the <b>Web Services</b> panel. Refer to <a href="#">Web Services</a> . |

### Next step

**OK** confirms the selections and returns to the previous panel.

## Map Images

### Access

Press **Images** in **Object Display, Background map** page.

| Key                       | Description  |
|---------------------------|--|
| <b>OK</b>                 | To confirm the selections and to return to the panel from where this panel was accessed. |
| <b>None</b> or <b>All</b> | To deactivate or activate all background images.   |
| <b>Delete</b>             | To delete the highlighted background image.  |
| <b>Use</b>                | To activate and deactivate the highlighted background image.                             |

### Description of metadata

| Metadata                 | Description   |
|--------------------------|---|
| -                        | The name of the background image.<br>Hierarchy of listing = hierarchy in the map: <ul style="list-style-type: none"> <li>Names alphabetically</li> <li>Numbers</li> </ul> The file that is on top of the list is shown on the top in the map. |
| <b>Size (kB)</b>         | The size of the background image in kilobytes.  |
| <b>Show in 3D viewer</b> | Use background image or not. <b>Use</b> changes between the options.  |

## Web Services

All configured Web Map Services are displayed.

### Access

Open the selectable list for **Web service** in **Object Display, Background map** page.

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To confirm the selections and to return to the panel from where this panel was accessed.     |
| <b>Add</b>  | To define the connection to the Web Map Service. Refer to <a href="#">Web Service Data</a> . |
| <b>Edit</b> | To edit the connection to the Web Map Service. Refer to <a href="#">Web Service Data</a> .   |

| Key           | Description   |
|---------------|---|
| <b>Remove</b> | To delete the connection to the highlighted Web Map Service.                        |
| <b>Layers</b> | To define the visibility state of the layers. Refer to <a href="#">WMS Layers</a> . |

#### Description of metadata

| Metadata      | Description  |
|---------------|--|
| -             | The abbreviation for the name of the Web Map Service.          |
| <b>Layers</b> | The number of active layers and the number of layers in total. |

#### Web Service Data

| Key       | Description  |
|-----------|--|
| <b>OK</b> | To confirm the selections and to return to the panel from where this panel was accessed. |

#### Description of fields

| Field                   | Option         | Description  |
|-------------------------|----------------|--|
| <b>Name</b>             | Editable field | The user defined name assigned to the Web Map Service.   |
| <b>Web service type</b> | <b>WMS</b>     | Web Map Service is an interface to get extractions of maps through the World Wide Web.   |
|                         | <b>WMTS</b>    | Web Map Tile Service is a standard protocol for serving pre-rendered or run-time computed georeferenced map tiles over the Internet.                             |
| <b>URL</b>              | Editable field | The Internet address to connect to the service.  |
| <b>Username</b>         | Editable field | Required for some Web Map Services. Type in the user name provided by the Web Map Service where you registered.  |
| <b>Password</b>         | Editable field | Required for some Web Map Services. Type in the password provided by the Web Map Service where you registered.   |
| <b>Display password</b> | Check box      | When this box is checked, the password is displayed in the <b>Password</b> field. When this box is not checked, dots are displayed in the <b>Password</b> field. |

#### WMS Layers

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To confirm the selections and to return to the panel from where this panel was accessed. |
| <b>Fn All</b> | To change the setting for the use for all layers at once.                                |

## Description of metadata

| Metadata | Description  |
|----------|--|
| -        | The name of the layers available in the Web Map Service. |

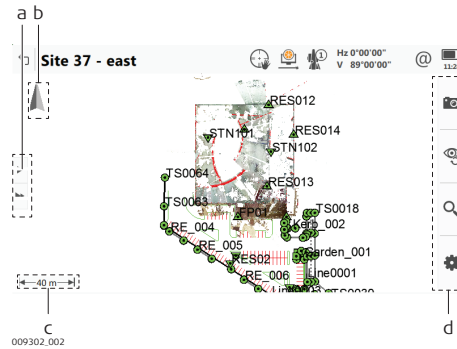
## 37.4

## 3D viewer Components

### 37.4.1

### Panel Area

#### Standard panel



- a Split panel on/off, available in apps
- b North arrow
- c Scale bar
- d Toolbar

| Icon | Hardware keys | Description  |
|------|---------------|--|
|      | Fn +          | Switches from full screen mode for <b>3D viewer</b> to split panel to full screen mode for surveying prompts area or advanced coding area.           |
|      | Fn +<br>twice | Switches directly from full screen mode for <b>3D viewer</b> to full screen mode for surveying prompts area or advanced coding area.                 |
|      | Fn +          | Switches from full screen mode for surveying prompts area or advanced coding area to split panel to full screen mode for <b>3D viewer</b> .          |
|      | Fn +<br>twice | Switches directly from full screen mode for surveying prompts area or advanced coding area to split panel to full screen mode for <b>3D viewer</b> . |

### 37.4.2

### Keys, Softkeys and Toolbar

#### Description

Standard functionality is provided by a toolbar and hardware keys.











Tools are available in a toolbar. The toolbar is always on the right side of the panel. Some of the functions performed by the tools can also be replicated using a hardware key. The softkey/key equivalent of each tool, if one exists, are indicated in the following table.









## Tools

Tools are available in groups. The groups available depend on the active app. Click an icon to display the group of related tools.





















To use the hardware keys, close the split panel so that only the 3D viewer is visible.






| Icon  | Hardware keys | Description  |
|---|---------------|--|
|    | <b>VIEW</b>   | Access to the different available views, depending on the app. The last used view is saved. When another app is opened, the same view is used.       |
|    |               | Plan view.<br>An orthometric top-down 2D view.   |
|    |               | Orbital view<br>A 3D perspective view.   |
|    |               | Navigation view<br>A 3D perspective view of 3D data. The navigation view guides you towards a position for staking.<br>Only available in Stake apps. |
|   |               | Stake view<br>The stake view guides you towards a position for staking.<br>Only available in Stake apps.   |
|  |               | Profile view<br>An app-specific cross section view of a particular location along an alignment.<br>Only available in Road apps.                      |
|  |               | Long section view<br>An app-specific long section view along an alignment.<br>Only available in Road apps.   |
|  |               | To switch to camera view.<br>Available when the instrument has a camera.<br>Available only in apps.  |
|  |               | Camera view<br>To switch to the telescope camera. The style of the crosshairs changes with the camera in use.  |
|  |               | Camera view<br>To switch to the overview camera. The style of the crosshairs changes with the camera in use.   |

| Icon  | Hardware keys                             | Description   |
|---|---|---|
|    | <b>NAVIGATE</b>                           |   |
|   |   | For plan and orbital view, the viewing volume is stored with the job.<br>When another app is opened, the same viewing volume is used.   |
|    | <b>1</b>                                  | Zoom extents<br>To fit all displayable data, according to filters and the 3D viewer settings, into the panel area, using the largest possible scale.  |
|    | <b>2 and 3</b> zoom in/out in fixed steps | Zoom real-time<br>To zoom into the data dragging the stylus in the 3D viewer area upwards to zoom in, or downwards to zoom out.   |
|    |   | Zoom window<br>To zoom to a specified area window. An area window can be drawn by dragging the stylus on the panel in a diagonal line to make a rectangular area. This action causes the panel to zoom to the selected area.  |
|    |   | Centre to point<br>To centre the 3D viewer on the selected point. If multiple points are selected, the last selected point using a tap is used.   |
|   | <b>5</b>                                  | Centre to current position<br>To centre the 3D viewer on the current position. Example the currently measured prism or the GS antenna.  |
|  |   | Orbit<br>Available in orbital view.<br>To orbit the data in 3D. The orbit is centred in the centre of the 3D viewer.<br>To orbit, drag the stylus in the 3D viewer area: <ul style="list-style-type: none"> <li>• Drag up and down to tilt the data up and down. The maximum view looking down is at the zenith, and the maximum view looking up is at the nadir.</li> <li>• Drag left and right to orbit the data left and right. The data is rotated around its true Z-axis.</li> </ul> The North arrow indicates how the view was moved. |
|  |   | Single autofocus<br>To activate a single autofocus. Single autofocus deactivates continuous autofocus. Same functionality as pressing the autofocus button on the side cover of the instrument.   |



| Icon  | Hardware keys | Description   |
|---|---------------|---|
|    |               | <p>Continuous focus on<br/>To switch on continuous autofocus.</p> <p> While continuous autofocus is active, any manually measured distance updates the focus position.</p>   |
|    | 2             | <p>Zoom +<br/>To zoom into the image.</p>   |
|    | 3             | <p>Zoom -<br/>To zoom out of the image.</p>   |
|    | SET           |   |
|    |               | <p>Selection window<br/>To select multiple objects. Points within the rectangular area are always selected. Lines are also selected, depending on the direction of the rectangular area, as detailed below.</p> <p>Drag the stylus on the panel in a diagonal line to make a rectangular area.</p> <ul style="list-style-type: none"> <li>• Drag to the left to include all lines that pass inside the area.</li> <li>• Drag to the right to include only lines that are completely inside the area.</li> </ul> |
|  |               | <p>CAD layers<br/>To turn layers of background maps (CAD files) on and off. Refer to <a href="#">6.2 Creating a New Job</a> for information on CAD files.</p>   |
|  |               | <p>Settings<br/>To define the display settings. Change the crosshair colour, what is displayed in the 3D viewer, separately to the plan or orbital views.</p>   |
|  |               | <p>Data range<br/>To define a range from the eye point by a minimum and maximum distance. Only data within the range is displayed.</p>  |

| Icon  | Hardware keys | Description  |
|---|---------------|--|
|   |               | <p>Top slider<br/>The maximum distance from the eyepoint, for example set to 400.</p> <p>Bottom slider<br/>The minimum distance from the eyepoint, for example set to 10.</p> <p>Result<br/>Points between 10 m and 400 m from the eyepoint are displayed on the image.</p> <p> To move the slider, tap on the slider, hold and drag it.</p> <p>Switch between tap and turn and selection mode. Available in the camera view.</p> |
|    |               | Goes to selection mode. Select data in the 3D viewer.  |
|    |               | Goes to tap and turn mode.   |
| <b>CAMERA</b>   |               |  |
|   |               | <p>Capture image<br/>To take an image with the active camera.</p>  |
| <b>BRIGHTNESS</b>   |               |  |
|  |               |  |
|  |               | <p>Auto Bright<br/>To turn on automatic brightness.</p>  |
|  |               | <p>Bright +<br/>To increase the brightness from the current value.</p>   |
|  |               | <p>Bright -<br/>To decrease the brightness from the current value.</p>   |
| <b>SKETCH</b>   |               |  |
|  |               |  |

| Icon  | Hardware keys | Description   |
|---|---------------|---|
|  |               | Erase<br>To remove sketched lines by moving the stylus over the area.   |
|  |               | On/off<br>To activate sketching.  |
|  |               | Line colour<br>To change the line colour.<br>Tap the icon to open a window displaying line colours for selection. Move the stylus over the window to display more colours.<br>The selected line colour is remembered. |
|  |               | Line weight<br>To change the line width.<br>Tap the icon to open a window displaying line widths for selection.<br>The selected line width is remembered.   |
|  |               | Text mode on/off<br>To type text into the image. Use the keys on the keypad. Tap the screen to specify the insertion point of the text.   |





### 37.4.3









### Point Symbols

#### Description

When **Points** is checked in **Object Display, Points** page, points are displayed according to their class.

#### Symbols

| Symbol  | Description   |
|---|---|
|  | Point of class <b>Control (Ctrl)</b> with full coordinate triplet |
|  | Point of class <b>Adjusted (Adj)</b> or <b>Average (Avge)</b>     |
|  | Point of class <b>Reference (Ref)</b>                             |
|  | Point of class <b>Measured (Meas)</b>                             |

| Symbol  | Description   |
|---|---|
|    | Single Point Position uploaded from Infinity<br>Point of class <b>Navigated (Nav)</b> or <b>Estimated (Est)</b>   |
|    | Point measured within a Stake app.  |
|    | Point to stakeout<br>The position of a point or along a line to stake out.  |
|    | Current TS position   |
|    | TS target   |
|   | TS target and AP20, tilted, quality for tilt compensation sufficient. Refer to <a href="#">37.4.5 AP20 Tilt Compensation</a> .<br>☞ When tilt compensation is not applied, the orientation of the AP20 3D model is not updated. |
|  | GS rover  |
|  | GS18 rover, tilted, quality for tilt compensation sufficient<br>When tilt compensation is not applied, then the red arrow on top of the GS18 icon is not shown.   |



Points of class **None** or points of class **Control/Measured** with a height only component cannot be displayed in 3D viewer.

### 37.4.4

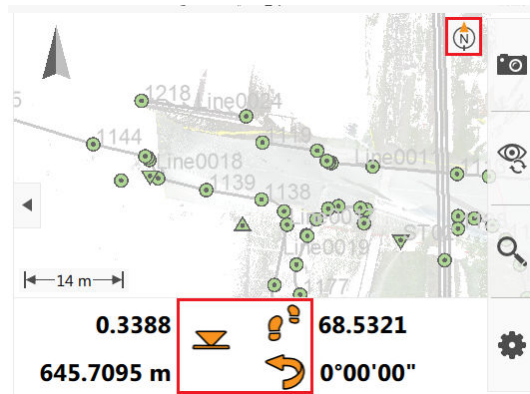
### Orientation Information for Stakeout








#### Description














In Stake views, the graphical display provides a guide to find the point to be staked out.

The settings for **Help me navigate** and **Navigational arrow types** are represented in the symbols.

## Symbols



| Symbol  | Description           |
|---|-----------------------|
|    | Orientation to line.  |
|    | Orientation to North. |
|   | Orientation to South. |
|  | Orientation to point. |
|  | Orientation to prism. |
|  | Orientation to sun.   |
|  | Orientation to TS.    |

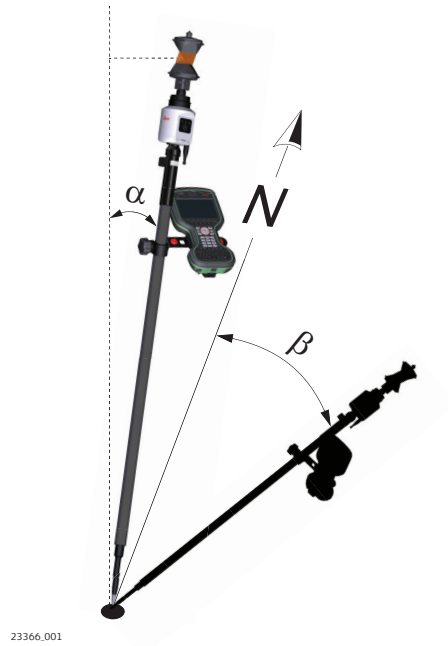
| Symbol  | Description   |
|---|---|
|    | <p>Forward/backward arrow, distance to point</p> <p>Before a measurement is done, this is the horizontal distance from the instrument to the stakeout point. When turning the instrument, the direction changes according to the telescope position of the instrument whereas the distance does not change. When a measurement is done, direction and distance are updated according to the measurement results. You must use <b>Help me navigate: From behind instrument</b> in combination with <b>Navigational arrow types: Direction &amp; distance</b>.</p> <p> Alternatively, configure the  page with <b>Go forward/backward</b> or <b>Go</b>.</p> |
|    | <p>Left/right arrow, distance to point</p> <p> Alternatively, configure the  page with <b>Go left/right</b>.</p>  |
|    | <p>Turn left/right arrow, direction to point</p> <p>Before a measurement is done, this is the direction from the current telescope position to the point to be staked. When turning the instrument, the direction changes according to the telescope position of the instrument whereas the distance does not change. When a measurement is done, direction and distance are updated according to the measurement results. You must use <b>Help me navigate: From behind instrument</b> in combination with <b>Navigational arrow types: Direction &amp; distance</b>.</p> <p> Alternatively, configure the  page with <b>Turn left/right</b>.</p>      |
|  | Distance to point   |
|  | Cut   |
|  | Fill  |
|  | The current position and/or height is within the configured stakeout limit for position and/or height.  |

### 37.4.5

### AP20 Tilt Compensation

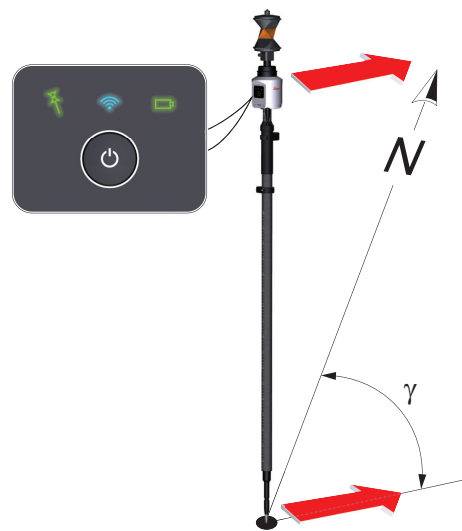
#### Tilt compensation

If **AP tilt compensation** is active, 3D viewer shows the current position and pole alignment in a graphical format.



23366.001

$\alpha$  Tilt toward vertical line  
 $\beta$  Direction of tilt toward North



23371.001

$\gamma$  AP heading

| Field or type            | Option       | Description  |
|--------------------------|--------------|--|
| <b>Tilt</b>              | Display only | The angle between the vertical and the tilted pole. The angle is calculated by AP20. |
| <b>Direction of tilt</b> | Display only | The azimuth of the tilted pole.  |
| AP heading               | -            | The direction in which the keyboard of the AP20 faces.                               |

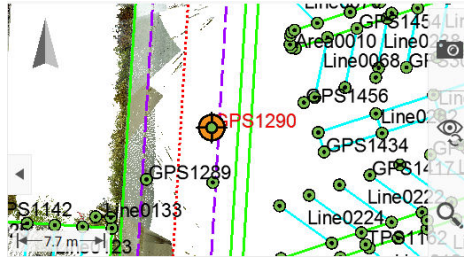
## 37.5

## Selecting Points and Lines

### Selecting a point/line using the touch screen step-by-step

Selecting points or lines may be required in apps, or before holding down the stylus to access the context menu to open further options.

1. Select **Leica Captivate - Home: 3D viewer**.
2. Tap on the point to be selected.

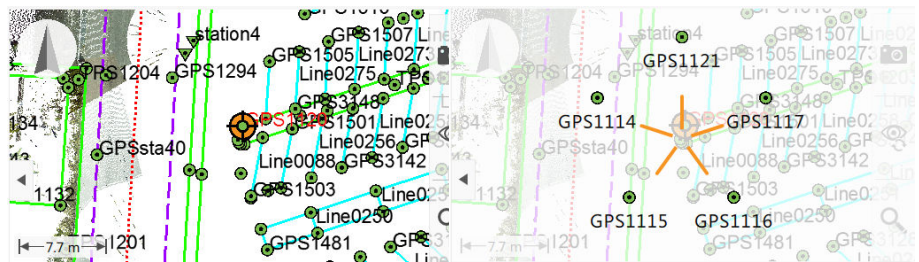


Depending on the app, one or more points or lines can be selected. Tap on the object and/or use the window selection to select multiple objects at the same time.

When multiple points or lines are selected with the same tap, the selection of the objects is offered in a graphical picker.

Tap on the desired point.

Or tap on the background to return to the original view.



3. The point symbol of the selected point is enlarged.  
A selected line appears thickened.

### Select a point/line without touch screen

Without touch screen or when **Use the touch screen** is not checked in **Screen, Audio & Text Input, Screen** page, points and lines can only be selected using the selectable lists.

## 37.6

## Context Menu

### Access

In **3D viewer**, hold down the stylus for 0.5 second.

### Options in the context menu

The options available in the context menu depend on the objects selected or other preconditions.

#### Tap and hold on no object and no other object is selected

| Option            | Description   |
|-------------------|---|
| Create point here | Available in the 2D views.<br>To open the <b>New Point</b> panel. |



| Option       | Description  |
|--------------|--|
| Turn to here | For TS.<br>Available in the 2D views.<br>The instrument turns to the direction of the tapped point or pixel.<br>If <b>Aim at target: Automatic</b> the instrument does an ATRplus search. If <b>Aim at target: With lock</b> the instrument tries to lock on to a prism. |

#### Tap and hold when one point is selected

| Option       | Description  |
|--------------|--|
| Turn to here | For TS.<br>Available in the 2D views.<br>The instrument turns to the direction of the tapped point or pixel.<br>If <b>Aim at target: Automatic</b> the instrument does an ATRplus search. If <b>Aim at target: With lock</b> the instrument tries to lock on to a prism. |

#### COGO

|                     |   |
|---------------------|---|
| Brng & dist from pt | To open the <b>Bearing &amp; Distance Input</b> . The tapped point is displayed in the field <b>From</b> .  |
| Line offset point   | To execute <b>Line &amp; arc calculation</b> using <b>Line/arc method: Calculate line offset point</b> . The tapped point is displayed in the field <b>Start point</b> .  |
| Line base point     | To execute <b>Line &amp; arc calculation</b> using <b>Line/arc method: Calculate line base point</b> . The tapped point is displayed in the field <b>Start point</b> .  |
| Segment line        | To execute <b>Line &amp; arc calculation</b> using <b>Line/arc method: Segment a line</b> . The tapped point is displayed in the field <b>Start point</b> .   |
| Check point         | For TS.<br>To open the <b>Check Point</b> panel.  |
| Stake point         | Available when a DBX or CAD point was tapped. To open the <b>Stake points</b> app. The tapped point is the point to be staked.  |
| Edit point          | To edit the point ID or the code.   |
| Import              | For CAD points. Imports the selected point into the DBX. The point is imported to the job the CAD is attached to. The import settings are configured in the job menu: <b>View &amp; edit job properties, Reference files</b> page, <b>Fn Settings</b> . |
| Information         | For CAD points. Displays the entities of the point.   |
| Delete point(s)     | To delete the tapped point.   |

| Option                        | Description  |
|-------------------------------|--|
| <b>Apply filter to points</b> | To start the Stake points app using the graphically selected filter. |
| <b>Clear selection</b>        | To remove the highlight from all highlighted objects.                |
| <b>Revert graphic filter</b>  | To remove the graphical selection for the filter.                    |

### Tap and hold when two points are selected

| Option             | Description   |
|--------------------|---|
| <b>Create line</b> | To create a line from the selected points. The points are added in the order in which they were tapped. A line ID is suggested but can be edited. |

### COGO

|                               |   |
|-------------------------------|---|
| <b>Calculate inverse</b>      | To open the <b>Inverse Point to Point</b> panel.  |
| <b>Segment line</b>           | To create a line which can then be segmented. The selected line is used as a local line. Start and end chainage are suggested. To open the <b>Define Line Segmentation</b> panel. Refer to <a href="#">COGO Road - Create points</a> .  |
| <b>2 Pts rectangle</b>        | To calculate the coordinates of points forming a rectangle.<br>Elements that must be known are <ul style="list-style-type: none"> <li>the coordinates of two points defining one side of the rectangle.</li> <li>the perpendicular distance to the second parallel side.</li> </ul> |
| <b>2 Pts square (base)</b>    | To calculate the coordinates of points forming a square.<br>Elements that must be known are <ul style="list-style-type: none"> <li>the coordinates of two points defining the baseline of the square.</li> </ul>  |
| <b>2 Pts square (diag)</b>    | To calculate the coordinates of points forming a square.<br>Elements that must be known are <ul style="list-style-type: none"> <li>the coordinates of two points defining the diagonal of the square.</li> </ul>  |
| <b>Import</b>                 | For CAD points. Imports the selected point into the DBX. The point is imported to the job the CAD is attached to. The import settings are configured in the job menu: <b>View &amp; edit job properties, Reference files</b> page, <b>Fn Settings</b> .                             |
| <b>Delete object(s)</b>       | To delete the tapped points.  |
| <b>Apply filter to points</b> | To start the Stake points app using the graphically selected filter.  |
| <b>Clear selection</b>        | To remove the highlight from all highlighted objects.   |

| Option                       | Description                                       |
|------------------------------|---|
| <b>Revert graphic filter</b> | To remove the graphical selection for the filter. |

### Tap and hold when three points are selected

| Option                    | Description  |
|---------------------------|--|
| <b>Create line</b>        | For CAD points. To create a line from the selected points. The points are added in the order in which they were tapped. A line ID is suggested but can be edited.        |
| <b>Create arc</b>         | For CAD points. To create an arc from the selected points. The points are added in the order in which they were tapped. An arc ID is suggested but can be edited.        |
| <b>Create closed line</b> | For CAD points. To create a closed line from the selected points. The points are added in the order in which they were tapped. A line ID is suggested but can be edited. |

### COGO

#### **3 Pts rectangle**

Calculates the coordinates of points forming a rectangle.

Elements that must be known are

- three points with right angles. Two points define one side of the rectangle. The third point defines the perpendicular distance to the second parallel side.

#### **3 Pts rectangle parallel**

Calculates the coordinates of points forming a parallelogram.

Elements that must be known are

- three points. The first and second point define the first side of the parallelogram. The second and third point define the second side of the parallelogram.

#### **2D circle & center pt**

Creates the circle matching the selected points and calculates the coordinates of the center point. Any combination of CAD points or points from the database is possible.

This is to survey features such as tanks, pillars, posts or tree canopies where the physical center point cannot be measured.

A line ID, a line style, a colour and a code can be assigned to the circle.

Elements that must be known are

- three points.



The circle will be defined in a 2D plane. By default, the height of the circle will be defined as the average height of the 3 selected points.

| Option                        | Description  |
|-------------------------------|--|
| <b>Calculate inverse</b>      | To open the <b>Inverse Point to Point</b> panel.                     |
| <b>Apply filter to points</b> | To start the Stake points app using the graphically selected filter. |
| <b>Clear selection</b>        | To remove the highlight from all highlighted objects.                |
| <b>Delete object(s)</b>       | To delete the tapped points.   |
| <b>Revert graphic filter</b>  | To remove the graphical selection for the filter.                    |

#### Tap and hold when four points are selected

| Option                    | Description  |
|---------------------------|--|
| <b>Create line</b>        | For CAD points. To create a line from the selected points. The points are added in the order in which they were tapped. A line ID is suggested but can be edited.        |
| <b>Create closed line</b> | For CAD points. To create a closed line from the selected points. The points are added in the order in which they were tapped. A line ID is suggested but can be edited. |
| <b>COGO</b>               |  |
| <b>Intersection</b>       | To open the Four Point Intersection panel.   |
| <b>Clear selection</b>    | To remove the highlight from all highlighted objects.  |
| <b>Delete object(s)</b>   | To delete the tapped points.   |

#### Tap and hold when one point and one line are selected

| Option   | Description   |
|--|---|
| <b>Add pt to line start</b><br>or<br><b>Add pt to line end</b> | Available for any type of open line. Unavailable for a closed line or an alignment. If a point and a line from the current working job are selected, the point will be added to the line. CAD lines must be imported first, before a point can be added to it. A point cannot be added to a line which has no points assigned, for example if a CAD line is imported without creating the nodes points. |

**COGO**

| Option                     | Description  |
|----------------------------|--|
| <b>Create line base pt</b> | This feature only works for lines that do not contain best fit arcs or splines.<br>To execute <b>Line &amp; arc calculation</b> using <b>Line/arc method: Calculate line base point</b> . The calculated point is displayed in <b>Line/Arc Calculation Result</b> .<br>Difference to the standard <b>Line &amp; arc calculation</b> using <b>Line/arc method: Calculate line base point</b> calculation: Additionally, the 3D intersection of the point onto the line is calculated. |
| <b>Clear selection</b>     | To remove the highlight from all highlighted objects.  |

#### Tap and hold when one line is selected

| Option                         | Description  |
|--------------------------------|--|
| <b>Stake / check road</b>      | To stake/check a (local) line/(local) manual slope.  |
| <b>Stake / measure line</b>    | To stake/measure a line (with slope), to stake a grid from the line or to select a stake/measure task.   |
| <b>Edit line</b>               | To edit the line properties.   |
| <b>Measure line/Stake line</b> | To measure/stake a line, segment, slope line or slope segment or to stake a grid.  |
| <b>Import</b>                  | For CAD lines. Imports the selected line into the DBX. The line is imported to the job the CAD is attached to. The import settings are configured in the job menu: <b>View &amp; edit job properties, Reference files</b> page, <b>Fn Settings</b> . |
| <b>Information</b>             | For CAD lines. Displays the entities of the line.  |
| <b>View details</b>            | For Road lines. To view and edit the design data.  |
| <b>Delete line(s)</b>          | To delete the highlighted line with or without the points defining its geometry.   |

#### COGO

##### **Segment line**

The selected line is used as a local line. Start and end chainage are suggested.  
To open the **Define Line Segmentation** panel. Refer to [COGO Road - Create points](#).

| Option                     | Description  |
|----------------------------|--|
| <b>Create center point</b> | Available when a circle, a closed triangle or a 4 points closed line is selected. When a line is selected from an attached DXF file, before calculating the centre point, the line will be imported to the database.<br>Creates a point in the center of a closed line. Easting and Northing are calculated and not editable.<br>The height is the mean height of all the vertices of the figure.<br>The point can be stored to the current working job or to any other job. |
| <b>Centre point</b>        | Calculates the center point of an arc.   |
| <b>Clear selection</b>     | To remove the highlight from all highlighted objects.  |

#### Tap and hold when two lines are selected

| Option                | Description  |
|-----------------------|--|
| <b>Delete line(s)</b> | To delete the highlighted line with or without the points defining its geometry. |

#### COGO

|                        |   |
|------------------------|---|
| <b>Intersection</b>    | To calculate the position of the intersection point between the lines.<br>One of the lines can be a temporary line from the context menu generated based on two selected points Only lines with straight segments are supported.<br>Multiple results are possible. The results of interest can be stored. |
| <b>Clear selection</b> | To remove the highlight from all highlighted objects.   |

#### Tap and hold when several lines are selected

| Option                  | Description   |
|-------------------------|---|
| <b>Delete object(s)</b> | To delete all highlighted objects.                    |
| <b>Clear selection</b>  | To remove the highlight from all highlighted objects. |

#### Tap and hold when at least one CAD element is selected

| Option                 | Description  |
|------------------------|--|
| <b>Hide layers</b>     | To set the status of the layer containing the CAD element to <b>Hidden</b> . When several CAD elements are selected and they belong to different layers, then the status of all layers is set to <b>Hidden</b> . |
| <b>Clear selection</b> | To remove the highlight from all highlighted objects.  |

**The job has a CAD file attached and at least one layer of the CAD has the status Hidden**

 Layers with status **Selectable** are not affected and remain visible.

| Option                 | Description   |
|------------------------|---|
| <b>Show all hidden</b> | For all layers with status <b>Hidden</b> : To set the status to <b>Selectable</b> . |

**Tap and hold when at least one IFC object is selected**

| Option                 | Description   |
|------------------------|---|
| <b>Import geometry</b> | To import the surfaces (triangles) defining the meshes. The imported geometries will be stored in the job containing the IFC. |
| <b>Import EOI</b>      | To import special points for specific shapes, for example circular.   |
| <b>Hide objects</b>    | To set the selected objects as hidden without opening the <b>IFC Tree View</b> panel.   |
| <b>Hide unselected</b> | To set all objects outside the current selection as hidden.   |
| <b>IFC tree view</b>   | To open the <b>IFC Tree View</b> panel. Refer to <a href="#">IFC Tree View</a> .  |
| <b>Clear selection</b> | To remove the highlight from all highlighted objects.   |

**Tap and hold when a cross section view of a Road job with more than one layer is selected**

| Option                     | Description  |
|----------------------------|--|
| <b>Set as active layer</b> | Tapping on a grey line of an inactive layer: To change the inactive layer into the active layer. |
| <b>Clear selection</b>     | To remove the highlight from all highlighted objects.  |

**Description**

Apps are software packages supporting specific tasks. They appear in the **Leica Captivate - Home** panel as follows:

- Setup (TS)
- Scanning (MS60)
- Measure, including auto point and for GS also hidden points
- Stake points
- Stake to line
- Stake DTM
- Stake pts & DTM
- Measure to line
- GS imaging
- QuickVolume
- Volume calc
- Traverse (TS)
- Measure sets (TS) including monitoring
- COGO
- Stake road
- Check road
- Stake rail
- Check rail
- Stake tunnel
- Check tunnel
- Create coord sys
- QuickGrid
- Meas plane/grid
- TS hidden point (TS)
- Disto (CS20)
- Inspect surfaces
- Customised apps

For an explanation of the apps refer to the relevant chapters.

**Loadable and non-loadable apps**

| Type             | Description  |
|------------------|--|
| Loadable apps    | <ul style="list-style-type: none"> <li>• Can be loaded onto the instrument.</li> <li>• Can be deleted from the instrument.</li> </ul>  |
| Non-loadable app | <ul style="list-style-type: none"> <li>• Are always available on the instrument.</li> <li>• Measure is a non-loadable app. To update the app, reload the system software.</li> </ul> |

**Licence key**

Some loadable apps are protected. They are activated through a specific licence key. Refer to [30.3 Entitlements & licences](#) for information on how to upload a licence key.

**Customised apps**

Customised apps can be developed locally using the GeoC++ development environment. Information on the GeoC++ development environment is available on request from the Leica Geosystems representative.




## Access to an app

On the **Leica Captivate - Home** menu:

Tap to select an app.

OR

On the keyboard, press the  key and then the number which is displayed for the app. The number corresponds to the order in the **App Visibility** panel.

OR

On the keyboard, press a hot key configured to access an app.

## Settings, Report sheet page

This page is common to several apps.

### Description of fields

| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Create report sheet</b> | Check box       | To generate a report sheet when the app is exited.<br>A report sheet is a file to which data from an app is written to. It is generated using the selected format file.   |
| <b>Report sheet</b>        | Selectable list | Available when <b>Create report sheet</b> is ticked. The name of the file to which the data is written. A report sheet is stored in the \DATA directory of the active data storage device. The data is always appended to the file.<br>Open the selectable list to access the <b>Report Sheets</b> panel. On this panel, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.  |
| <b>Format file</b>         | Selectable list | Available when <b>Create report sheet</b> is ticked. A format file defines which and how data is written to a report sheet. Format files are created using Infinity. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to <a href="#">30.1 Transfer user objects</a> for information on how to transfer a format file.<br>Open the selectable list to access the <b>Format Files</b> panel where an existing format file can be selected or deleted. |

### Next step

**Page** changes to the first page on this panel.

## 39.1

## The Toolbox

## Description

The toolbox contains extra functionality to those existing functions which are available using the function keys.

Frequently used functionality can be accessed quickly. The change is applied immediately. The workflow is not interrupted.

## Access

Press **Fn Tools** on any page in the some apps.




OR

Press a hot key or favourites key configured to **User - App tools** on any page in the some apps.

## Tools

| Key                           | Description   |
|-------------------------------|---|
| OK                            | To apply the selected setting, or to access the selected function.  |
| <b>Description of options</b> |   |
| Icon                          | Description   |
| <b>Reset backsight point</b>  | Available for the setup methods <b>Set orientation</b> , <b>Known backsight</b> , <b>Resection</b> and <b>Multiple backsights</b> . To check the backsight angle and correct the angle if necessary while working with a job. The record of a checked backsight point can be stored with or without updating the current setup. Refer to <a href="#">39.2 Reset backsight point</a> .             |
| <b>Check point</b>            | To check a point or the instrument orientation. Refer to <a href="#">39.3 Check Point</a> .   |
| <b>Measure remote points</b>  | To determine the 3D coordinates of inaccessible points. Refer to <a href="#">39.4 Measure - Remote Point</a> .  |
| <b>2 Store</b>                | Available for <b>Measure distance: Once</b> and <b>Measure distance: Once &amp; fast</b> . <b>Aim at target: Manually</b> must be selected. To aim manually at the target and only record the angle measurement (Hz/V) in face I and face II. The point stored is an average of the two measurements.   |
| <b>2 Face</b>                 | Available for <b>Measure distance: Once</b> and <b>Measure distance: Once &amp; fast</b> . To take an angle and distance measurement in Face I and Face II. The point stored is an average of the two measurements. Using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |

| Icon  | Description   |
|---|---|
| <b>Store code template and Load code template</b> | <p>Available for the Measure app.</p> <p>To save the current list of up to ten code boxes to a template. The template is stored to the job codelist. When storing a template, a name must be assigned.</p> <p>The template can be reloaded so that the current code boxes are filled in the order and with the codes including related features.</p> <p>When working in <b>Zig-zag</b> mode or <b>Same direction</b> mode, a missing code can be added anywhere in the stack of the existing template. For example, with the <b>Same direction</b> mode enabled, highlight the code before which the missing code should be added, add the code and save the updated list as template again.</p> <p>Available for <b>Coding functionality: Create linework</b> with multicoding disabled, that is <b>Multi on</b> is visible on the screen.</p> |
| <b>Zig-zag</b>                                    | <p>Method by which the multicoding points are measured. Each new sequence is started at the same end as where the previous cross section finished.</p>  |
| <p>021544.001</p>                                 |   |
| <b>Same direction</b>                             | <p>Method by which the multicoding points are measured. Each new sequence is started at the same end as where the previous cross section started.</p>   |
| <p>021545.001</p>                                 |   |
| <b>Manual select next code</b>                    | <p>To turn off <b>Zig-zag</b> mode or <b>Same direction</b> mode. Multicoding is turned off. For each point, a code box must be selected manually.</p>  |

| Icon   | Description  |
|--|--|
| <b>Individual point ID and Sequential point ID</b> | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to <a href="#">27.3 ID templates</a> .   |
| <b>Measure hidden point</b>                        | To measure points which cannot be measured directly by GNSS, because, either they cannot be physically reached, or because satellites are obstructed, for example by trees or tall buildings. Refer to <a href="#">39.5 Measure - Hidden Points</a> .  |
| <b>Select next nearest point</b>                   | <p>For GS Stakeout:<br/>To search the design job for the point nearest to the current position. The point is selected as the point to be staked and is displayed in the first field on the panel. After staking and storing the nearest point, the next point suggested for staking out is the one which was suggested before the key was pressed.</p> <p> Assign the function <b>GS - Select next nearest point</b> to the favourites or a hot key. Refer to <a href="#">2.2.1 Hot Keys</a> for information on hot keys.</p> |
| <b>Turn TS to point in 2D</b>                      | <p>For TS Stakeout:<br/>To position the telescope (X,Y) onto the point to be staked.</p> <p> Assign the function <b>TS - Turn to point in 2D</b> to the favourites or a hot key. Refer to <a href="#">27.4 Hot keys &amp; favourites</a> for information on hot keys.</p>   |
| <b>Turn TS to point in 3D</b>                      | <p>For TS Stakeout:<br/>To position the telescope (X,Y,Z) onto the point to be staked.</p> <p> Assign the function <b>TS - Turn to point in 3D</b> to the favourites or a hot key. Refer to <a href="#">27.4 Hot keys &amp; favourites</a> for information on hot keys.</p>   |
| <b>Manual enter Hz &amp; distance</b>              | For TS Stakeout:<br>To enter angle and distance values to stake out a point.   |
| <b>Stake elevation</b>                             | Available for the Stake points app:<br>To only work with heights and not with 2D coordinates, without using the information from a design point.   |
| <b>Stake points</b>                                | For all stakeout apps:<br>To return to the standard stakeout app using 3D coordinates.   |
| <b>Export cut sheet</b>                            | For all stakeout apps:<br>To export a stake report showing the differences between the staked points and the design points.  |
| <b>Closest point</b>                               | To select the point closest to the point which was measured.   |
| <b>Measure foresight</b>                           | Provides points calculated from averaged backsight-foresight sets from the setup position.   |

| Icon   | Description  |
|--|--|
| <b>Multiple offset lines and Deactivate multiple offsets</b> | For several parallel alignments/lines. To measure one single line. The other lines are generated automatically based on an entered offset and a point code. Refer to <a href="#">39.9 Multiple Offsets</a> . |

## 39.2

### Reset backsight point

#### Description

This feature is available in TS mode.

Available for the setup methods **Set orientation**, **Known backsight**, **Resection** and **Multiple backsights**.

#### Usage

- Checking the direction to the backsight point
- Correcting the angle if necessary while working
- Store the difference after checking the backsight
- Store a record of the backsight check values

#### Reset Backsight Point

The behaviour of the tool depends on the settings of the current setup.

For measurements to a prism:

- The settings are recalled.
- The instrument turns to the angle with which the (first) backsight point was measured, searches the prism and measures to the prism.
- The instrument measures a distance.
- The differences in angle, horizontal distance and height between the measurements and the original measurements are displayed.

For measurements to any surface (reflectorless):

- The settings are recalled.
- The instrument turns to the angle with which the (first) backsight point was measured.
- The telescope can be manually be turned to the exact backsight direction.
- The difference in horizontal angle is shown.

**Reset Backsight Point**

Point ID: 1

Target height: 1.000 m

Target: Leica round prism

Difference in azimuth: -0°00'03"

Difference in horizontal distance: -----

Difference in height: -----

Press 'Reset Ang' to store the difference values & create a new Set Orientation setup record. All future measurements will refer to the new setup.

Reset Ang | Distance | Store | Cancel

| Key              | Description  |
|------------------|--|
| <b>Reset Ang</b> | To set the measured horizontal angle of the checked backsight point back to what it has been during the original setup and to store the new measurement as a new setup record (Set orientation). All future measurements will refer to the new setup.<br>A record of the backsight check values is saved before the new setup is stored. Provides a record of what the difference values were during the checks. |
| <b>Distance</b>  | To measure a distance. The angle and distance fields are updated.  |
| <b>Store</b>     | To save the difference after checking the backsight. Provides a record of regular setup checks being done.   |
| <b>Cancel</b>    | To continue with the current setup.  |

#### Description of fields

| Field                                    | Option          | Description   |
|--|-----------------|---|
| <b>Point ID</b>                          | Display only    | Point ID of the backsight point.  |
| <b>Target height</b>                     | Editable field  | Height of the target above or below the backsight point.  |
| <b>Target</b>                            | Selectable list | Last configured target type the backsight point was measured with as stored in the settings.                                  |
| <b>Difference in azimuth</b>             | Display only    | The difference in horizontal angle between the setup point and the backsight point.   |
| <b>Difference in horizontal distance</b> | Display only    | The difference between the calculated horizontal distance from setup to backsight point and the measured horizontal distance. |
| <b>Difference in height</b>              | Display only    | The vertical distance between the setup point and the backsight point.  |

## 39.3

### Check Point

#### Description

This panel is used to check if a measured point is identical to a point already stored in the job, or if the orientation of the instrument to a backsight point is still correct.

#### Check Point

The screenshot shows the 'Check Point' interface with the following fields and values:

- Point ID:** TS0002
- Target height:** 0.000 m
- Target:** Any surface
- Difference in azimuth:** -----
- Difference in horizontal distance:** -----
- Difference in height:** -----

Choose the point to be checked. Press 'Store' to store the measurement.

Navigation buttons: Back, Distance, Store, Turn to, More, Last

| Key             | Description  |
|-----------------|--|
| <b>Back</b>     | To return to the app.  |
| <b>Distance</b> | To measure a distance.   |
| <b>Store</b>    | To store the result of the point check. The result can be exported as part of the current job.   |
| <b>Turn to</b>  | To position to the selected point.<br>For <b>Aim at target: Automatic</b> the instrument does an ATRplus search.<br>For <b>Aim at target: Lock</b> the instrument tries to lock on to a prism. |
| <b>More</b>     | To display additional information.   |
| <b>Last</b>     | To recall the point ID of the last checked point.  |

#### Description of fields

| Field                                    | Option          | Description   |
|--|-----------------|---|
| <b>Point ID</b>                          | Selectable list | Point ID to be checked.<br>If a stored point was checked, the point ID for that point is remembered and recalled when <b>Last</b> is pressed. |
| <b>Target height</b>                     | Editable field  | The last used prism height is suggested. An individual prism height can be typed in.  |
| <b>Target</b>                            | Selectable list | Target names as configured in the <b>Targets</b> panel.   |
| <b>Difference in azimuth</b>             | Display only    | Difference between calculated azimuth and current orientation.  |
| <b>Difference in horizontal distance</b> | Display only    | Difference between calculated and current distance.<br>Displayed after a distance was measured with <b>Distance</b> .                         |
| <b>Difference in height</b>              | Display only    | Difference between calculated and current height.<br>Displayed after a distance was measured with <b>Distance</b> .                           |
| <b>Current azimuth</b>                   | Display only    | Current orientation.  |
| <b>Horizontal distance</b>               | Display only    | Current distance between setup and backsight point.<br>Displayed after a distance was measured with <b>Distance</b> .                         |
| <b>Difference in height</b>              | Display only    | Current height difference between setup and backsight point.<br>Displayed after a distance was measured with <b>Distance</b> .                |
| <b>Calculated azimuth</b>                | Display only    | Calculated azimuth between setup and backsight point.   |
| <b>Calculated horizontal distance</b>    | Display only    | Calculated horizontal distance between setup and backsight point.   |

| Field                                  | Option       | Description   |
|--|--------------|---|
| <b>Calculated difference in height</b> | Display only | Calculated height difference between setup and backsight point. |

## 39.4

## Measure - Remote Point

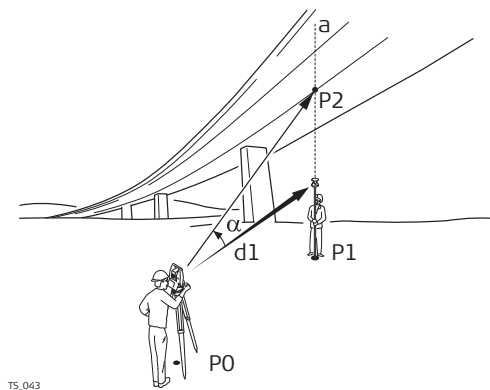
### 39.4.1

### Overview

#### Description

Remote point is used to determine the 3D coordinates of inaccessible points, for example on bridges. The horizontal distance to a base point directly underneath or above the remote point is measured. Then the instrument is aimed at the remote point. The coordinates of the remote point are calculated with the distance measured to the base point and the angles measured to the remote point.

#### Diagram



- P0 Instrument setup
- P1 Base point
- P2 Remote point
- d1 Horizontal distance to the base point
- $\alpha$  Vertical angle between base point and remote point
- a Vertical axis from P1 to P2



To ensure correct results, the remote point and the prism must be lined up vertically. If it is not possible to maintain an exactly vertical line, the acceptable **Horizontal distance tolerance** must be chosen. The horizontal distance to the remote point and to the base point should coincide.

#### Averaging of remote points

An average can be calculated for remote points if a measured point of class **Measured** already exists with the same point ID. The average flag for the point is **Auto**.

#### Coding of remote points

| Type         | Description  |
|--------------|--|
| Point coding | Available in <b>Remote points</b> .  |
| Free coding  | Free coding of remote points is identical to coding of manually measured points. |
| Quick coding | Not available.   |

### 39.4.2

### Accessing Remote Point

#### Description

Select **Measure remote points** from the toolbox. A valid distance measurement must be available.



## Measure Remote Point, Remote points page

| Measure Remote Point                                 |           |
|--|-----------|
| Remote points Code                                   |           |
| Point ID   | TS0003    |
| Difference in height from remote point to base point | 1.500 m   |
| Hz   | 41.3188 g |
| V  | 0.0003 g  |
| Slope distance                                       | 0.000 m   |
| Horizontal distance                                  | 0.000 m   |
| Fn   | Store     |
|  | Base pt   |
|  | Page      |
|  | Fn        |

| Key                                   | Description  |
|---------------------------------------|--|
| <b>Store</b>                          | Stores the remote point. Stays in this panel.  |
| <b>Base pt</b>                        | Returns to <b>Measure</b> . The distance measurement is cleared.   |
| <b>Fn Settings</b>                    | To configure hidden point measurements. Refer to <a href="#">39.4.3 Configuring Remote Point</a> .   |
| <b>Fn Individ ID</b><br><b>Fn Run</b> | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to <a href="#">27.3 ID templates</a> . |

### Description of fields

| Field   | Option         | Description   |
|---|----------------|---|
| <b>Point ID</b>   | Editable field | Displays the point ID for the remote point. The point ID in <b>Measure Remote Point</b> is always identical to the point ID in <b>Measure</b> . |
| <b>Difference in height from remote point to base point</b> | Display only   | The elevation difference between the base point and the remote point.   |
| <b>Hz</b>   | Display only   | The current horizontal angle.   |
| <b>V</b>  | Display only   | The current vertical angle.   |
| <b>Slope distance</b>                                       | Display only   | The current slope distance to the remote point calculated from the horizontal distance to the base point and the current vertical angle.        |
| <b>Horizontal distance</b>                                  | Display only   | The horizontal distance measured to the base point.   |
| <b>Easting</b>  | Display only   | Calculated Easting coordinate for the remote point.   |
| <b>Northing</b>   | Display only   | Calculated Northing coordinate for the remote point.  |
| <b>Height</b>   | Display only   | Calculated height for the remote point.   |

### Next step

| IF                            | THEN          |
|-------------------------------|---------------|
| a remote point must be stored | <b>Store.</b> |

| IF                                | THEN   |
|-----------------------------------|--|
| a new base point must be measured | <b>Base pt</b> to return to the Measure app. |
| a code must be added              | change to the <b>Code</b> page.              |

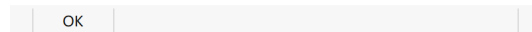
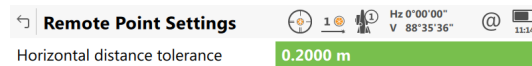
### 39.4.3

### Configuring Remote Point

#### Access

In **Remote points** press **Fn Settings** to access **Remote points**.

#### Measure Remote Point



| Key | Description   |
|-----|---|
| OK  | To accept changes and return to the panel from where this panel was accessed. |

#### Description of fields

| Field                                | Option         | Description  |
|--------------------------------------|----------------|--|
| <b>Horizontal distance tolerance</b> | Editable field | The horizontal distance to the remote point is equal to the horizontal distance of the base point. The value is the maximum tolerated length of the chord between the base point and the remote point. |

### 39.5

### Measure - Hidden Points

#### 39.5.1

#### Overview

#### Description

This feature is available in GS mode. It allows measuring points that cannot be directly accessed with the GS. For instance, if a point physically cannot be reached or because no satellites can be tracked in the point to be measured due to obstructions.

- A hidden point can be calculated by measuring distances and/or azimuths to the hidden point using a hidden point measurement device. Or for distances a tape can be used.
- Extra auxiliary points can be manually measured.
- Bearings can be computed from previously measured points.

In contrast to the COGO app, hidden point measurements are more of a measuring app than a calculation app.

#### Example

Application:

Completing a survey of telegraph poles for a telecommunication company.

Aim: The telegraph poles must be surveyed to 0.3 m accuracy in plan but height is not of concern.

Use of hidden point measurements: For poles surrounded by heavy undergrowth, where it is not possible to measure the pole directly without taking time to cut a path through the undergrowth.



Changing coordinates of a point which has been previously used in hidden point measurements does not result in the hidden point being recomputed.

### Hidden point measurement methods

A hidden point can be measured by

- Bearing and distance
- Two bearings
- Two distances
- Chainage and offset
- Backwards bearing and distance



A hidden point measurement device can be attached to the instrument such that the measurements are automatically transferred to the instrument.

### Heights

If configured, heights are taken into account. Refer to [39.5.8 Hidden Point Measurement Including Heights](#) for information on configuring height offsets.

**Device height** and **Target height** configured in **Hidden Point Settings** are applied when the hidden points are computed. **Difference in height in Measure Hidden Point** is the value directly from the hidden point measuring device.

### Coding of hidden points

| Type         | Description  |
|--------------|--|
| Point coding | Available in <b>Hidden Point Result</b> after the calculation of a hidden point. |
| Free coding  | Free coding of hidden points is identical to coding of manually measured points. |
| Quick coding | Not available.   |



**Azimuth** is used throughout this chapter. This term should also always be considered to mean **Bearing**.

### Auxiliary points

Auxiliary points are used to compute azimuths required for the calculation of hidden point coordinates. Auxiliary points can be points existing in the job or they can be manually measured. The point ID template configured for **Auxiliary points** in **ID Templates** is applied.

## 39.5.2

### Hidden Point Methods

#### Bearing & Distance

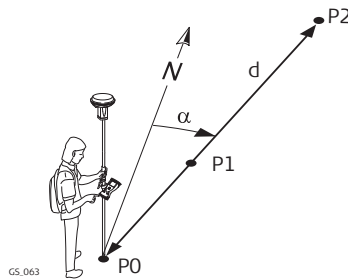
#### Description

One point must be known. It

- can exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The distance and the bearing from the known point to the hidden point are to be determined. An auxiliary point helps compute the bearing which might not be known. The auxiliary point can be determined in the direction from the known point to the hidden point.

### Diagram



#### Known

P0 Known point

#### To be measured

d Distance from P0 to P2

$\alpha$  Bearing from P0 to P2

P1 Auxiliary point, optional

#### Unknown

P2 Hidden point

## Using two bearings

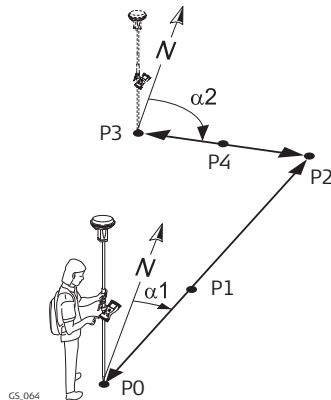
### Description

Two points must be known. They

- can exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The bearings from the known points to the hidden point are to be determined. Auxiliary points help compute the bearings which might not be known. Auxiliary points can be measured in the direction from the known points to the hidden points.

### Diagram



#### Known

P0 First known point

P3 Second known point

#### To be measured

$\alpha_1$  Bearing from P0 to P2

$\alpha_2$  Bearing from P3 to P2

P1 First auxiliary point, optional

P4 Second auxiliary point, optional

#### Unknown

P2 Hidden point

## Using two distances

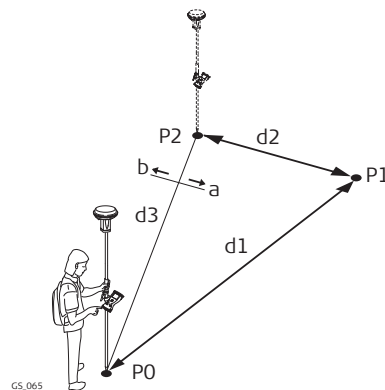
### Description

Two points must be known. They

- can exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The distances from the known points to the hidden points are to be determined. The location of the hidden point relative to the line between the two known points is to be defined.

### Diagram



### Known

- P0 First known point
- P2 Second known point
- d3 Line from P0 to P2
- a Right of d3
- b Left of d3

### To be measured

- d1 Distance from P0 to P1
- d2 Distance from P2 to P1

### Unknown

- P1 Hidden point

## Chainage & offset

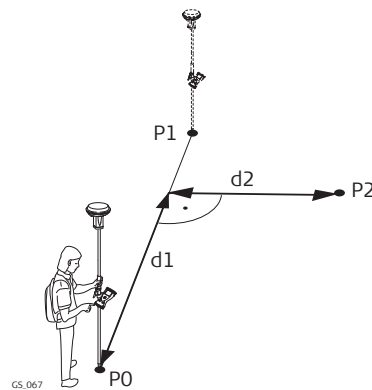
### Description

Two points must be known. They

- can exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The chainage from one known point along the line between the two known points must be determined. The offset of the hidden point to the line between the two known points must be determined.

### Diagram



### Known

- P0 First known point
- P1 Second known point

### To be measured

- d1 Chainage
- d2 Offset

### Unknown

- P2 Hidden point

## Backwards bearing & distance

### Description

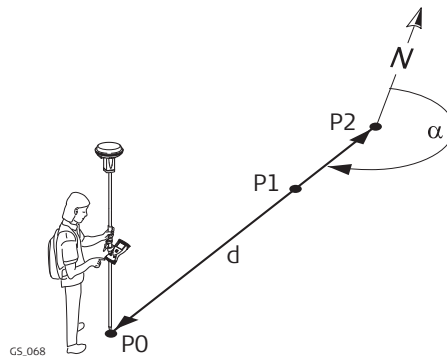
In order to compute the hidden point, the measurements are taken from the hidden point.

One point must be known. It

- can exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The distance and the bearing from the hidden point to the known point are to be determined. An auxiliary point helps compute the bearing which might not be known. An auxiliary point can be measured in the direction from the hidden point to the known point.

### Diagram



#### Known

P0 Known point

#### To be measured

$\alpha$  Bearing from P2 to P0

d Distance from P2 to P0

P1 Auxiliary point, optional

#### Unknown

P2 Hidden point

### 39.5.3

### Hidden Point Settings

#### Hidden Point Settings, General page

| Key    | Description  |
|--------|--|
| OK     | To accept changes and return to the panel from where this panel was accessed.  |
| Search | Available when a Bluetooth port and device is selected. To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. |
| Device | To create, select, edit or delete a device.  |
| Page   | To change to another page on this panel.   |

#### Description of fields

| Field                                 | Option                            | Description   |
|---------------------------------------|-----------------------------------|---|
| Use a device to measure hidden points | Check box                         | To compute a hidden point with height. Activates the hidden point connection. If not checked, the measured values must be entered manually. |
| Connect using                         | CS Bluetooth 1 and CS Bluetooth 2 | The Bluetooth ports on the field controller which are used for the connection functionality.  |
|                                       | CS RS232 port                     | The RS232 port on the field controller.   |
|                                       | Internal Disto                    | The DISTO in the CS20.  |
| Device                                | Display only                      | The name of the selected hidden point device.   |
| Measure distance from                 |                                   | Available for <b>Device: Internal Disto</b> . The settings define the offsets applied to the measurements.                                  |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

**Front of CS20**

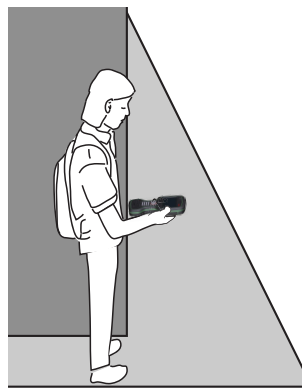
The CS20 is placed to with its front to an object to measure the distance.



0014510.001

**Back of CS20**

The CS20 is placed to with its back to an object to measure the distance.



0014509.001

**Front of pole**

Right-handed setup  
The offset of the reference point inside the CS20 turning around the axis of the clamp is taken in account.


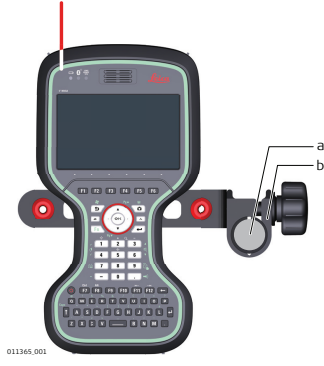
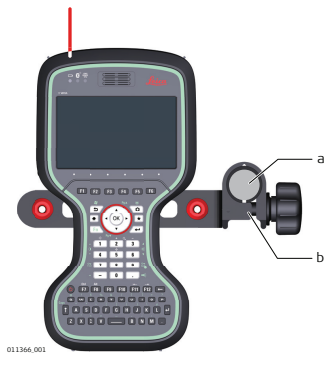


011363.001

a Pole  
b Clamp

**Back of pole**

Right-handed setup  
The offset of the reference point inside the CS20 turning around the axis of the clamp is taken in account.

| Field                                     | Option       | Description  |
|---|--------------|--|
|   |              |  <p>011366.001</p> <p>a Pole<br/>b Clamp</p>   |
| <b>Left-handed setup</b>                  | Check box    | <p>Available for <b>Measure distance from: Front of pole</b> and <b>Measure distance from: Back of pole</b>.<br/>The settings define the offsets applied to the measurements.<br/>Front of CS20, left-handed setup:</p>  <p>011365.001</p> <p>a Pole<br/>b Clamp</p> <p>Back of CS20, left-handed setup:</p>  <p>011366.001</p> <p>a Pole<br/>b Clamp</p> |
| <b>Bluetooth ID</b>                       | Display only | Available if <b>CS Bluetooth 1</b> or <b>CS Bluetooth 2</b> are selected. The Bluetooth ID of the hidden point device.   |
| <b>Measure azimuth using CS20 compass</b> | Check box    | Use the compass in the CS20.   |



### Next step

**Page** changes to the **Height & offsets** page.

Hidden Point Settings,  
Height & offsets page

| Key  | Description  |
|------|--|
| OK   | To accept changes and to return to <b>Measure Hidden Point</b> . |
| Page | To change to another page on this panel.                         |

### Description of fields

| Field                                   | Option                    | Description  |
|---|---------------------------|--|
| <b>Compute height for hidden points</b> | Check box                 | When this box is checked, heights are computed for hidden points.  |
| <b>Use distance offset</b>              | Check box                 | When this box is checked, a defined distance offset is added to the measured distance.   |
| <b>Offset</b>                           | Editable field            | Available when <b>Use distance offset</b> is checked. The distance offset is automatically added to the measured distance.   |
| <b>Use angle offset</b>                 | Check box                 | When this box is checked, a defined angle offset is added.<br>The offset is an angle between the North of the device being used and WGS1984 geodetic North. The offset is applied when measuring hidden points using a device capable of measuring azimuths.<br>When this box is not checked, no angle offset is applied to the azimuth measurement received from the hidden point measurement device. |
| <b>Type</b>                             |                           | Sets the default method for entering an angle offset.  |
|   | <b>Permanent</b>          | Applies a default value for the offset angle. The value is changeable.   |
|   | <b>New for each point</b> | Offset angle values must be entered for each new hidden point.   |
| <b>Angle offset</b>                     | Editable field            | The default value for the offset angle.  |
| <b>Use height offset</b>                | Check box                 | When this box is checked, a defined height offset is added to the measured.<br>When this box is not checked, no height offsets are used. The result is the delta height between the centre of the device and the aimed point.  |
| <b>Type</b>                             |                           | Available when <b>Use height offset</b> is checked.  |
|   | <b>Device height</b>      | When measuring hidden points, the height of the hidden point measurement device can be typed in. This option should be used when the hidden point can be directly measured using the hidden point device.  |

| Field                | Option                        | Description   |
|----------------------|-------------------------------|---|
|                      | <b>Device &amp; target ht</b> | When measuring hidden points, the height of the hidden point measurement device as well as the target height can be typed in. Use this option when the hidden point cannot be directly measured with a hidden point device, but a target point can be used to calculate the position. |
| <b>Device height</b> | Editable field                | The height of the hidden point measurement device. This height is the distance from the ground to the centre of the device.   |
| <b>Target height</b> | Editable field                | The distance from the hidden point to the aimed point.  |

### Next step

**Page** changes to the **Measurement quality** page.

Hidden Point Settings,  
Measurement quality  
page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To accept changes and to return to <b>Measure Hidden Point</b> . |
| <b>Page</b> | To change to another page on this panel.                         |

### Description of fields

| Field             | Option         | Description                          |
|-------------------|----------------|--------------------------------------|
| <b>2D quality</b> | Editable field | Define a distance and height quality |
| <b>1D quality</b> | Editable field | Define a distance quality            |

## 39.5.4



### Hidden Point Measurements

Hidden point measurements are possible from the Measure app and when the Measure app is called from another app.

### Access

Press **Measure hidden point** in the toolbox of the **Measure** app.



Measure Hidden Point,  
Hidden point page

The setting for **Method** on this panel determines the availability of the subsequent fields and softkeys.

| Key              | Description   |
|------------------|---|
| <b>Calculate</b> | To calculate the hidden point and to display the results. |

| Key                | Description   |
|--------------------|---|
| <b>Ang Offset</b>  | To change or enter an <b>External Angle Offset</b> . Available when <b>Compute height for hidden points</b> and <b>Use height offset</b> is checked in <b>Hidden Point Settings, Height &amp; offsets</b> page.   |
| <b>Heights</b>     | To type in the device and target heights to be considered. Available when <b>Compute height for hidden points</b> and <b>Use angle offset</b> is checked in <b>Hidden Point Settings, Height &amp; offsets</b> page.  |
| <b>Sun</b>         | Available when <b>Azimuth</b> is highlighted. The azimuth from the direction of the sun to the known point is computed.   |
| <b>Azimuth</b>     | Available when <b>Azimuth</b> is highlighted. To select or manually measure an auxiliary point and to compute the azimuth.  |
| <b>Dist along</b>  | To determine chainage and offset of the current position relative to the line between the two known points. The values are displayed in <b>Distance along</b> and <b>Offset</b> . The point from where the chainage has been measured is selected in <b>Start point</b> . |
| <b>Slope</b>       | Available when <b>Horizontal distance</b> is highlighted. To measure a slope distance and an elevation angle or percentage grade. The values are used to compute the horizontal distance.   |
| <b>Meas app</b>    | Available when a point field is highlighted. To measure the known point manually for the calculation of the hidden point.   |
| <b>Fn Settings</b> | To configure hidden point measurements. Refer to <a href="#">39.5.3 Hidden Point Settings</a> .   |

#### Description of fields

| Field          | Option          | Description  |
|----------------|-----------------|--|
| <b>Method</b>  | Selectable list | The method for measuring hidden points. The last used method is displayed. Refer to <a href="#">39.5.2 Hidden Point Methods</a> for a description of the methods.  |
| <b>Point</b>   | Selectable list | The point ID of the current position. This point is the known point for the calculation of the hidden point.<br> To type in coordinates manually for the known point open the selectable list and create a point.       |
| <b>Point A</b> | Selectable list | The point ID of the current position. This point is the first known point for the calculation of the hidden point.<br> To type in coordinates manually for the known point open the selectable list and create a point. |

| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Point B</b>             | Selectable list | The point ID of the current position. This point is the second known point for the calculation of the hidden point.<br><br>☞ To type in coordinates manually for the known point open the selectable list and create a point.   |
| <b>Azimuth</b>             | Editable field  | The azimuth from the known point to the hidden point. Type in an azimuth. When a hidden point measurement device is attached to the instrument to measure the azimuth, the value is automatically transferred.  |
| <b>Horizontal distance</b> | Editable field  | The horizontal distance from the known point to the hidden point. Type in a distance. When a hidden point measurement device is attached to the instrument to measure the distance, the value is automatically transferred.   |
| <b>Side of line</b>        | Selectable list | Available for <b>Method:Using 2 distances</b> . The location of the hidden point relative to the line from <b>Point A</b> to <b>Point B</b> .   |
| <b>Start point</b>         | Selectable list | Available for <b>Method:Distance &amp; offset</b> . The chainage from one known point along the line between the two known points. Looking from the point selected in <b>Start point</b> , a positive chainage is towards the second known point. A negative chainage is into the opposite direction of the second known point. |

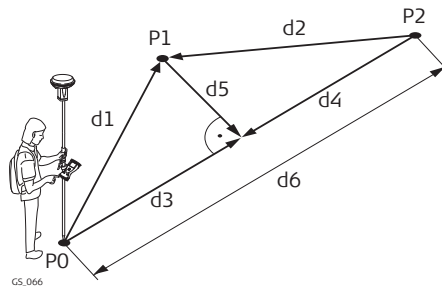
#### Next step

**Calculate** calculates the hidden point and displays the results in **Hidden Point Result**.

### 39.5.5

### Hidden Point Results

#### Computed distances on Hidden Point Result



- P0 First known point
- P1 Hidden point
- P2 Second known point
- d1 Distance from P0 to P1
- d2 Distance from P2 to P1
- d3 **Distance from A**
- d4 **Distance from B**
- d5 **Offset**
- d6 **Distance between A & B**

#### Hidden Point Result

| Key          | Description                              |
|--------------|--|
| <b>Store</b> | To store the result.                     |
| <b>Page</b>  | To change to another page on this panel. |

| Key  | Description   |
|--|---|
| <b>Next</b>                                | To store the hidden point and to return to <b>Measure Hidden Point</b> . Another hidden point can be measured.                                |
| <b>Fn Indiv ID</b><br>and<br><b>Fn Run</b> | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. |

#### Description of fields

| Field                             | Option         | Description   |
|-----------------------------------|----------------|---|
| <b>Point ID</b>                   | Editable field | The identifier for the hidden point. The configured point ID template is used. The ID can be changed. Type in a point ID.   |
| <b>Distance between A &amp; B</b> | Display only   | Available for <b>Method:Using 2 bearings</b> and <b>Method:Using 2 distances</b> . The computed horizontal distance between <b>Point A</b> and <b>Point B</b> .                               |
| <b>Bearing between A &amp; B</b>  | Display only   | Available for <b>Method:Using 2 bearings</b> and <b>Method:Distance &amp; offset</b> . The computed bearing from <b>Point A</b> to <b>Point B</b> .   |
| <b>Distance to A</b>              | Display only   | Available for <b>Method:Using 2 bearings</b> and <b>Method:Using 2 bearings</b> . The computed horizontal distance between <b>Point A</b> and the hidden point.                               |
| <b>Distance to B</b>              | Display only   | Available for <b>Method:Using 2 bearings</b> and <b>Method:Distance &amp; offset</b> . The computed horizontal distance between <b>Point B</b> and the hidden point.                          |
| <b>Distance from A</b>            | Display only   | Available for <b>Method:Using 2 distances</b> . The computed distance on the line from <b>Point A</b> to <b>Point B</b> from <b>Point A</b> to the point of intersection with <b>Offset</b> . |
| <b>Distance from B</b>            | Display only   | Available for <b>Method:Using 2 distances</b> . The computed distance on the line from <b>Point B</b> to <b>Point A</b> from <b>Point B</b> to the point of intersection with <b>Offset</b> . |
| <b>Offset</b>                     | Display only   | Available for <b>Method:Using 2 distances</b> . The computed perpendicular distance from the hidden point to the line from <b>Point A</b> to <b>Point B</b> .                                 |

#### Next step

On the **Code** page, type in a code if desired.

### 39.5.6

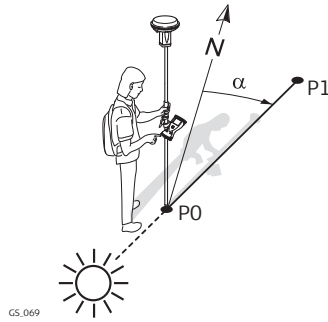
#### Computing an Azimuth

##### Using the sun

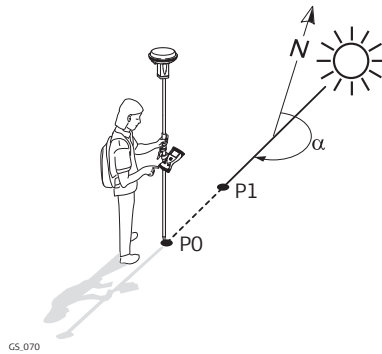
##### Description

The azimuth for a hidden point measurement can be computed using a known point and the sun. The known point can be manually measured. The location of the hidden point can be away from the sun or in the direction towards the sun. Ensure that the shadow of the pole falls in the direction of the point.

## Diagram



P0 Known point  
P1 Hidden point  
 $\alpha$  Bearing from P0 to P1



P0 Known point  
P1 Hidden point  
 $\alpha$  Bearing from P0 to P1

## Requirements

**Bearing & distance, Using 2 bearings** or **Back bearing & distance** must be selected for **Method**.

## Access

In **Measure Hidden Point** highlight **Azimuth**. Press **Sun**.

Follow the instructions on the panel.

## Using azimuth point

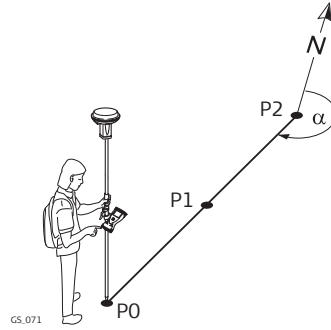
### Description

The azimuth for a hidden point measurement can be computed using an auxiliary point. The auxiliary point

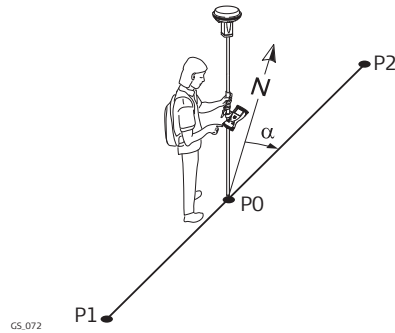
- can exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

The location of the auxiliary point can be in the direction towards the hidden point or away from the hidden point.

## Diagram



- P0 Known point
- P1 Auxiliary point, **Azimuth Pt**
- P2 Hidden point
- $\alpha$  Bearing from P2 to P0



- P0 Known point
- P1 Auxiliary point, **Azimuth Pt**
- P2 Hidden point
- $\alpha$  Bearing from P0 to P2

## Requirements

**Bearing & distance, Using 2 bearings** or **Back bearing & distance** must be selected for **Method**.

## Access

In **Measure Hidden Point** highlight **Azimuth**. Press **Azimuth**.

## Choose Azimuth Point

Choose Azimuth Point
2D 2.354 m  
1D 2.397 m

Azimuth Pt Pt3 >

Direction Towards hidden pt v

OK Meas app

| Key             | Description  |
|-----------------|--|
| OK              | To accept changes and return to the panel from where this panel was accessed. The azimuth is computed and displayed in <b>Azimuth</b> in <b>Measure Hidden Point</b> . |
| <b>Meas app</b> | Available for <b>Azimuth Pt</b> being highlighted. To measure the auxiliary point manually for the calculation of the azimuth.   |

### Description of fields

| Field             | Option          | Description   |
|-------------------|-----------------|---|
| <b>Azimuth Pt</b> | Selectable list | The auxiliary point for the calculation of the azimuth.           |
| <b>Direction</b>  | Selectable list | The location of the auxiliary point relative to the hidden point. |

### Next step

**OK** closes the panel.

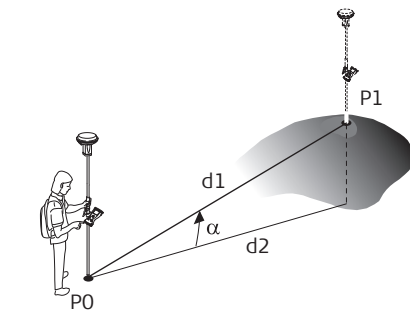
## 39.5.7

### Computing Horizontal Distances from Slope Distances

#### Description

The horizontal distance for a hidden point measurement can be computed using a slope distance, and an elevation angle or percentage grade. The slope distance and the elevation angle can either be typed in or measured with a hidden point measurement device.

#### Diagram



GS\_073

- P0 Known point
- P1 Hidden point
- d1 Slope distance
- d2 Horizontal distance
- $\alpha$  Elevation angle

#### Requirements

**Bearing & distance, Using 2 bearings** or **Back bearing & distance** must be selected for **Method**.

#### Access

In **Measure Hidden Point** highlight **Horizontal distance**. Press **Slope**.


#### Slope Distance

| Slope Distance       |           |
|----------------------|-----------|
| Slope distance       | 5.850 m   |
| Elevation angle      | 25.0000 g |
| Grade (%)            | 41.4 %    |
| Horizontal distance  | 5.405 m   |
| Difference in height | 2.239 m   |
| OK                   |           |

| Key       | Description              |
|-----------|--------------------------|
| <b>OK</b> | To take over the result. |



### Description of fields

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Slope distance</b>       | Editable field | Type in a distance from the known point to the hidden point. When a hidden point measurement device is attached to the instrument to measure the distance, the value is automatically transferred.   |
| <b>Elevation angle</b>      | Editable field | Type in the elevation angle from the known point to the hidden point. When a hidden point measurement device is attached to the instrument to measure the elevation angle, the value is automatically transferred.   |
| <b>Grade (%)</b>            | Editable field | The grade from the known point to the hidden point is automatically computed from the slope distance and the elevation angle.<br> The value for <b>Grade (%)</b> can be typed in instead of the value for <b>Elevation angle</b> . Then <b>Elevation angle</b> is computed automatically. |
| <b>Horizontal distance</b>  | Display only   | The horizontal distance from the known point to the hidden point is automatically computed from the slope distance and the elevation angle.  |
| <b>Difference in height</b> | Display only   | The height difference between the known point and the hidden point is automatically computed from the slope distance and the elevation angle.<br>Available if <b>Compute height for hidden points</b> is checked in <b>Hidden Point Settings, Height &amp; offsets</b> page.   |

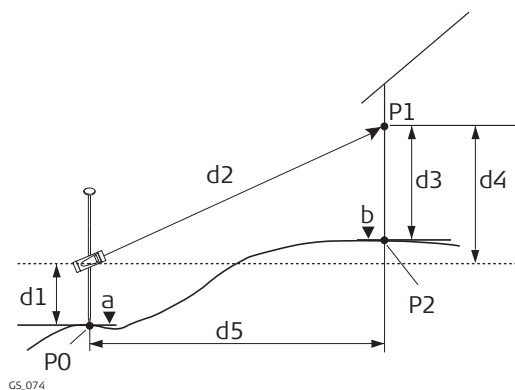
### Next step

**OK** returns to **Measure Hidden Point**. The horizontal distance is displayed in **Horizontal distance**.

## 39.5.8

### Hidden Point Measurement Including Heights

#### Diagram




- P0 Known point
- P1 Target point
- P2 Hidden point
- a Height of P0
- b Height of P2 = a + d1 + d4 - d3
- d1 Device height: Height of hidden point measurement device above P0
- d2 Slope distance
- d3 Target height: Height of P1 above P2
- d4 Height difference between hidden point measurement device and P1
- d5 Horizontal distance

## Configuration

Check **Compute height for hidden points** and **Use height offset** in **Hidden Point Settings, Height & offsets** page.


## Measure Hidden Point

### Description of fields

| Field                       | Option          | Description  |
|-----------------------------|-----------------|--|
| <b>Difference in height</b> | Selectable list | <p>The positive or negative height difference between the centre of the hidden point measurement device and the target point. Type in the value. When a hidden point measurement device is attached to the instrument to measure the height difference, the value is automatically transferred.</p> <p> For hidden point measurement methods using two known points, <b>Difference in height</b> must be determined from each known point.</p> <p>Refer to <a href="#">39.5.4 Hidden Point Measurements</a> for a description of all other fields on the panel.</p> |

### Next step

Press **Heights**.

 The **Heights** key is only available if **Compute height for hidden points** and **Use height offset** are checked in **Hidden Point Settings, Height & offsets** page.

## Device & Target Height

### Description of fields

| Field                           | Option         | Description   |
|---------------------------------|----------------|---|
| <b>Device height at point A</b> | Editable field | The height of the hidden point measurement device above <b>Point A</b> .  |
| <b>Target height</b>            | Editable field | The height of the target point above the hidden point when measured from <b>Point A</b> .   |
| <b>Device height at point B</b> | Editable field | Available for hidden point measurement methods using two known points. The height of the hidden point measurement device above <b>Point B</b> . |

| Field                | Option         | Description  |
|----------------------|----------------|--|
| <b>Target height</b> | Editable field | Available for hidden point measurement methods using two known points. The height of the target point above the hidden point when measured from <b>Point B</b> . |

#### Next step

**OK** closes the screen and returns to **Measure Hidden Point**.

There, **Difference in height** still displays the positive or negative height difference between the centre of the hidden point measurement device and the target point. The heights of the hidden point measurement device above the ground, and the target point above the hidden point, are applied when the hidden point is computed. For hidden point measurement methods using two known points, this computation is done for each known point. In this case, the height of the hidden point is the average.

## 39.6

### Measure Foresight

#### Description

**Measure foresight** provides points calculated from averaged backsight-foresight sets from the setup position.

**Measure foresight** includes:

- Collecting, reviewing and editing sets
- Classifying the resulting foresight points independently from other points
- Exporting the raw observations in order to process the data in the office.



**Measure foresight** cannot be used when the setup was done using the setup method **Orientate to object**.

#### Access

Select **Measure foresight** in the toolbox.

#### Measure Foresight, Automation behaviour page

| Key         | Description                                       |
|-------------|---|
| <b>OK</b>   | To accept changes and continue to the next panel. |
| <b>Page</b> | To change to another page on this panel.          |

#### Description of fields

| Field                       | Option               | Description   |
|-----------------------------|----------------------|---|
| <b>Measurement sequence</b> | <b>B'F'...F''B''</b> | All points are measured in face I, then measured in face II in reverse sequential order.                                    |
|                             | <b>B'F'...B''F''</b> | All points are measured in face I, then measured in face II.  |
|                             | <b>B'B''F'F''...</b> | Backsight point is measured in face I immediately followed by face II. Other points are measured in face I, face II order.  |
|                             | <b>B'B''F'F'...</b>  | Backsight point is measured in face I immediately followed by face II. Other points are measured in alternating face order. |
|                             | <b>B'F'...</b>       | All points are measured in face I only.   |

| Field   | Option    | Description   |
|---|-----------|---|
| <b>When using auto target aiming, automatically measure targets</b> | Check box | For instruments with automatic aiming and this option checked, automatic aiming search and automatic aiming measurements are done to specified targets and subsequent sets. |

#### Next step

Page changes to the **Quality control** page.

### Measure Foresight, Quality control page

#### Description of fields

| Field                                  | Option         | Description  |
|--|----------------|--|
| <b>Check for errors before storing</b> | Check box      | The entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements. |
| <b>Hz tolerance</b>                    | Editable field | Tolerance for horizontal directions.   |
| <b>V tolerance</b>                     | Editable field | Tolerance for vertical directions.   |
| <b>Distance tolerance</b>              | Editable field | Tolerance for distance.  |
| <b>Check the backsight height</b>      | Check box      | The entered height tolerance for the backsight point is checked during the measurements to verify accurate pointing and measurements.      |
| <b>Height limit</b>                    | Editable field | Tolerance for the backsight height.  |

#### Next step

OK changes to **Set Backsight Reference**.

### Set Backsight Reference

Available when the instrument was set up using **Setup method: Known backsight**.

Set the backsight to which the angles of the foresight measurements are related.

The current setup is used.

#### Description of fields

| Field   | Option        | Description   |
|---|---------------|---|
| <b>Use the current backsight as the reference point</b> | Option button | Available when the instrument was set up using <b>Setup method: Known backsight</b> . The backsight from the current setup is used. Foresight measurement is referenced to the backsight. |

| Field   | Option        | Description   |
|---|---------------|---|
| <b>Set another backsight as reference point (the current setup will be updated)</b> | Option button | Available when the instrument was set up using <b>Setup method: Known backsight</b> . The backsight from the current setup is ignored. A new backsight must be defined. |

#### Next step

| IF   | THEN   |
|--|--|
| <b>Use the current backsight as the reference point</b> was selected                             | <b>OK</b> to measure backsight-foresight sets.   |
| <b>Set another backsight as reference point (the current setup will be updated)</b> was selected | <b>OK</b> accesses <b>Define the Backsight</b> . Refer to <a href="#">Define the Backsight</a> . |

## Define the Backsight

This panel is displayed

- when the instrument was set up without a known backsight. The instrument is orientated but has no physical point as a backsight. Therefore a backsight point must be measured.
- when **Set another backsight as reference point (the current setup will be updated)** was previously selected.

| Key             | Description   |
|-----------------|---|
| <b>Set</b>      | To set the setup and orientation.   |
| <b>Distance</b> | To measure a distance to the point being used to set the azimuth.   |
| <b>GS</b>       | When using SmartPole. To enter the Measure panel and measure a point with GS. The antenna height is automatically converted from the target height. |
| <b>More</b>     | To change between the slope and the horizontal distance.  |
| <b>Page</b>     | To change to another page on this panel.  |

#### Description of fields

| Field                                    | Option         | Description   |
|--|----------------|---|
| <b>Backsight ID</b>                      | Editable field | Point ID of the backsight point.  |
| <b>Target height</b>                     | Editable field | Height of the target above or below the backsight point. The last setup target height is always remembered.                   |
| <b>Computed direction</b>                | Display only   | Displays the calculated azimuth from the selected setup to the backsight point.   |
| <b>Computed horizontal distance</b>      | Display only   | Displays the calculated horizontal distance between the selected setup and backsight point.                                   |
| <b>Difference in horizontal distance</b> | Display only   | The difference between the calculated horizontal distance from setup to backsight point and the measured horizontal distance. |

| Field                               | Option       | Description   |
|-------------------------------------|--------------|---|
| <b>Computed slope dist</b>          | Display only | Displayed after <b>More</b> was pressed. The calculated slope distance to the backsight point.  |
| <b>Difference in slope distance</b> | Display only | Displayed after <b>More</b> was pressed. The difference between the calculated slope distance from setup to backsight point and the measured slope distance.                  |
| <b>Difference in height</b>         | Display only | The difference between the design height of the backsight point and the measured height of the backsight point. If the backsight point is a 2D point, this field shows -----. |

#### Next step

**Set** starts backsight-foresight set measurements.

## Foresight

| Key             | Description  |
|-----------------|--|
| <b>Measure</b>  | To measure and record the foresight point. The measurement settings for the first measurement to each point are used for all further sets. |
| <b>Distance</b> | To measure and display distances.  |
| <b>Store</b>    | To record data.  |

#### Description of fields

| Field                      | Option         | Description  |
|----------------------------|----------------|--|
| <b>Foresight ID</b>        | Editable field | The name of the foresight point.   |
| <b>Target height</b>       | Editable field | The target height of the foresight point.  |
| <b>Number of sets</b>      | Editable field | The number of sets to be measured.   |
| <b>Hz</b>                  | Display only   | Displays the horizontal angle to the foresight point.                              |
| <b>V</b>                   | Display only   | Displays the vertical angle to the foresight point.                                |
| <b>Horizontal distance</b> | Display only   | Displays the calculated horizontal distance between the setup and foresight point. |

#### Next step

Measure more foresight points or measure the set sequence.

## Measure set sequence

1. **Foresight**  
**Foresight ID** The name of the foresight point.  
**Target height** The target height of the foresight point.  
**Number of sets** The number of sets to be measured.
2. **Measure** to measure and record the foresight points. The measurement settings for the first measurement to each point are used for all further sets.

3. **Backsight, Set:**  
Enter **Target height**.  
**Hz, V** and **Horizontal distance** The measured values are displayed.
4. **Measure** to measure and record the backsight point.

## Point Results

| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store the results and to quit.  |
| <b>Sets</b>  | To include or exclude measured sets in the calculation of a foresight point. |
| <b>More</b>  | To display additional information.   |

### Description of fields

| Field                              | Option                          | Description   |
|------------------------------------|---------------------------------|---|
| <b>Point ID</b>                    | Selectable list or display only | Selected point ID.  |
| <b>Target height</b>               | Selectable list or display only | The target height of the target point.                                |
| <b>Backsight ID</b>                | Display only                    | The point ID of the backsight.  |
| <b>Number of sets</b>              | Display only                    | The number of sets out of all measured sets used for the calculation. |
| <b>Hz arc average</b>              | Display only                    | Average horizontal angle.   |
| <b>V average</b>                   | Display only                    | Average vertical angle.   |
| <b>Distance average</b>            | Display only                    | Average distance.   |
| <b>Hz arc standard deviation</b>   | Display only                    | Standard deviation of horizontal angle.                               |
| <b>V standard deviation</b>        | Display only                    | Standard deviation of vertical angle.                                 |
| <b>Distance standard deviation</b> | Display only                    | Standard deviation of distance.                                       |
| <b>Hz spread</b>                   | Display only                    | Spread of horizontal angle.   |
| <b>V spread</b>                    | Display only                    | Spread of vertical angle.   |
| <b>Distance spread</b>             | Display only                    | Spread of distance.   |

## Set Results

All the measured sets for the selected foresight are listed.

Check a box to include a set in the calculation.

Uncheck a box to exclude a set from the calculation.

The metadata and the foresight results are recalculated with the selection.

| Key      | Description  |
|----------|--|
| OK       | To accept and store changes.   |
| Add sets | To add more sets while still at the setup. It could be necessary that more than the designated number of sets is required. Possibly some of the sets from the first run exceeded the tolerance limit and must be disabled. |
| More     | To display additional information.   |

#### Description of metadata

| Field                       | Option       | Description                             |
|-----------------------------|--------------|---|
| Hz arc average              | Display only | Average horizontal angle.               |
| V average                   | Display only | Average vertical angle.                 |
| Distance average            | Display only | Average distance.                       |
| Hz arc standard deviation   | Display only | Standard deviation of horizontal angle. |
| V standard deviation        | Display only | Standard deviation of vertical angle.   |
| Distance standard deviation | Display only | Standard deviation of distance.         |
| Hz spread                   | Display only | Spread of horizontal angle.             |
| V spread                    | Display only | Spread of vertical angle.               |
| Distance spread             | Display only | Spread of distance.                     |

## 39.7

### Stake elevation

#### Description

To only work with heights and not with 2D coordinates in the Stakeout app. Enter the desired value for the elevation to be staked. Decide if the elevation is used once or more times.

While staking, the offered point ID follows the defined point ID template.

The design height displays the entered value for the elevation and is editable.

In **Stake Results** only height relevant fields are displayed.

#### Enter Elevation

| Key | Description           |
|-----|-----------------------|
| OK  | To return to the app. |

#### Description of fields

| Field     | Option         | Description                                       |
|-----------|----------------|---|
| Elevation | Editable field | The desired value for the elevation to be staked. |



| Field   | Option    | Description   |
|---|-----------|---|
| <b>Use the entered elevation to stake more than one point</b> | Check box | When this box is checked, more points with the entered elevation only are staked. To return to the standard Stakeout app, use <b>Stake points</b> in the toolbox. |

## 39.8

### Export Cut Sheet

#### Description

To export a stake report showing the differences between the staked points and the design points.


The type of points included in the export depends on the app from where the cut sheet is exported.

| App   | Points Exported   |
|---|---|
| <b>Stake points, Stake DTM, Stake pts &amp; DTM</b> | All the points staked in any of these apps will be included in the same file. |
| <b>Stake to line</b>                                | All points staked in this app only will be included.                          |
| <b>Stake road</b>                                   | All points staked in this app only will be included.                          |
| <b>Stake rail</b>                                   | All points staked in this app only will be included.                          |
| <b>Stake tunnel</b>                                 | All points staked in this app only will be included.                          |

#### Export Cut Sheet

| Key             | Description                                      |
|-----------------|--|
| <b>OK</b>       | To return to the app.                            |
| <b>Settings</b> | To define the format of the data to be exported. |

#### Description of fields

| Field                       | Option          | Description  |
|-----------------------------|-----------------|--|
| <b>Job</b>                  | Display only    | The job to export.   |
| <b>Cut sheet definition</b> | Selectable list | The format is user defined and selectable.   |
| <b>To device</b>            | Selectable list | Defines where the exported data are saved to.<br><br> For <b>To device: Internal memory</b> the data is always exported to the \DATA directory. |
| <b>To folder</b>            | Selectable list | The data can be exported to the \DATA or the root directory or to the folder where the selected job is located.  |
| <b>Output file</b>          | Editable field  | The name of the file to which the data is exported.  |

#### Settings

| Key            | Description                            |
|----------------|--|
| <b>OK</b>      | To store the settings.                 |
| <b>Default</b> | To recall the default export settings. |

### Description of fields

| Field                         | Option                    | Description  |
|-------------------------------|---------------------------|--|
| <b>Default file extension</b> | Editable field            | The extension of the file to which the data is exported. Default is "txt" but can be changed to anything else. |
| <b>Filter to export</b>       | <b>Entire job</b>         | To export all data from the working job.   |
|                               | <b>Current day</b>        | To export points staked on that day.   |
|                               | <b>Range of point IDs</b> | To export points with point IDs between the entered start and end ID.  |
|                               | <b>Time</b>               | To export points which were recorded within a defined time window.   |
| <b>Start ID and End ID</b>    | Editable field            | Enter the range of points to be exported.  |

### Select Cut Sheet Definition

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To return to the previous panel.  |
| <b>New</b>    | To create a new cut sheet definition. Refer to <a href="#">Define Cut Sheet Content</a> .         |
| <b>Edit</b>   | To edit the highlighted cut sheet definition. Refer to <a href="#">Define Cut Sheet Content</a> . |
| <b>Delete</b> | To delete the highlighted cut sheet definition.   |

### Description of metadata

| Metadata    | Description  |
|-------------|--|
| -           | The name of the cut sheet definition.                |
| <b>Date</b> | When the cut sheet definition was stored was stored. |

### Next step

**New** or **Edit** access a panel to define the cut sheet content.

### Define Cut Sheet Content

| Key               | Description                            |
|-------------------|--|
| <b>OK</b>         | To return to the previous panel.       |
| <b>Clear</b>      | To set all fields to <b>None</b> .     |
| <b>Fn Default</b> | To recall the default import settings. |

### Description of fields

| Field                            | Option                         | Description                                 |
|----------------------------------|--------------------------------|---|
| <b>Cut sheet definition name</b> | Editable field or display only | The name of the cut sheet definition.       |
| <b>Delimiter</b>                 | Selectable list                | The separator between the export variables. |

| Field                    | Option  | Description   |
|--------------------------|---|---|
| <b>Use table headers</b> | Check box   | When this box is checked, the text in each field below is used as header for the column. The header is displayed only once on the first row of the exported file. |
| <b>1st to 21th</b>       | None,<br>Design point ID,<br>Design code,<br>Design code description,<br>Design easting,<br>Design northing,<br>Design height,<br>Design offset,<br>Design line distance,<br>Design chainage,<br>Staked point ID,<br>Staking date,<br>Staking time,<br>Staked code,<br>Staked code description,<br>Staked northing,<br>Staked easting,<br>Staked height,<br>Staked line offset,<br>Staked distance along line,<br>Staked chainage,<br>1D quality,<br>2D quality,<br>3D quality,<br>Cut/fill,<br>Cut,<br>Fill,<br>Difference in northing,<br>Difference in easting,<br>Difference in offset,<br>Difference in chainage,<br>Difference in dist. along line,<br>and<br>Target height | Select the variable of the particular positions. The availability of variables depends on the app.  |

## 39.9

### Multiple Offsets

#### Description


When doing outdoor surveying, especially when measuring cross sections for roads, several parallel alignments/lines must be followed and measured. Using the **Multiple offset lines** tool, just one single line must be measured. The other lines are generated automatically based on an entered offset and a point code.

The defined offsets and codes can be edited.

Some tools will be unavailable when **Multiple offset lines** is used. These are:

- **Store code template**
- **Load code template**
- **Zig-zag**
- **Same direction**

## Requirements

- **Coding functionality: Create linework** must be set in **Leica Captivate - Home: Settings\Customisation\Coding**.
- Multicode check box is unchecked.
- No other automatic measurement modes or tool such as **Zig-zag** or **Same direction** are used.
- The user definable page  must be active.





## Multiple Offsets


Up to ten different offset lines can be defined.

The entered offsets do not need to be sorted in any way.

Only filled lines are considered for the drawing of the lines.


### Check box behaviour

|   | Description                          |
|---|--------------------------------------|
|    | Starts the edit or selection mode.   |
|   | Starts the edit or selection mode.   |
|  | Move the focus on to previous field. |
|  | Move the focus on to next field.     |

| Key              | Description   |
|------------------|---|
| <b>OK</b>        | To return to the measure panel with the tool being activated.<br>The icon for the user definable page changes to  .<br>When measuring points, parallel lines at the determined offsets are drawn in the map. |
| <b>Inverse</b>   | To calculate the distance and angle between two points from the job.  |
| <b>Clear all</b> | To clear all parameters from all lines.   |

### Description of fields

| Field                    | Option         | Description  |
|--------------------------|----------------|--|
| <b>Horizontal offset</b> | Editable field | The horizontal distance between the measured line and the parallel line. |
| <b>Vertical offset</b>   | Editable field | The vertical difference between the measured line and the parallel line. |

| Field       | Option          | Description  |
|-------------|-----------------|--|
| <b>Code</b> | Selectable list | All codes from the codelist of the current working job are listed.<br>To create a new code, type in the name.<br> For new codes, the linework flag is assigned automatically. |

---

### Next step

Measure the points of the line.

To pause and resume the tool press **Pause** or **Resume**.

To edit offsets or codes press **Edit multiple offsets**.

To stop the tool press **Fn Tools** and then **Deactivate multiple offsets**.

---

## 40.1

## Overview

## Description

COGO is an app to perform **coordinate geometry** calculations such as

- coordinates of points.
- bearings between points.
- distances between points.

The calculations can be made from

- existing point data in the job, known distances or known azimuths.
- manually measured points.
- entered coordinates.

In contrast to hidden point measurements within the Measure app, COGO is more of a calculation program than a measuring program.

## Linked jobs and global data

If the working job has linked jobs, then the list of points available for the calculations contains points from the working job and the linked jobs.

If the working job has no linked jobs, then the points from the working job will be used.



Changing coordinates of a point which has been previously used in COGO does not result in the point being recomputed.

## COGO calculation methods

The COGO calculation methods are:

- Inverse
- Bearing & distance
- Intersection
- Line and arc calculations
- Object division
- Shift, rotate & scale
- Angle calculations
- Horizontal curve
- Triangle

## Distances and azimuths

| Type      | Description   |
|-----------|---|
| Distances | The choices are <ul style="list-style-type: none"> <li>• Ground</li> <li>• Grid</li> <li>• Ellipsoidal</li> </ul> |
| Azimuths  | The azimuths are grid azimuths relative to the local grid.  |

## Coding of COGO points


- Point coding is available in the results panel after the COGO calculation. Point coding of COGO points is identical to coding manually measured points. Refer to [28 Coding](#) for information on coding.
- For the COGO calculation shift, rotate & scale, the codes from the original points are taken over for the calculated COGO points.

## 40.2

## Accessing COGO

## Access

1. Select **COGO** from the **Leica Captivate - Home** menu.

2. Select a COGO calculation method from the **COGO** menu.  
 Use **Next** to display more COGO calculation methods.

## COGO calculation methods

### Description of the COGO calculation methods

| COGO calculation methods          | Description   |
|-----------------------------------|---|
| <b>Inverse</b>                    | <p>To calculate the direction, the distance and the 3D coordinate differences between two known points (or one known point and the current GNSS position).</p> <p>To calculate the direction, the distance and the 3D coordinate differences between a known point (or the current GNSS position) and a user-defined line.</p> <p>To calculate the direction, the distance and the 3D coordinate differences between a known point (or the current GNSS position) and a user-defined arc.</p> <p>For these calculations, only points with full coordinate triplets or position only points can be used.</p> |
| <b>Bearing &amp; distance</b>     | <p>To calculate the position of new points using</p> <ul style="list-style-type: none"> <li>• the azimuth/bearing and the distance from a known point. Offset optional.</li> <li>• the angle and the distance from a known point. Offset optional.</li> </ul> <p>For these calculations, only points with full coordinate triplets or position only points can be used.</p>   |
| <b>Intersection</b>               | <p>To calculate the position of an intersection point using</p> <ul style="list-style-type: none"> <li>• bearings from two known points.</li> <li>• a bearing and a distance from two known points.</li> <li>• distances from two known points.</li> <li>• four points.</li> <li>• two TS observation lines.</li> </ul> <p>For these calculations, only points with full coordinate triplets or position only points can be used.</p>   |
| <b>Line &amp; arc calculation</b> | <p>To calculate:</p> <ul style="list-style-type: none"> <li>• the centre point of an arc.</li> <li>• an offset point from a distance along, and offset from, an arc.</li> <li>• an offset point from a distance along, and offset from, a line.</li> <li>• a base point on an arc of a known offset point.</li> <li>• a base point on a line of a known offset point.</li> <li>• new points along an arc by segmentation.</li> <li>• new points along a line by segmentation.</li> </ul>  |

| COGO calculation methods         | Description  |
|----------------------------------|--|
| <b>Shift, rotate &amp; scale</b> | To calculate the coordinates of new points using shifts, rotation and scale. The values for the shift, rotation and/or scale can either be entered manually or computed using selected matching points. For these calculations, points with full coordinate triplets, position only points or height only points can be used.  |
| <b>Area division</b>             | To divide an object by a <ul style="list-style-type: none"> <li>• defined line.</li> <li>• percentage.</li> <li>• defined size.</li> </ul>   |
| <b>Angle</b>                     | To calculate the angles that are defined by three points.  |
| <b>Horizontal curve</b>          | To calculate the missing parameters of a curve by the input of the known parameters.   |
| <b>Triangle</b>                  | To define a triangle by entering the three sides of the triangle or by selecting three points.   |
| <b>Rectangle</b>                 | To define a rectangle by <ul style="list-style-type: none"> <li>• two points and a perpendicular distance.</li> <li>• two points forming the baseline. The distance between the two points also defines the length of the second side of the square.</li> <li>• two points forming the diagonal of the square.</li> <li>• three points with right angles. Two points define one side of the rectangle. The third point defines the perpendicular distance to the second parallel side.</li> <li>• three points as parallelogram. The first and second point define the first side of the parallelogram. The second and third point define the second side of the parallelogram.</li> </ul> |

## 40.3

### Configuring COGO

#### Access

Press **Fn Settings** in the Input panel of a COGO calculation method.



**Fn Settings** is unavailable for **Angle**, **Horizontal curve**, and **Triangle**.



The availability of fields depends on the COGO calculation method.

#### Settings, General page

This panel consists of several pages. The explanations given for the softkeys given are valid for all pages.



Settings Hz 19°01'32" V 0°00'01" 10:58

General Points & quality TS specific Residuals Report sheet

Distance type **Grid** ▼

Allow use of offsets in calculations


Restart calculation with last selected points & entered values

Suggested code for calculated point should be <None> ▼

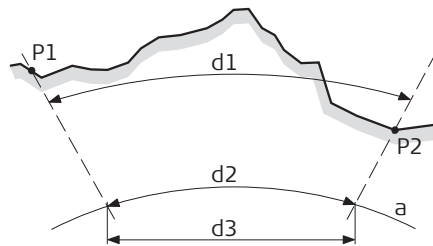
OK Page

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Page | To change to another page on this panel.                                      |

### Description of fields

| Field   | Option           | Description   |
|---|------------------|---|
| <b>Distance type</b>  | <b>Grid</b>      | Distances are calculated as the trigonometric distance between the position of two points. The distance field is <b>Horizontal distance</b> .   |
|   | <b>Ground</b>    | Distances are horizontal distances between two points at the mean elevation parallel to the ellipsoid of the active coordinate system. The distance field is <b>Horizontal distance (ground)</b> .  |
|   | <b>Ellipsoid</b> | Distances are reduced to the ellipsoid. They are calculated as the shortest distance between the two points on the ellipsoid. A scale factor is applied. The distance field is <b>Horizontal distance (ellipsoid)</b> .<br> In the attached coordinate system, a projection, an ellipsoid and a transformation have to be defined to calculate grid, ground and ellipsoid coordinates. |
| <b>Allow use of offsets in calculations</b>                               | Check box        | Activates the use of offsets in the COGO calculations. Editable fields for the offsets are available in the Input panel of any COGO calculation method.   |
| <b>Restart calculation with last selected points &amp; entered values</b> | Check box        | When this box is checked, after storing a result, the <b>Input</b> page is displayed showing the previously used values.  |

| Field  | Option                        | Description  |
|--|-------------------------------|--|
| <b>Suggested code for calculated point should be</b> |                               | The selection defines the suggestion for the code of the COGO point.           |
|  | <b>Same as for From point</b> | The code of the point which is selected in the <b>From</b> field is suggested. |
|  | <b>&lt;None&gt;</b>           | No code is suggested.  |
|  | <b>Last used</b>              | The code which was assigned to the last stored point is suggested.             |



91513.001

a Ellipsoid

**Known**

- P1 First known point
- P2 Second known point

**Unknown**

- d1 Ground distance
- d2 Ellipsoid distance
- d3 Grid distance

**Next step**

Page changes to the **Points & quality** page.

Settings,  
Points & quality page

**Description of fields**

| Field   | Option  | Description  |
|---|---|--|
| <b>Store computed COGO points with class</b>    | <b>Measured (Meas)</b> or <b>Control (Ctrl)</b> | Defines the point class of COGO calculated and stored points as <b>Measured (Meas)</b> or <b>Control (Ctrl)</b> triplets.        |
| <b>Position quality for computed COGO point</b> | Editable field                                  | The estimated value for the position quality assigned to all calculated COGO points which is used for the averaging calculation. |
| <b>Height quality for computed COGO point</b>   | Editable field                                  | The estimated value for the height quality assigned to all calculated heights which is used for the averaging calculation.       |

**Next step**

Page changes to the **TS specific** page.

Description of fields

| Field   | Option                  | Description  |
|---|-------------------------|--|
| <b>Use two face measurements</b>                                    | Check box               | <p>Defines if the instrument measures the second face automatically after storing the first.</p> <p>When this box is checked:<br/>After storing a measurement with <b>Measure</b> or <b>Store</b> motorised instruments change face automatically, non-motorised instruments access <b>Telescope Positioning</b>. The measurements of face I and face II are averaged on the base of face I. The averaged value is stored.</p> <p>When this box is not checked:<br/>No automatic measurement in two faces.</p> |
|   |                         |  |
| <b>Compute ht when computing intersect pt using TS observations</b> |                         | Defines the height being used within TS observations.  |
|   | <b>Using average</b>    | Using an average of the two observations.  |
|   | <b>Use upper height</b> | Using the upper height.  |
|   | <b>Use lower height</b> | Using the lower height.  |

Next step

Page changes to the **Residuals** page.

This page applies to **Shift, Rotate & Scale (Match Points)**.

Description of fields

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| <b>Easting</b>          | Editable field | The limit above which Easting residuals are flagged as possible outliers.                                   |
| <b>Northing</b>         | Editable field | The limit above which Northing residuals are flagged as possible outliers.                                  |
| <b>Height</b>           | Editable field | The limit above which Height residuals are flagged as possible outliers.                                    |
| <b>Residual Distbtn</b> |                | The method by which the residuals of the control points are distributed throughout the transformation area. |
|                         | <b>None</b>    | No distribution is made. Residuals remain with their associated points.                                     |

| Field | Option  | Description   |
|-------|---|---|
|       | <b>1/distance,</b><br><b>1/distance<sup>2</sup></b><br>or<br><b>1/</b><br><b>distance<sup>3/2</sup></b> | Distributes the residuals according to the distance between each control point and the newly transformed point. |
|       | <b>Multiquad-ratic</b>  | Distributes the residuals using a multiquad-ratic interpolation approach.                                       |

### Next step

Page changes to the **Report sheet** page. Refer to [38 Apps - General](#).



**Azimuth** is used throughout this chapter. This term should also always be considered to mean **Bearing**.

## 40.4

## COGO Calculation - Inverse Method

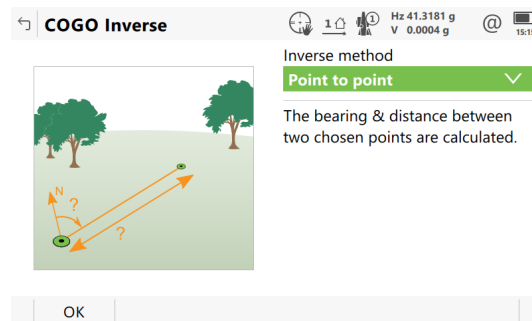
### 40.4.1

### Selecting the Inverse Method

#### Access

Select **Inverse** from the **COGO** menu.

#### COGO Inverse



| Key | Description   |
|-----|---|
| OK  | To select a method and to continue with the subsequent panel. |

#### Description of the Inverse methods

| Inverse methods       | Description   |
|-----------------------|---|
| <b>Point to point</b> | <p>The direction, the distance and the coordinate differences between the two known points can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used. Elements that must be known are</p> <ul style="list-style-type: none"> <li>coordinates of two points.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>can be taken from the job.</li> <li>can be manually measured during the COGO calculation.</li> <li>can be entered.</li> </ul> |

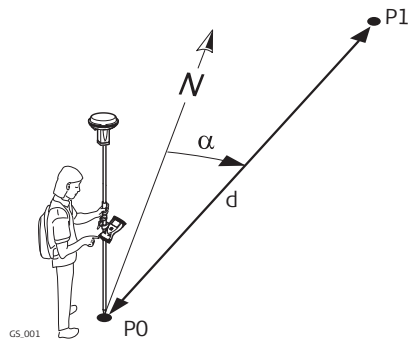
| Inverse methods                  | Description  |
|----------------------------------|--|
| <b>Point to current position</b> | <p>The direction, distance and coordinate differences between the current rover position and a known point can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of one point.</li> </ul> <p>The coordinates of the known point</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> |
| <b>Current position to line</b>  | <p>The direction, distance and coordinate differences between the current position and a given line can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.</p> <p>Sufficient information must be known to define a line.</p> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul>   |
| <b>Point to line</b>             | <p>The direction, distance and coordinate differences between a known point and a given line can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.</p> <p>Sufficient information to define a line and the coordinates of one point must be known.</p> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul>   |
| <b>Point to arc</b>              | <p>The direction, distance and coordinate differences between the current position and a given arc can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used.</p> <p>Sufficient information to define an arc and the coordinates of one point must be known.</p> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul>                                       |

| Inverse methods                | Description   |
|--------------------------------|---|
| <b>Current position to arc</b> | <p>The direction, distance and coordinate differences between a known point and a given arc can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used. Sufficient information must be known to define an arc.</p> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> |

#### 40.4.2

#### Point to Point and Current Position to Point

##### Diagram



##### Known

P0 First known point/current position

P1 Second known point

##### Unknown

$\alpha$  Direction from P0 to P1

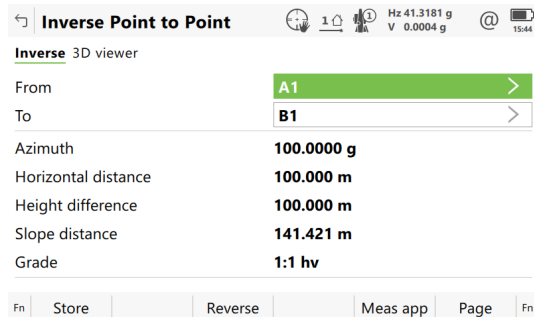
d Horizontal distance between P0 and P1

##### Inverse Point to Point/ Inverse Pt to Current Pos, Inverse page

For all point fields, 3D viewer can be used to select the desired point.

To type in coordinates for a known point, open a selectable list. Press **New** to create a point.

----- is displayed for unavailable information, for example **Height difference** cannot be calculated if a position only point is used.



| Key                | Description   |
|--------------------|---|
| <b>Store</b>       | To store the result.  |
| <b>Reverse</b>     | To swap the <b>From</b> and <b>To</b> points around.  |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>From</b> or <b>To</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |

### Description of fields

| Field   | Option                  | Description  |
|---|-------------------------|--|
| <b>From</b>   | Selectable list         | The point ID of the first known point for the COGO calculation.  |
|   | <b>Current position</b> | Available for <b>Inverse method: Point to current position</b> . |
| <b>To</b>   | Selectable list         | The point ID of the second known point for the COGO calculation. |
|   | <b>Current position</b> | Available for <b>Inverse method: Point to current position</b> . |
| <b>Azimuth</b>  | Display only            | The direction from the first to the second known point.          |
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Display only            | The horizontal distance between the two known points.            |
| <b>Height difference</b>  | Display only            | The height difference between the two known points.              |
| <b>Slope distance</b>   | Display only            | The slope distance between the two known points.                 |
| <b>Grade</b>  | Display only            | The grade between the two known points.                          |
| <b>Difference in easting</b>  | Display only            | The difference in Easting between the two known points.          |
| <b>Difference in northing</b>   | Display only            | The difference in Northing between the two known points.         |

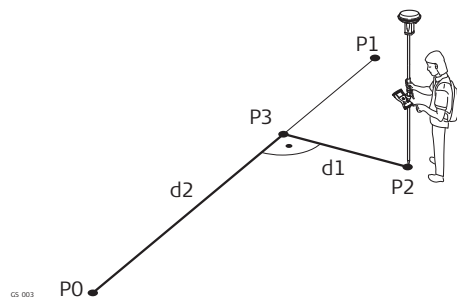
### Next step

The calculated distance between the two known points is indicated in 3D viewer.

## 40.4.3

### Point to Line and Current Position to Line

#### Diagram



#### Known

- P0 Start point
- P1 End point
- P2 Offset point

#### Unknown

- P3 Base point
- d1 Offset distance
- d2  $\Delta$ Line distance

## Inverse Point to Line/ Inverse Current Pos to Line, Input page

For all point fields, 3D viewer can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New** to create a point.

----- is displayed for unavailable information, for example **Height difference** cannot be calculated if a position only point is used.

Fn Calculate Page Fn

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate COGO point.  |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available if <b>Azimuth</b> or <b>Horizontal distance</b> is highlighted. |
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available if <b>Azimuth</b> or <b>Horizontal distance</b> is highlighted.                        |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available if <b>Start point</b> , <b>End point</b> or <b>Offset point</b> is highlighted.             |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To modify the values manually. Available if <b>Azimuth</b> or <b>Horizontal distance</b> is highlighted.  |

### Description of fields

| Field                    | Option                               | Description  |
|--------------------------|--------------------------------------|--|
| <b>Offset point</b>      | Selectable list                      | Available for <b>Inverse method: Point to line</b> . The offset point.       |
|                          | <b>Current position</b>              | Available for <b>Inverse method: Current position to line</b> .              |
| <b>Create line using</b> |                                      | The method by which the line is defined.                                     |
|                          | <b>2 points</b>                      | Uses two known points to define the line.                                    |
|                          | <b>Point, bearing &amp; distance</b> | Defines the line using a known point, a distance and an azimuth of the line. |
| <b>Start point</b>       | Selectable list                      | The start point of the line.   |
| <b>End point</b>         | Selectable list                      | Available for <b>Method: 2 points</b> . The end point of the line.           |



| Field   | Option         | Description   |
|---|----------------|---|
| <b>Azimuth</b>  | Editable field | Available for <b>Method: Point, bearing &amp; distance</b> . The azimuth of the line.   |
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Editable field | Available for <b>Method: Point, bearing &amp; distance</b> . The horizontal distance from the start point to the end point of the line. |

### Next step

**Calculate** calculates and accesses **Inverse Result**.

### Inverse Result, Result page

| Result                  | 3D viewer         |
|-------------------------|-------------------|
| Offset point            | <b>C1</b>         |
| Distance along line     | <b>50.000 m</b>   |
| Offset                  | <b>-50.000 m</b>  |
| Bearing to offset point | <b>0.0000 g</b>   |
| Line length             | <b>100.000 m</b>  |
| Line bearing            | <b>100.0000 g</b> |
| Easting                 | <b>50.000 m</b>   |

| Key          | Description                              |
|--------------|--|
| <b>Store</b> | To store the result.                     |
| <b>Page</b>  | To change to another page on this panel. |

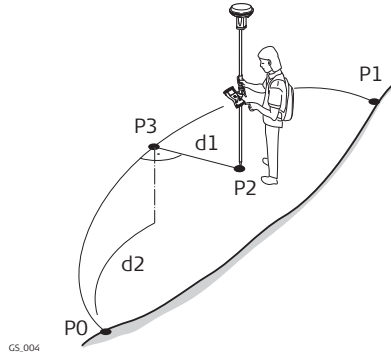
### Description of fields

| Field                          | Option       | Description   |
|--------------------------------|--------------|---|
| <b>Offset point</b>            | Display only | Point ID of offset point or <b>Current position</b> .   |
| <b>Distance along line</b>     | Display only | Horizontal distance from start point to base point.   |
| <b>Offset</b>                  | Display only | Offset from base point to offset point. Positive to the right and negative to the left of the line. |
| <b>Bearing to offset point</b> | Display only | Bearing from base point to offset point.  |
| <b>Line length</b>             | Display only | Length of line from start point to end point.   |
| <b>Line bearing</b>            | Display only | Bearing of line from start point to end point.  |
| <b>Easting and Northing</b>    | Display only | The calculated coordinates.   |
| <b>Height</b>                  | Display only | The height of the calculated point.   |

### Next step

**Page** changes to the **3D viewer** page.

Diagram



**Known**

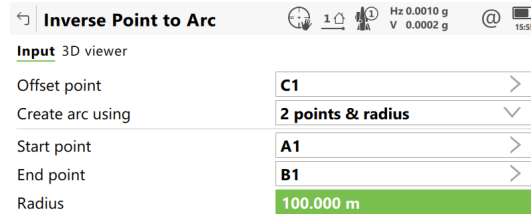
- P0 Start point
- P1 End point
- P2 Offset point

**Unknown**

- P3 Base point
- d1 Offset-XX
- d2 ΔArcDist-XX

Point to arc/  
Current position to arc,  
Input page

For all point fields, 3D viewer can be used to select the desired point.  
To type in coordinates for a known point open a selectable list. Press **New** to create a point.  
----- is displayed for unavailable information, for example **Height difference** cannot be calculated if a position only point is used.



Fn Calculate Inverse Last Inv Page Fn

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate COGO point.  |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available if <b>Radius</b> , <b>Arc length</b> or <b>Chord length</b> is highlighted.                 |
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available if <b>Radius</b> , <b>Arc length</b> or <b>Chord length</b> is highlighted.  |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available if <b>Start point</b> , <b>Second point</b> , <b>End point</b> , <b>Offset point</b> or <b>PI point</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To modify the values manually. Available if <b>Radius</b> , <b>Arc length</b> or <b>Chord length</b> is highlighted.  |

## Description of fields

| Field                                | Option   | Description  |
|--------------------------------------|--|--|
| <b>Offset point</b>                  | Selectable list  | Available for <b>Point to arc: Point to line.</b><br>The offset point.   |
|                                      | <b>Current position</b>                                      | Available for <b>Inverse method: Current position to arc.</b>  |
| <b>Create arc using</b>              |  | The method by which the arc is defined.  |
|                                      | <b>3 points</b>  | Uses three known points to define the arc.   |
|                                      | <b>2 points &amp; radius</b>                                 | Defines the arc using two known points and a radius of the arc.  |
|                                      | <b>2 tangents &amp; radius</b>                               | Defines the arc using two tangents and a radius of the arc.  |
|                                      | <b>2 tangents &amp; arc length</b>                           | Defines the arc using two tangents and the length of the arc.  |
| <b>2 tangents &amp; chord length</b> | Defines the arc using two tangents and the chord of the arc. |  |
| <b>Start point</b>                   | Selectable list  | The start point of the arc. Available for <b>Method: 3 points</b> and <b>Method: 2 points &amp; radius.</b>  |
| <b>Second point</b>                  | Selectable list  | The second point of the arc. Available for <b>Method: 3 points.</b>  |
| <b>End point</b>                     | Selectable list  | The end point of the arc. Available for <b>Method: 3 points</b> and <b>Method: 2 points &amp; radius.</b>  |
| <b>Point 1</b>                       | Selectable list  | A point on the first tangent. Available for <b>Method: 2 tangents &amp; radius, Method: 2 tangents &amp; arc length</b> and <b>Method: 2 tangents &amp; chord length.</b>                  |
| <b>PI point</b>                      | Selectable list  | The point of intersection of the two tangents. Available for <b>Method: 2 tangents &amp; radius, Method: 2 tangents &amp; arc length</b> and <b>Method: 2 tangents &amp; chord length.</b> |
| <b>Point 2</b>                       | Selectable list  | A point on the second tangent. Available for <b>Method: 2 tangents &amp; radius, Method: 2 tangents &amp; arc length</b> and <b>Method: 2 tangents &amp; chord length.</b>                 |
| <b>Radius</b>                        | Editable field   | The radius of the arc. Available for <b>Method: 2 points &amp; radius</b> and <b>Method: 2 tangents &amp; radius.</b>  |
| <b>Arc length</b>                    | Editable field   | The length of the arc. Available for <b>Method: 2 tangents &amp; arc length.</b>   |
| <b>Chord length</b>                  | Editable field   | The length of the chord. Available for <b>Method: 2 tangents &amp; chord length.</b>   |

## Next step

**Calculate** calculates the result and accesses **Inverse Result**.

## Inverse Result, Result page

| Field                   | Value      |
|-------------------------|------------|
| Offset point            | C1         |
| Distance along arc      | -70.137 m  |
| Offset                  | 52.523 m   |
| Bearing to offset point | 276.8230 g |
| Arc radius              | 100.000 m  |
| Arc length              | 182.348 m  |
| Easting                 | 49.081 m   |

| Key          | Description                              |
|--------------|--|
| <b>Store</b> | To store the result.                     |
| <b>Page</b>  | To change to another page on this panel. |

### Description of fields

| Field                          | Option       | Description   |
|--------------------------------|--------------|---|
| <b>Offset point</b>            | Display only | Point ID of offset point for <b>Inverse method: Point to arc</b> or current position.               |
| <b>Distance along arc</b>      | Display only | Horizontal distance along the arc from start point to base point.                                   |
| <b>Offset</b>                  | Display only | Offset from base point to offset point. Positive to the right and negative to the left of the line. |
| <b>Bearing to offset point</b> | Display only | Bearing of offset point from base point to offset point.  |
| <b>Arc radius</b>              | Display only | Computed radius of arc.   |
| <b>Arc length</b>              | Display only | Computed length of arc.   |
| <b>Easting and Northing</b>    | Display only | The calculated coordinates.   |
| <b>Height</b>                  | Display only | The height of the calculated point.   |

## Next step

**Page** changes to the **3D viewer** page.

## 40.5

### COGO Calculation - Traverse Method

#### Description

Elements that must be known are

- the coordinates of one point.
- the direction from the known point to the COGO point.
- the distance from the known point to the COGO point.
- offsets, if necessary and configured.

The coordinates of the known point

- can be taken from the job.
- can be manually measured during the COGO calculation.
- can be entered.

The direction from the known point to the COGO point can be an azimuth or an angle.

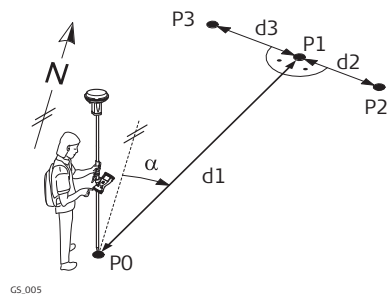
Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.

A COGO traverse calculation can be calculated for

- a single point.
- multiple points. Several single points are calculated in one sequence.
- sideshots.

## Diagram

### COGO traverse calculation with offset for a single point



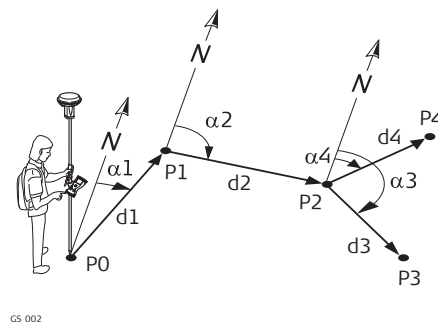
#### Known

- P0 Known point
- $\alpha$  Direction from P0 to P1
- d1 Distance between P0 and P1
- d2 Positive offset to the right
- d3 Negative offset to the left

#### Unknown

- P1 COGO point without offset
- P2 COGO point with positive offset
- P3 COGO point with negative offset

### COGO traverse calculation without offset for multiple points



#### Known

- P0 Known point
- $\alpha_1$  Direction from P0 to P1
- $\alpha_2$  Direction from P1 to P2
- $\alpha_3$  Direction from P2 to P3
- $\alpha_4$  Direction from P2 to P4
- d1 Distance between P0 and P1
- d2 Distance between P1 and P2
- d3 Distance between P2 and P3
- d4 Distance between P2 and P4





#### Unknown

- P1 First COGO point
- P2 Second COGO point
- P3 Third COGO point - sideshot
- P4 Fourth COGO point

## Bearing & Distance Input, Input page

For all point fields, 3D viewer can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New** to create a point.

← **Bearing & Distance Input**    Hz 0.0010 g V 0.0002 g  1600

**Input** 3D viewer

|                     |          |
|---------------------|----------|
| Method              | Azimuth  |
| From                | 1004     |
| Azimuth             | 0.0000 g |
| Horizontal distance | 0.000 m  |
| Offset              | 0.000 m  |

Fn Calculate Side shot Page Fn

| Key                | Description  |
|--------------------|--|
| <b>Calculate</b>   | To calculate the result.   |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Azimuth</b> , <b>Horizontal distance</b> , <b>Offset</b> or <b>Angle right</b> is highlighted. |
| <b>Side shot</b>   | To calculate the point as a sideshot.  |
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available when <b>Azimuth</b> , <b>Horizontal distance</b> , <b>Offset</b> or <b>Angle right</b> is highlighted.                        |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>From</b> or <b>Backsight</b> is highlighted.   |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the COGO app.   |
| <b>Fn Modify</b>   | To add, subtract, multiply and divide values. Available when <b>Azimuth</b> , <b>Horizontal distance</b> , <b>Offset</b> or <b>Angle right</b> is highlighted.                                     |

#### Description of fields

| Field              | Option             | Description  |
|--------------------|--------------------|--|
| <b>Method</b>      | <b>Azimuth</b>     | The direction from the known point to the COGO point is an azimuth.  |
|                    | <b>Angle right</b> | The direction from the known point to the COGO point is an angle.  |
| <b>From</b>        | Selectable list    | The point ID of the known point for the COGO calculation.  |
| <b>Backsight</b>   | Selectable list    | The point ID of a point used as backsight. Available for <b>Method: Angle right</b> .  |
| <b>Angle right</b> | Editable field     | The angle between <b>Backsight</b> and the new COGO point to be calculated from the point selected as <b>From</b> . A positive value is for clockwise angles. A negative value is for anticlockwise angles. Available for <b>Method: Angle right</b> . |
| <b>Azimuth</b>     | Editable field     | The direction from the known point to the COGO point.  |

| Field   | Option         | Description  |
|---|----------------|--|
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Editable field | The horizontal distance between the known point and the COGO point.  |
| <b>Offset</b>   | Editable field | The offset of the COGO point from the line of direction. A positive offset is to the right, a negative offset is to the left. Available when <b>Allow use of offsets in calculations</b> is ticked in <b>Settings, General</b> page. |

### Next step

**Calculate** calculates the result and accesses **Bearing & Distance Results**.

### Bearing & Distance Results, Result page

Fn Store Stake Page Fn

| Key                            | Description  |
|--------------------------------|--|
| <b>Store</b>                   | To store the result.   |
| <b>Stake</b>                   | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                    | To change to another page on this panel.   |
| <b>Fn Coord</b>                | To view other coordinate types.  |
| <b>Fn Ell Ht and Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

### Description of fields

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Point ID</b>             | Editable field | The identifier for the COGO point depending on the point ID template configured for the currently active instrument type in <b>ID Templates</b> . The point ID can be changed. |
| <b>Easting and Northing</b> | Display only   | The calculated coordinates.  |

| Field  | Option         | Description   |
|--------|----------------|---|
| Height | Editable field | The height of the known point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in. |

### Next step

On the **Code** page, type in a code if desired.

On the **3D viewer** page, an arrow points from the known point to the calculated COGO point.

**Store** stores the result.

## 40.6

## COGO Calculation - Intersection Method

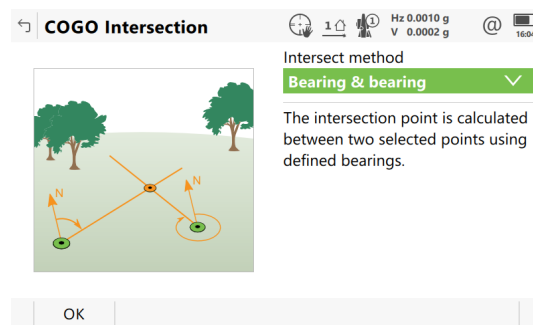
### 40.6.1

### Selecting the Intersection Method

#### Access

Select **Intersection** from the **COGO** menu.

#### COGO Intersection



| Key | Description   |
|-----|---|
| OK  | To select a method and to continue with the subsequent panel. |

#### Description of the Intersection methods

| Intersection methods         | Description   |
|------------------------------|---|
| <b>Bearing &amp; bearing</b> | <p>Calculates the intersection point of two lines. A line is defined by a point and a direction.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>the coordinates of two points.</li> <li>the direction from these known points to the COGO point.</li> <li>offsets if necessary and configured.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>can be taken from the job.</li> <li>can be manually measured during the COGO calculation.</li> <li>can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.</p> |



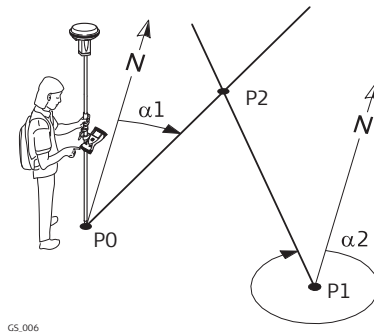
| Intersection methods           | Description  |
|--------------------------------|--|
| <b>Distance &amp; distance</b> | <p>Calculates the intersection point of two circles. The circles are defined by the known point as the centre point and the distance from the known point to the COGO point as the radius.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• the coordinates of two points.</li> <li>• the distance from the known points to the COGO point.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used.</p>  |
| <b>Bearing &amp; distance</b>  | <p>Calculates the intersection point of a line and a circle. The line is defined by a point and a direction. The circle is defined by the centre point and the radius.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• the coordinates of points.</li> <li>• the direction from one known point to the COGO point.</li> <li>• the distance from the second known point to the COGO point.</li> <li>• offsets if necessary and configured.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used.</p> |
| <b>Four points</b>             | <p>Calculates the intersection point of two lines. A line is defined by two points.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• the coordinates of four points.</li> <li>• offsets of the lines if necessary and configured.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used.</p>  |

| Intersection methods       | Description   |
|----------------------------|---|
| <b>Two TS observations</b> | <p>Calculates the intersection point of two lines. A line is defined by a TPS setup and a TPS measurement from this setup.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>the coordinates of two points.</li> <li>azimuths of the lines.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>must be taken from the job.</li> <li>must be TPS setup points.</li> </ul> <p>The azimuths of the lines</p> <ul style="list-style-type: none"> <li>must be TPS measurements from the known points.</li> </ul> <p>Points with full coordinate triplets and position only points can be used.</p> |

## 40.6.2

### Intersection with Double Bearing

#### Diagram



#### Known

- P0 First known point
- P1 Second known point
- $\alpha 1$  Direction from P0 to P2
- $\alpha 2$  Direction from P1 to P2

#### Unknown

- P2 COGO point

#### Intersection Brng & Brng, Input page

For all point fields, the 3D viewer can be used to select the desired point. To type in coordinates for a known point open a selectable list. Press **New** to create a point.

Intersection Brng & Brng Hz 0.0004 g V 0.0002 g

Input 3D viewer

|           |          |
|-----------|----------|
| 1st point | C1       |
| Azimuth   | 0.0000 g |
| Offset    | 5.000 m  |
| 2nd point | B1       |
| Azimuth   | 0.0000 g |
| Offset    | 0.000 m  |

Fn Calculate Meas app Page Fn

| Key              | Description  |
|------------------|--|
| <b>Calculate</b> | To calculate the result.   |
| <b>Inverse</b>   | To calculate the values for the distance and the offset from two existing points. Available when <b>Azimuth</b> or <b>Offset</b> is highlighted. |

| Key                | Description   |
|--------------------|---|
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available when <b>Azimuth</b> or <b>Offset</b> is highlighted. |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>1st point</b> or <b>2nd point</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To add, subtract, multiply and divide values. Available when <b>Azimuth</b> or <b>Offset</b> is highlighted.              |

### Description of fields

| Field            | Option          | Description  |
|------------------|-----------------|--|
| <b>1st point</b> | Selectable list | The point ID of the first known point for the COGO calculation.  |
| <b>2nd point</b> | Selectable list | The point ID of the second known point for the COGO calculation.   |
| <b>Azimuth</b>   | Editable field  | The direction from the first known point to the COGO point.  |
| <b>Offset</b>    | Editable field  | The offset of the COGO point from the line of direction. A positive offset is to the right, a negative offset is to the left. Available when <b>Allow use of offsets in calculations</b> is ticked in <b>Settings, General</b> page. |

### Next step

**Calculate** calculates the result and accesses **Intersection Brng & Brng**.

## Intersection Result, Result page

| Result   | Code      | 3D viewer |
|----------|-----------|-----------|
| Point ID | 1003      |           |
| Easting  | 222.578 m |           |
| Northing | 522.359 m |           |
| Height   | 1.000 m   |           |

Fn | Store | Stake | Page | Fn

| Key                            | Description  |
|--------------------------------|--|
| <b>Store</b>                   | To store the result.   |
| <b>Stake</b>                   | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                    | To change to another page on this panel.   |
| <b>Fn Coord</b>                | To view other coordinate types.  |
| <b>Fn Ell Ht and Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

### Description of fields

| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Point ID</b>             | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>Auxiliary points</b> in <b>ID Templates</b> . The point ID can be changed. |
| <b>Easting and Northing</b> | Display only   | The calculated coordinates.   |
| <b>Height</b>               | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in.                   |

### Next step

On the **Code** page, type in a code if desired.

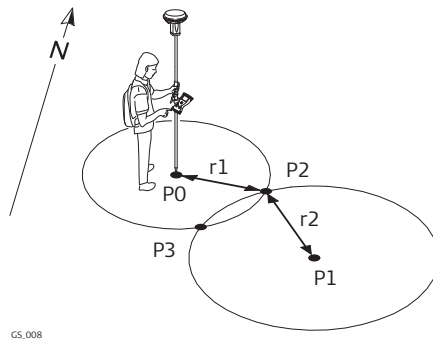
On the **3D viewer** page, arrows point from the known points to the calculated COGO point.

**Store** stores the result.

## 40.6.3

### Intersection with Distance & Distance

#### Diagram



#### Known

- P0 First known point
- P1 Second known point
- r1 Radius, as defined by the distance from P0 to P2
- r2 Radius, as defined by the distance from P1 to P2

#### Unknown

- P2 First COGO point
- P3 Second COGO point

#### Intersection Dist & Dist, Input page

For all point fields, the 3D viewer can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New** to create a point.

Intersection Dist & Dist Hz 0.0001 g V 0.0001 g 16:09

Input 3D viewer

|                     |         |
|---------------------|---------|
| 1st point           | C1      |
| Horizontal distance | 5.000 m |
| 2nd point           | B1      |
| Horizontal distance | 0.000 m |

Fn Calculate Meas app Page Fn

| Key              | Description              |
|------------------|--------------------------|
| <b>Calculate</b> | To calculate the result. |

| Key                | Description   |
|--------------------|---|
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Horizontal distance</b> is highlighted. |
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available when <b>Horizontal distance</b> is highlighted.                        |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>1st point</b> or <b>2nd point</b> is highlighted.                   |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To add, subtract, multiply and divide values. Available when <b>Horizontal distance</b> is highlighted.                                     |

### Description of fields

| Field   | Option          | Description  |
|---|-----------------|--|
| <b>1st point</b>  | Selectable list | The point ID of the first known point for the COGO calculation.      |
| <b>2nd point</b>  | Selectable list | The point ID of the second known point for the COGO calculation.     |
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Editable field  | The horizontal distance between the known points and the COGO point. |

### Next step

**Calculate** calculates the result and accesses **Intersection Result**.

### Intersection Result, Result 1/ Result 2 page

| Key                                | Description   |
|------------------------------------|---|
| <b>Store</b>                       | To store the result.  |
| <b>Result 1</b> or <b>Result 2</b> | To view the first and second result.                                |
| <b>Stake</b>                       | To access the Stakeout app and stake out the calculated COGO point. |
| <b>Page</b>                        | To change to another page on this panel.                            |

| Key                            | Description  |
|--------------------------------|--|
| <b>Fn Coord</b>                | To view other coordinate types.  |
| <b>Fn Ell Ht and Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

#### Description of fields

| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Point ID</b>             | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>GS points</b> / <b>TS points</b> in <b>ID Templates</b> . The point ID can be changed. |
| <b>Easting and Northing</b> | Display only   | The calculated coordinates.   |
| <b>Height</b>               | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in.                               |

#### Next step

On the **Code** page, type in a code if desired.

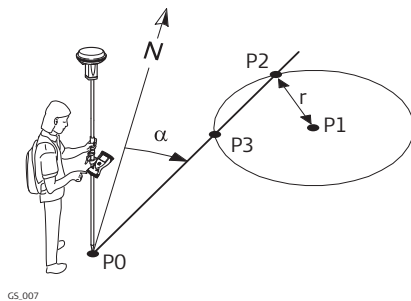
On the **3D viewer** page, arrows point from the known points to the calculated COGO point.

**Store** stores the result.

### 40.6.4

### Intersection with Bearing & Distance

#### Diagram



#### Known

- P0 First known point
- P1 Second known point
- $\alpha$  Direction from P0 to P2
- r Radius, as defined by the distance from P1 to P2

#### Unknown

- P2 First COGO point
- P3 Second COGO point

#### Intersection Brng & Dist, Input page

For all point fields, the 3D viewer can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New** to create a point.

Intersection Brng & Dist

Input 3D viewer

|                     |          |
|---------------------|----------|
| 1st point           | 1004     |
| Azimuth             | 0.0000 g |
| Offset              | 10.000 m |
| 2nd point           | 1003     |
| Horizontal distance | 12.000 m |

Fn Calculate Inverse Last Inv Page Fn

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate the result.  |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Azimuth</b> , <b>Horizontal distance</b> or <b>Offset</b> is highlighted. |
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available when <b>Azimuth</b> , <b>Horizontal distance</b> or <b>Offset</b> is highlighted.                        |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>1st point</b> or <b>2nd point</b> is highlighted.   |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To add, subtract, multiply and divide values. Available when <b>Azimuth</b> , <b>Horizontal distance</b> or <b>Offset</b> is highlighted.                                     |

#### Description of fields

| Field   | Option          | Description  |
|---|-----------------|--|
| <b>1st point</b>  | Selectable list | The point ID of the first known point for the COGO calculation.  |
| <b>2nd point</b>  | Selectable list | The point ID of the second known point for the COGO calculation.   |
| <b>Azimuth</b>  | Editable field  | The direction from the first known point to the COGO point.  |
| <b>Offset</b>   | Editable field  | The offset of the COGO point from the line of direction. A positive offset is to the right, a negative offset is to the left. Available for <b>Allow use of offsets in calculations: Yes</b> in <b>Measure Settings, General</b> page. |
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Editable field  | The horizontal distance between the known point and the COGO point.  |

## Next step

**Calculate** calculates the result and accesses **Intersection Result**.

## Intersection Result, Result page

**Intersection Result** Hz 0.0010 g V 0.0002 g 16:15

**Result 1** Code 3D viewer

Point ID **1003**

Easting **286.603 m**

Northing **50.000 m**

Height **1.000 m**

Fn Store Result 2 Stake Page Fn

| Key                                   | Description  |
|---------------------------------------|--|
| <b>Store</b>                          | To store the result.   |
| <b>Result 1</b> or <b>Result 2</b>    | To view the first and second result.   |
| <b>Stake</b>                          | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                           | To change to another page on this panel.   |
| <b>Fn Coord</b>                       | To view other coordinate types.  |
| <b>Fn Ell Ht</b> and <b>Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                       | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

## Description of fields

| Field                              | Option         | Description   |
|------------------------------------|----------------|---|
| <b>Point ID</b>                    | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>GS points</b> / <b>TS points</b> in <b>ID Templates</b> . The point ID can be changed. |
| <b>Easting</b> and <b>Northing</b> | Display only   | The calculated coordinates.   |
| <b>Height</b>                      | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in.                               |

## Next step

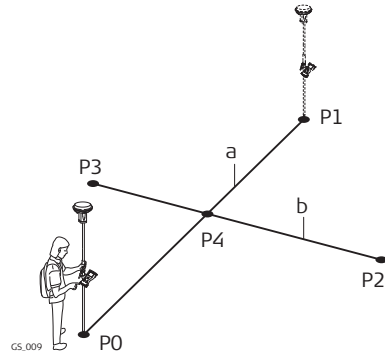
On the **Code** page, type in a code if desired.

On the **3D viewer** page, an arrow points from the first known points to the calculated COGO point.

**Store** stores the result.



Diagram



**Known**

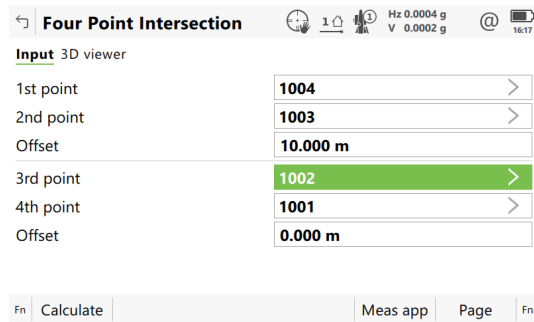
- P0 First known point
- P1 Second known point
- P2 Third known point
- P3 Fourth known point
- a Line from P0 to P1
- b Line from P2 to P3

**Unknown**

- P4 COGO point

**Four Point Intersection, Input page**

For all point fields, the 3D viewer can be used to select the desired point. To type in coordinates for a known point open a selectable list. Press **New** to create a point.



| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate the result.  |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Offset</b> is highlighted.                                  |
| <b>Last Inv</b>    | To recall previous results from COGO inverse calculations. Available when <b>Offset</b> is highlighted.   |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>1st point</b> , <b>2nd point</b> , <b>3rd point</b> or <b>4th point</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To add, subtract, multiply and divide values. Available when <b>Offset</b> is highlighted.  |

**Description of fields**

| Field            | Option          | Description   |
|------------------|-----------------|---|
| <b>1st point</b> | Selectable list | The point ID of the known start point of the first line for the COGO calculation. |
| <b>2nd point</b> | Selectable list | The point ID of the known end point of the first line for the COGO calculation.   |

| Field            | Option          | Description  |
|------------------|-----------------|--|
| <b>3rd point</b> | Selectable list | The point ID of the known start point of the second line for the COGO calculation.   |
| <b>4th point</b> | Selectable list | The point ID of the known end point of the second line for the COGO calculation.   |
| <b>Offset</b>    | Editable field  | The offset of the line in the direction <b>1st point</b> to <b>2nd point</b> or <b>3rd point</b> to <b>4th point</b> . A positive offset is to the right, a negative offset is to the left. Available for <b>Allow use of offsets in calculations: Yes</b> in <b>Measure Settings, General</b> page. |

### Next step

**Calculate** calculates the result and accesses **Intersection Result**.

## Intersection Result, Result page

| Field    | Value    |
|----------|----------|
| Point ID | 1005     |
| Easting  | 12.500 m |
| Northing | 37.500 m |
| Height   | 1.000 m  |

Fn Store Stake Page Fn

| Key                                   | Description  |
|---------------------------------------|--|
| <b>Store</b>                          | To store the result.   |
| <b>Stake</b>                          | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                           | To change to another page on this panel.   |
| <b>Fn Coord</b>                       | To view other coordinate types.  |
| <b>Fn Ell Ht</b> and <b>Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                       | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

### Description of fields

| Field                              | Option         | Description   |
|------------------------------------|----------------|---|
| <b>Point ID</b>                    | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>GS points</b> / <b>TS points</b> in <b>ID Templates</b> . The point ID can be changed. |
| <b>Easting</b> and <b>Northing</b> | Display only   | The calculated coordinates.   |
| <b>Height</b>                      | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in.                               |

### Next step

On the **Code** page, type in a code if desired.

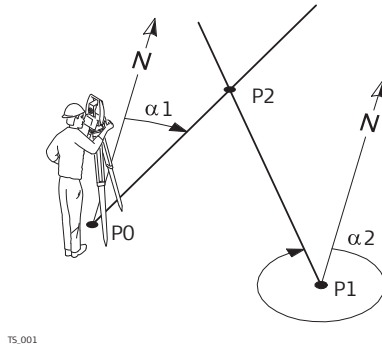
On the **3D viewer** page, two solid lines are displayed.

**Store** stores the result.

## 40.6.6

## Intersection with Two TS Observations

### Diagram



### Known

P0 First known point (TS setup)

P1 Second known point (TS setup)

$\alpha 1$  Direction from P0 to P2

$\alpha 2$  Direction from P1 to P2

### Unknown

P2 COGO point

### Two TS Observations, Input page

For all point fields, the 3D viewer can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New** to create a point.

Two TS Observations

Hz 0.0010 g  
V 0.0002 g

Input 3D viewer

First TS setup point

TS observation

Azimuth

Second TS setup point

TS observation

Azimuth

Fn Calculate Page Fn

| Key                | Description  |
|--------------------|--|
| <b>Calculate</b>   | To calculate the result.   |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>First TS setup point</b> or <b>Second TS setup point</b> is highlighted and the selected setup is the active TS setup. |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the COGO app.   |

### Description of fields

| Field                       | Option          | Description   |
|-----------------------------|-----------------|---|
| <b>First TS setup point</b> | Selectable list | The point ID of the first TS setup which is the known start point of the first line for the COGO calculation. |

| Field                        | Option          | Description   |
|------------------------------|-----------------|---|
| <b>TS observation</b>        | Selectable list | The point ID of the TS measurement which is the known end point of the first line for the COGO calculation.     |
| <b>Azimuth</b>               | Display only    | The azimuth related to the known end point of the first/second line for the COGO calculation.                   |
| <b>Second TS setup point</b> | Selectable list | The point ID of the second TS setup which is the known start point of the second line for the COGO calculation. |
| <b>TS observation</b>        | Selectable list | The point ID of the TS measurement which is the known end point of the second line for the COGO calculation.    |

### Next step

**Calculate** calculates the result and accesses **Intersection Result**.

### Intersection Result, Result page

| Key   | Description  |
|---|--|
| <b>Store</b>                                | To store the result.   |
| <b>Stake</b>                                | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                                 | To change to another page on this panel.   |
| <b>FnCoord</b>                              | To view other coordinate types.  |
| <b>Fn Ell Ht</b><br>and<br><b>Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                             | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

### Description of fields

| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Point ID</b>             | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>GS points / TS points in ID Templates</b> . The point ID can be changed. |
| <b>Computed height</b>      | Display only   | The height being used as defined on <b>Settings, TS specific</b> page.  |
| <b>Easting and Northing</b> | Display only   | The calculated coordinates.   |
| <b>Height</b>               | Editable field | The height of the first point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in.                 |

### Next step

On the **Code** page, type in a code if desired.

On the **3D viewer** page, arrows point from the known points to the calculated COGO point.

On the **Checks** page, values for check are displayed:

- the difference between the height calculations from **First TS setup point** and **Second TS setup point**
- the horizontal distances from both setup points to the calculated point.

**Store** stores the result.

## 40.7

## COGO Calculation - Line/Arc Calculations Method

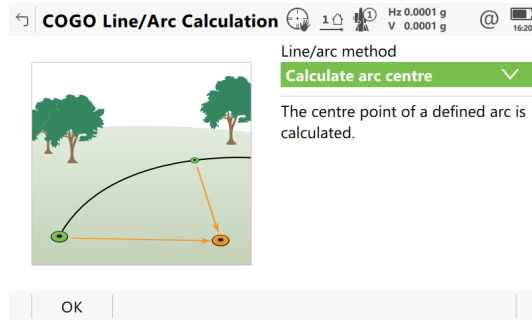
### 40.7.1

### Selecting the Line/Arc Method

#### Access

Select **Line & arc calculation** from the **COGO** menu.

#### COGO Line/Arc Calculation



| Key | Description   |
|-----|---|
| OK  | To select a method and to continue with the subsequent panel. |

#### Description of the Line/Arc methods

| Line/Arc Methods            | Description   |
|-----------------------------|---|
| <b>Calculate arc centre</b> | <p>Calculates the coordinates of the centre of the arc.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of three points</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• coordinates of two points</li> <li>• radius to the two points</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> |

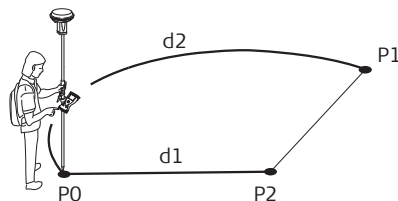
| Line/Arc Methods                   | Description   |
|------------------------------------|---|
| <b>Calculate arc offset point</b>  | <p>Calculates the coordinates of a new point after input of arc and offset values in relation to an arc.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of three points.</li> <li>• offsets.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• coordinates of two points.</li> <li>• radius to the two points.</li> <li>• offsets.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul>                                       |
| <b>Calculate line offset point</b> | <p>Calculates the coordinates of a new point after input of station and offset values in relation to a line.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of two points.</li> <li>• offsets.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• coordinates of one point.</li> <li>• bearing and distance from one point.</li> <li>• offsets.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul>                           |
| <b>Calculate arc base point</b>    | <p>Calculates the coordinates of the base point, station and offset of a point in relation to an arc.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of three points</li> <li>• coordinates of an offset point</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• coordinates of two points</li> <li>• radius to the two points</li> <li>• coordinates of an offset point</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> |

| Line/Arc Methods                 | Description  |
|----------------------------------|--|
| <b>Calculate line base point</b> | <p>Calculates the base point, station and offset of a point in relation to a line.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of two points and an offset point.</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• coordinates of one point and an offset point</li> <li>• bearing and distance from one point</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul>  |
| <b>Segment an arc</b>            | <p>This method is similar to <b>Segment a line</b>. See the following row.</p>   |
| <b>Segment a line</b>            | <p>Calculates the coordinates of new points on a line.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• coordinates of the start and the end point of the line</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• a bearing and distance from a known point that define the line</li> </ul> <p>AND EITHER</p> <ul style="list-style-type: none"> <li>• the number of segments dividing the line</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• a segment length for the line.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> |

## 40.7.2

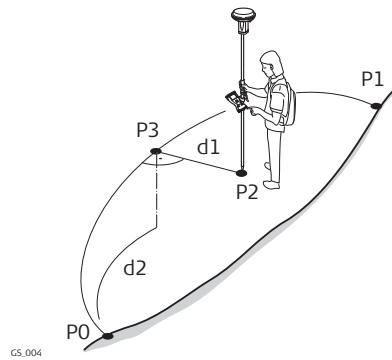
### Arc Calculation

#### Diagram for arc centre



GS\_010

## Diagram for arc base point and offset point



- P0 **Start point**
- P1 **End point**
- P2 **Offset point**
- P3 Base point
- d1 **Offset**
- d2 **Distance along arc**

## Create Arc, Input page

The softkeys are similar to line calculation. Refer to [40.7.3 Calculate Line Offset Point and Calculate Line Base Point](#) for information on softkeys.

### Description of fields

| Field                                | Option   | Description   |
|--------------------------------------|--|---|
| <b>Create arc using</b>              |  | The method by which the arc is defined.   |
|                                      | <b>3 points</b>  | Uses three known points to define the arc.  |
|                                      | <b>2 points &amp; radius</b>                                 | Defines the arc using two known points and a radius of the arc.   |
|                                      | <b>2 tangents &amp; radius</b>                               | Defines the arc using two tangents and a radius of the arc.   |
|                                      | <b>2 tangents &amp; arc length</b>                           | Defines the arc using two tangents and the length of the arc.   |
| <b>2 tangents &amp; chord length</b> | Defines the arc using two tangents and the chord of the arc. |   |
| <b>Start point</b>                   | Selectable list  | The start point of the arc. Available for <b>Create arc using: 3 points</b> and <b>Create arc using: 2 points &amp; radius</b> .  |
| <b>Second point</b>                  | Selectable list  | The second point of the arc. Available for <b>Create arc using: 3 points</b> .  |
| <b>End point</b>                     | Selectable list  | The end point of the arc. Available for <b>Create arc using: 3 points</b> and <b>Create arc using: 2 points &amp; radius</b> .  |
| <b>Point 1</b>                       | Selectable list  | A point on the first tangent. Available for <b>Create arc using: 2 tangents &amp; radius</b> , <b>Create arc using: 2 tangents &amp; arc length</b> and <b>Create arc using: 2 tangents &amp; chord length</b> .                  |
| <b>PI point</b>                      | Selectable list  | The point of intersection of the two tangents. Available for <b>Create arc using: 2 tangents &amp; radius</b> , <b>Create arc using: 2 tangents &amp; arc length</b> and <b>Create arc using: 2 tangents &amp; chord length</b> . |



| Field               | Option          | Description   |
|---------------------|-----------------|---|
| <b>Point 2</b>      | Selectable list | A point on the second tangent. Available for <b>Create arc using: 2 tangents &amp; radius</b> , <b>Create arc using: 2 tangents &amp; arc length</b> and <b>Create arc using: 2 tangents &amp; chord length</b> . |
| <b>Radius</b>       | Editable field  | The radius of the arc. Available for <b>Create arc using: 2 points &amp; radius</b> and <b>Create arc using: 2 tangents &amp; radius</b> .  |
| <b>Arc length</b>   | Editable field  | The length of the arc. Available for <b>Create arc using: 2 tangents &amp; arc length</b> .   |
| <b>Chord length</b> | Editable field  | The length of the chord. Available for <b>Create arc using: 2 tangents &amp; chord length</b> .   |

#### Next step

| IF   | THEN  |
|--|---|
| Line/arc method: <b>Calculate arc centre</b>       | <b>Calculate</b> accesses <b>Centre of Arc Result</b> . |
| Line/arc method: <b>Calculate arc offset point</b> | <b>OK</b> accesses <b>Calculation Input</b> .           |
| Line/arc method: <b>Calculate arc base point</b>   | <b>OK</b> accesses <b>Calculation Input</b> .           |

Calculation Input, Input page

#### Description of fields

| Field  | Option          | Description   |
|--|-----------------|---|
| <b>Distance along arc</b>  | Editable field  | Horizontal distance along the arc from start point to base point. Available for <b>Line/arc method: Calculate arc offset point</b> .                                  |
| <b>Offset, Off-set (ground)</b><br>or<br><b>Offset (ellipsoid)</b> | Editable field  | Offset from base point to offset point. Positive to the right and negative to the left of the arc. Available for <b>Line/arc method: Calculate arc offset point</b> . |
| <b>Offset point</b>  | Selectable list | Point ID of offset point. Available for <b>Line/arc method: Calculate arc base point</b> .  |

#### Next step

| IF   | THEN   |
|--|--|
| Line/arc method: <b>Calculate arc offset point</b> | <b>Calculate</b> accesses <b>Line/Arc Calculation Result</b> . |
| Line/arc method: <b>Calculate arc base point</b>   | <b>Calculate</b> accesses <b>Line/Arc Calculation Result</b> . |

Centre of Arc Result/  
Line/Arc Calculation  
Result,  
Result page

The result panels for base point and offset point are similar. Refer to paragraph [40.7.3 Calculate Line Offset Point and Calculate Line Base Point](#) for information on softkeys.

### Description of fields

| Field  | Option         | Description  |
|--|----------------|--|
| <b>Point ID</b>  | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>GS / TS</b> in <b>ID Templates</b> .  |
| <b>Height</b> or <b>Local ellipsoid height</b>   | Editable field | The height of the start point of the arc is suggested. A height value to be stored with the calculated point can be typed in.  |
| <b>Arc radius</b>  | Display only   | Computed radius of arc.  |
| <b>Arc length</b>  | Display only   | Computed length of arc.  |
| <b>Bearing to offset point</b>   | Display only   | Bearing of offset point from base point to offset point. Available for <b>Line/arc method: Calculate arc offset point</b> .  |
| <b>Offset point</b>  | Display only   | Point ID of offset point. Available for <b>Line/arc method: Calculate arc base point</b> .   |
| <b>Distance along arc, Distance along arc (ground) or Distance along arc (ellipsoid)</b> | Display only   | Horizontal distance along the arc from start point to base point. Available for <b>Line/arc method: Calculate arc offset point</b> .                                   |
| <b>Offset, Offset (ground) or Offset (ellipsoid)</b>                                     | Display only   | Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for <b>Line/arc method: Calculate arc offset point</b> . |

### Next step

On the **Code** page, type in a code if desired.

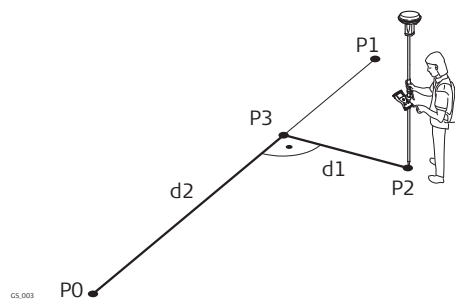
On the **3D viewer** page, the arc and the new point is shown.

**Store** stores the result

## 40.7.3

### Calculate Line Offset Point and Calculate Line Base Point

#### Diagram



- P0 **Start point**
- P1 **End point**
- P2 **Offset point**
- P3 **Base point**
- d1 **Offset**
- d2 **Distance along line**



Line management is not available for COGO line calculations.

## Create Line, Input page

**Create Line** Hz 0.0004 g V 0.0002 g 16:23

Input 3D viewer

Create line using: **2 points**

Start point: **1001**

End point: **1002**

Fn OK Meas app Page Fn

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To change to the second layer of editable fields.   |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available if <b>Azimuth</b> or <b>Horizontal distance</b> is highlighted.             |
| <b>Last Inv</b>    | To select the values for the distance and the offset from previous COGO inverse calculations. Available if <b>Azimuth</b> or <b>Horizontal distance</b> is highlighted. |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available if <b>Start point</b> or <b>End point</b> is highlighted.   |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |
| <b>Fn Modify</b>   | To modify the values manually. Available if, <b>Azimuth</b> or <b>Horizontal distance</b> is highlighted.   |

### Description of fields

| Field                    | Option                               | Description  |
|--------------------------|--------------------------------------|--|
| <b>Create line using</b> |                                      | The method by which the line is defined.   |
|                          | <b>2 points</b>                      | Uses two known points to define the line.  |
|                          | <b>Point, bearing &amp; distance</b> | Defines the line using a known point, a distance and an azimuth of the line.                     |
| <b>Start point</b>       | Selectable list                      | The start point of the line.   |
| <b>End point</b>         | Selectable list                      | The end point of the line. Available for <b>Create line using: 2 points</b> .                    |
| <b>Azimuth</b>           | Editable field                       | The azimuth of the line. Available for <b>Create line using: Point, bearing &amp; distance</b> . |

| Field   | Option         | Description   |
|---|----------------|---|
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Editable field | The horizontal distance from the start point to the end point of the line. Available for <b>Create line using: Point, bearing &amp; distance.</b> |

#### Next step

OK accesses **Calculation Input.**

### Calculation Input, Input page

#### Description of fields

| Field   | Option          | Description  |
|---|-----------------|--|
| <b>Distance along line, Distance along line (ground) or Distance along line (ellipsoid)</b> | Editable field  | Available for <b>Create line using: Calculate line offset point.</b> Horizontal distance from start point to base point.   |
| <b>Offset, Off-set (ground) or Offset (ellipsoid)</b>                                       | Editable field  | Available for <b>Create line using: Calculate line offset point.</b> Offset from base point to offset point. Positive to the right and negative to the left of the line. |
| <b>Offset point</b>   | Selectable list | Available for <b>Create line using: Calculate line base point.</b> The offset point.   |

#### Next step

Calculate accesses **Line/Arc Calculation Result.**

### Line/Arc Calculation Result, Result page

The result panels for base point and offset point are similar. The explanations given for the softkeys are valid for the **Result** page.

The screenshot shows the 'Line/Arc Calculation Result' page with the following data:

| Field                   | Value      |
|-------------------------|------------|
| Point ID                | 109        |
| Easting                 | 61.068 m   |
| Northing                | 48.419 m   |
| Height                  | 7.000 m    |
| Line length             | 158.114 m  |
| Line bearing            | 79.5167 g  |
| Bearing to offset point | 179.5167 g |

At the bottom of the page, there are softkeys: Fn, Store, Stake, Page, and Fn.

| Key          | Description          |
|--------------|----------------------|
| <b>Store</b> | To store the result. |

| Key   | Description  |
|---|--|
| <b>Stake</b>                                | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                                 | To change to another page on this panel.   |
| <b>Fn Coord</b>                             | To view other coordinate types.  |
| <b>Fn Ell Ht</b><br>and<br><b>Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                             | Refer to <a href="#">38 Apps - General</a> .   |

#### Description of fields

| Field   | Option         | Description   |
|---|----------------|---|
| <b>Point ID</b>   | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>GS points</b> / <b>TS points</b> in <b>ID Templates</b> .                        |
| <b>Height</b> or<br><b>Local ellipsoid height</b>   | Editable field | The height of the start point of the line is suggested. A height value to be stored with the calculated point can be typed in.  |
| <b>Offset point</b>   | Display only   | Point ID of offset point. Available for <b>Create line using: Calculate line base point</b> .   |
| <b>Distance along line, Distance along line (ground) or Distance along line (ellipsoid)</b> | Display only   | Horizontal distance from start point to base point. Available for <b>Create line using: Calculate line base point</b> .   |
| <b>Offset, Offset (ground) or Offset (ellipsoid)</b>  | Display only   | Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for <b>Create line using: Calculate line base point</b> . |
| <b>Line length</b>  | Display only   | Length of line from start point to end point.   |
| <b>Line bearing</b>   | Display only   | Bearing of line from start point to end point.  |
| <b>Bearing to offset point</b>  | Display only   | Bearing of offset point from base point to offset point.  |

#### Next step

On the **Code** page, type in a code if desired.

On the **3D viewer** page, the line and the new point is shown.

**Store** stores the result.

#### 40.7.4

#### Segment an Arc

#### Exceptions to line calculation segmentation

The arc segmentation and the functionality of all panels and fields are similar to those for line segmentation. Refer to [40.7.5 Segment a Line](#)

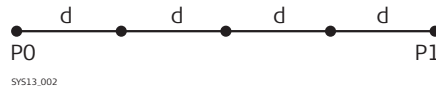
## New field and option in Define Arc Segmentation

| Field              | Option             | Description   |
|--------------------|--------------------|---|
| <b>Method</b>      | <b>Delta angle</b> | To divide the arc by an angular value.                        |
| <b>Delta angle</b> | Editable field     | The angular value by which new points are defined on the arc. |

### 40.7.5

### Segment a Line

#### Diagram



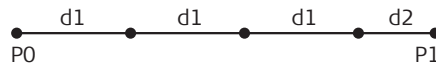
SYS13.002

Line divided by **Method: Number of segments**

P0 **Start point**

P1 **End point**

d Equally spaced segments result from dividing a line by a certain number of points.



SYS13.003

Line divided by **MethodSegment length**

P0 **Start point**

P1 **End point**

d1 **Segment length**

d2 Remaining segment



For a description of the **Create Line, Input** page, refer to [40.7.3 Calculate Line Offset Point and Calculate Line Base Point](#).

#### Define Line Segmentation

##### Description of fields

| Field                     | Option                         | Description   |
|---------------------------|--------------------------------|---|
| <b>Method</b>             | Selectable list                | How the line is divided. Depending on the selection, the following fields are editable or display only fields.  |
| <b>Line length</b>        | Display only                   | Calculated line length between the selected <b>Start point</b> and <b>End point</b> .   |
| <b>Number of segments</b> | Editable field or display only | For <b>Method: Number of segments</b> type in the number of segments for the line. For <b>Method: Segment length</b> this field indicates the calculated number of segments. This method can result in a remaining segment. |
| <b>Segment length</b>     | Editable field or display only | For <b>Method: Number of segments</b> this field is the calculated length of each segment. For <b>Method: Segment length</b> type in the required segment length.   |
| <b>Last segment</b>       | Display only                   | Available for <b>Method: Segment length</b> . The length of the remaining segment.  |
| <b>Starting point ID</b>  | Editable field                 | The point ID to be assigned to the first new point on the line. The selected point ID templates from <b>ID Templates</b> are not applied.   |

| Field                     | Option         | Description   |
|---------------------------|----------------|---|
| <b>Point ID increment</b> | Editable field | Is incremented numerically for the second, third, and so on, point on the line. |

**Next step**

**Calculate** calculates the coordinates of the new points. The heights are computed along the line assuming a linear slope between **Start point** and **End point**.

On the **3D viewer** page, the known points defining the line and those points created on the line are shown.

**40.8**

**COGO Calculation - Shift, Rotate & Scale**

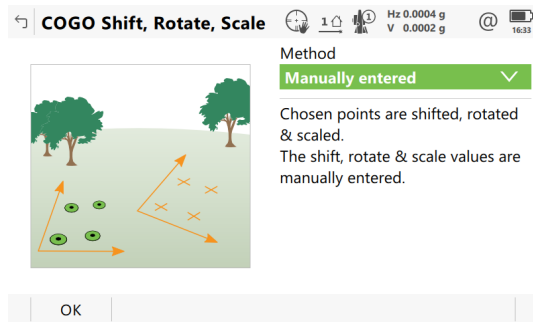
**40.8.1**

**Selecting the Shift, Rotate & Scale Method and the Points to be Moved**

**Access**

Select **Shift, rotate & scale** from the **COGO** menu.

**COGO Shift, Rotate, Scale**



| Key       | Description   |
|-----------|---|
| <b>OK</b> | To select a method and to continue with the subsequent panel. |

## Description of the Shift, Rotate & Scale methods

| Shift, Rotate & Scale methods | Description  |
|-------------------------------|--|
| <b>Manually entered</b>       | <p>Applies shifts and/or rotation and/or scale to one or several known points. The values for shifts and/or rotation and/or scale are typed in manually.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"><li>• the coordinates of the points to be shifted, rotated and/or scaled. They must be stored in the job.</li><li>• the shift values. They can be defined as: the direction of Easting, Northing and Height, or as an azimuth and a grid distance, or as shift from one point to another.</li><li>• the rotation value. It can be defined by a point as rotation centre plus a rotation or by an existing and new azimuth.</li><li>• the scale. It is only applied to the position, not to the height.</li></ul> <p>Points with full coordinate triplets, position only points and height only points can be used.</p> |
| <b>Matching points</b>        | <p>Applies shifts and/or rotation and/or scale to one or several known points. The shifts and/or rotation and/or scale are calculated from selected points using a 2D Helmert transformation.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"><li>• the coordinates of at least two matching points for the calculation of the shifts and/or rotation and/or scale.</li><li>• the coordinates of the points to be shifted, rotated and/or scaled. They must be stored in the job.</li></ul> <p>Points with full coordinate triplets, position only points and height only points can be used.</p> <p>The number of pairs of points matched determines whether the shift, rotation and scale values are computed. For only one point, only shifts are calculated, rotation and scale are not.</p>                                |
| <b>Next step</b>              | <p><b>OK</b> accesses <b>Point Selection</b> which is the same for <b>Method: Manually entered</b> and <b>Method: Matching points</b>.</p>   |



## Point Selection

Listed are points which have been selected for shifting, rotating and/or scaling.

| Point Selection  |               |                           |
|--|---------------|---------------------------|
| <b>1003</b>  | Time 16:13:26 | Date 27.09.2017 Code ---- |
| <b>1002</b>  | Time 16:07:29 | Date 27.09.2017 Code ---- |
| <b>1001</b>  | Time 16:07:16 | Date 27.09.2017 Code ---- |
| <b>E1</b>  | Time 16:02:37 | Date 27.09.2017 Code ---- |
| <b>1004</b>  | Time 16:00:20 | Date 27.09.2017 Code ---- |
| <b>C1</b>  | Time 15:46:25 | Date 27.09.2017 Code ---- |
| Fn <input type="button" value="OK"/> <input type="button" value="Add all"/> <input type="button" value="Add one"/> <input type="button" value="Remove"/> <input type="button" value="More"/> <input type="button" value="Fn"/> |               |                           |

| Key                  | Description   |
|----------------------|---|
| <b>OK</b>            | To perform the shift, rotation and scale calculation and to continue with the subsequent panel. Calculated COGO points are not yet stored.  |
| <b>Add all</b>       | To add all points from the job to the list. Selected sort and filter settings apply. <b>OK</b> adds all displayed points to the list in <b>Point Selection</b> and returns to that panel.           |
| <b>Add one</b>       | To add one point from the job to the list. Selected sort and filter settings apply. <b>OK</b> adds the currently highlighted point to the list in <b>Point Selection</b> and returns to that panel. |
| <b>Remove</b>        | To remove the highlighted point from the list. The point itself is not deleted.   |
| <b>More</b>          | To display information about the codes if stored with any point, the time and the date of when the point was stored and the 3D coordinate quality and the class.                                    |
| <b>Fn Remove all</b> | To remove all points from the list. The points themselves are not deleted.  |
| <b>Fn Range</b>      | To define a range of points from the job to be added to the list.   |

### Next step

For **Method:Manually entered:**

**OK** accesses **Computed Parameters**. Refer to [40.8.2 Manually Entered](#).

For **Method:Matching points:**

**OK** accesses **Match Common Pts (%d)**. Refer to [40.8.3 Matching Points](#).

## Choose Pts by Pt ID Range

| Choose Pts by Pt ID Range   |  |
|---|--|
| From point ID   | <input type="text" value="A1"/>                                    |
| To point ID   | <input style="background-color: #90EE90;" type="text" value="B1"/> |
| <input type="button" value="OK"/> <input type="button" value="Next"/> |  |

| Key  | Description  |
|------|--|
| OK   | To add the points within the selected range to the list in <b>Point Selection</b> . Returns to the panel from where this panel was accessed.               |
| Next | To add the points within the selected range to the list in <b>Point Selection</b> without quitting this panel. Another range of point IDs can be selected. |

#### Description of fields

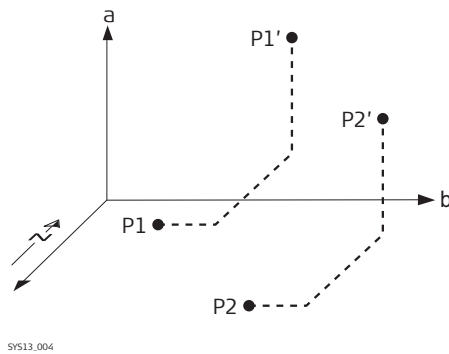
| Field                                | Option         | Description   |
|--------------------------------------|----------------|---|
| <b>From point ID and To point ID</b> | Editable field | <ul style="list-style-type: none"> <li>Numeric point IDs in both fields: Points with numeric point IDs falling within the range are selected. Example:<br/><b>From point ID: 1, To point ID: 50</b><br/>Selected are point IDs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10... 49, 50 as well as 001, 01, 0000045, ...<br/>Not selected are point IDs 100,200,300, ...</li> <li>Alphanumeric point IDs in both fields: The left-most character of both entries is used as the basis for the range. The standard ASCII numerical range is used. Points with alphanumeric point IDs falling within the range are selected. Example:<br/><b>From point ID: a9, To point ID: c200</b><br/>Selected are point IDs a, b, c, aa, bb, cc, a1, b2, c3, c4, c5, a610, ...<br/>Not selected are point IDs d100, e, 200, 300, tzz ...</li> </ul> |

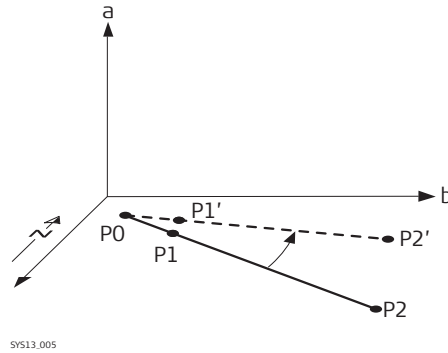
#### Next step

Select a range of points.

**OK** returns to **Point Selection**.

#### Diagram

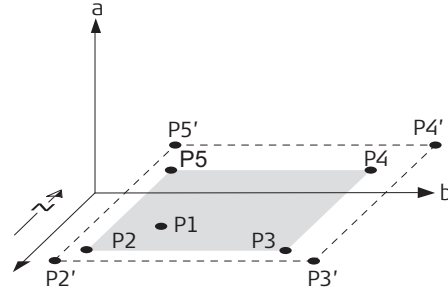




SYS13.005

### Rotation

- a Height
- b Easting
- P0 **Rotation point**
- P1 Known point
- P1' Rotated point
- P2 Known point
- P2' Rotated point



SYS13.006

### Scale

- a Height
- b Easting
- P1 **Rotation point**, can be held fixed, all other points are then scaled from here
- P2 Known point
- P2' Scaled point
- P3 Known point
- P3' Scaled point
- P4 Known point
- P4' Scaled point
- P5 Known point
- P5' Scaled point

## 40.8.2

### Computed Parameters, Shift page

### Manually Entered

← **Computed Parameters**
🔄
🏠
📶
Hz 0.0001 g
🔒
🔋 16:40

**Shift** Rotate Scale

Method Easting, northing, ht diffs

Difference in easting 10.000 m

Difference in northing 0.000 m

Height difference 0.000 m

Fn Calculate Inverse Last Inv Page Fn

| Key              | Description  |
|------------------|--|
| <b>Calculate</b> | To perform the shift, rotation and scale calculation and to continue with the subsequent panel. Calculated COGO points are not yet stored.   |
| <b>Inverse</b>   | To calculate the amount of shift in Easting, Northing and height from two existing points. Available if <b>Azimuth, Horizontal distance, Difference in easting, Difference in northing</b> or <b>Height difference</b> is highlighted. |
| <b>Last Inv</b>  | To select the value for the shift from previous COGO inverse calculations. Available if <b>Azimuth, Horizontal distance, Difference in easting, Difference in northing</b> or <b>Height difference</b> is highlighted.                 |

| Key                | Description  |
|--------------------|--|
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available for <b>Method: Use 2 points</b> if <b>From</b> or <b>To</b> is highlighted.  |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the COGO app. Refer to <a href="#">40.3 Configuring COGO</a> .  |
| <b>Fn Modify</b>   | To modify the values manually. Available if <b>Azimuth</b> , <b>Horizontal distance</b> , <b>Difference in easting</b> , <b>Difference in northing</b> or <b>Height difference</b> is highlighted. |

#### Description of fields

| Field   | Option                                | Description  |
|---|---------------------------------------|--|
| <b>Method</b>   |                                       | The method by which the shift in $\Delta$ Easting, $\Delta$ Northing and $\Delta$ Height is determined.                                  |
|   | <b>Easting, northing, ht diffs</b>    | Defines the shift using coordinate differences.  |
|   | <b>Bearing, distance &amp; height</b> | Defines the shift using an azimuth, a distance and a height difference.  |
|   | <b>Use 2 points</b>                   | Computes the shift from the coordinate differences between two known points.   |
| <b>From</b>   | Selectable list                       | Available for <b>Method: Use 2 points</b> . The point ID of the first known point for calculating the shift.                             |
| <b>To</b>   | Selectable list                       | Available for <b>Method: Use 2 points</b> . The point ID of the second known point for calculating the shift.                            |
| <b>Azimuth</b>  | Editable field                        | Available for <b>Method: Bearing, distance &amp; height</b> . The azimuth defines the direction of the shift.                            |
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Editable field                        | Available for <b>Method: Bearing, distance &amp; height</b> . The amount of shift from the original point to the calculated COGO points. |
| <b>Difference in easting</b>  | Editable field or display only        | The amount of shift in East direction.   |
| <b>Difference in northing</b>   | Editable field or display only        | The amount of shift in North direction.  |
| <b>Height difference</b>  | Editable field or display only        | The amount of shift in height.   |

### Next step

Page changes to the **Rotate** page.

## Computed Parameters, Rotate page

The softkeys are the same as on the **Shift** page.

### Description of fields

| Field                   | Option                         | Description  |
|-------------------------|--------------------------------|--|
| <b>Method</b>           |                                | The method by which the rotation angle is determined.                            |
|                         | <b>User entered</b>            | The rotation can be manually typed in.   |
|                         | <b>Computed</b>                | The rotation is calculated as <b>New azimuth</b> minus <b>Existing azimuth</b> . |
| <b>Rotation point</b>   | Selectable list                | The point around which all points are rotated.                                   |
| <b>Existing azimuth</b> | Editable field                 | Available for <b>Method: Computed</b> . A known direction before rotating.       |
| <b>New azimuth</b>      | Editable field                 | Available for <b>Method: Computed</b> . A known direction after rotating.        |
| <b>Rotation</b>         | Editable field or display only | The amount by which the points are rotated.                                      |

### Next step

Page changes to the **Scale** page.

## Computed Parameters, Scale page

The softkeys are the same as on the **Shift** page.

### Description of fields

| Field                    | Option                         | Description   |
|--------------------------|--------------------------------|---|
| <b>Method</b>            |                                | The method by which the scale factor is determined.   |
|                          | <b>User entered</b>            | The scale factor can be manually typed in.  |
|                          | <b>Computed</b>                | The scale factor is calculated as <b>New distance</b> divided by <b>Existing distance</b> .                                   |
| <b>Existing distance</b> | Editable field                 | Available for <b>Method: Computed</b> . A known distance before scaling. This value is used for calculating the scale factor. |
| <b>New distance</b>      | Editable field                 | Available for <b>Method: Computed</b> . A known distance after scaling. This value is used for calculating the scale factor.  |
| <b>Scale</b>             | Editable field or display only | The scale factor used in the calculation.   |

| Field                   | Option    | Description  |
|-------------------------|-----------|--|
| <b>Scale from point</b> | Check box | When this box is ticked:<br><b>Scale</b> is applied to the coordinate difference of all points relative to <b>Rotation point</b> selected on the <b>Rotation</b> page. The coordinates of <b>Rotation point</b> do not change.<br><br>When this box is not ticked:<br>Scaling is performed by multiplying the original coordinates of the points by <b>Scale</b> . |

### Next step

**Calculate** performs the shift, rotation and scale calculation and accesses **Shift, Rotate, Scale Results**.

## Shift, Rotate, Scale Results, General page

**Shift, Rotate, Scale Results** Summary 3D viewer

Points selected: 7

Update selected TS setups:

Store points to job: Default

Store points with: Suffix

Prefix / suffix: S

Delete original points:

Shift, rotate & scale linework:

Store Page

| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store the results and continue with the next panel. |
| <b>Page</b>  | To change to another page on this panel.               |

### Description of fields

| Field                            | Option          | Description  |
|----------------------------------|-----------------|--|
| <b>Points selected</b>           | Display only    | The number of selected points having been shifted, rotated and/or scaled.  |
| <b>Update selected TS setups</b> | Check box       | Available when TS setup points are in the list of selected points. When this box is checked, recalculations are done according to the COGO results in the following cases: <ul style="list-style-type: none"> <li>All observations made from the selected TS setup points are update</li> <li>All data measured from the selected TS setup points, such as linework, images and scans, are updated.</li> <li>If the current setup is one of the setups selected to be transformed, the current setup is updated according to the new orientation.</li> </ul> The updated points are stored in the same job and stored with the original point IDs. |
| <b>Store points to job</b>       | Selectable list | The calculated COGO points are stored in this job. The original points are not copied to this job.   |

| Field                                     | Option                    | Description   |
|---|---------------------------|---|
| <b>Store points with</b>                  | <b>Original point IDs</b> | Stores the points with the original point IDs.  |
|   | <b>Prefix</b>             | Adds the setting for <b>Store points with</b> in front of the original point IDs.   |
|   | <b>Suffix</b>             | Adds the setting for <b>Store points with</b> at the end of the original point IDs.   |
| <b>Prefix / suffix</b>                    | Editable field            | The identifier with up to four characters is added in front of or at the end of the ID of the calculated COGO points.   |
| <b>Delete original points</b>             | Check box                 | When this box is checked, then the original points which were shifted, rotated and scaled are deleted. The deletion will be done no matter if the calculated COGO points are stored in the same job or in a different one.  |
| <b>Shift, rotate &amp; scale linework</b> | Check box                 | When this box is checked, then the initially measured linework is added into the new location of the transformed points.<br>Advantages: <ul style="list-style-type: none"> <li>• No need to replicate all the linework again in the office using the transformed points</li> <li>• No need to readapt the workflow in the field such as first calculate the transformation and then start measuring the linework</li> </ul> |

#### Next step

| IF  | THEN  |
|---|---|
| the used parameters are to be viewed        | <b>Page</b> accesses <b>Shift, Rotate, Scale Results, Summary</b> page.   |
| the calculated COGO points are to be stored | <b>Store</b> accesses <b>Shift, Rotate, Scale Results, Result</b> page. Refer to paragraph <a href="#">Shift, Rotate, Scale Results, Result</a> page. |

#### Shift, Rotate, Scale Results, Result page

#### Description of fields

| Field                           | Option       | Description   |
|---------------------------------|--------------|---|
| <b>Number of new points</b>     | Display only | Number of new points created.   |
| <b>Number of skipped points</b> | Display only | Number of points which were skipped either due to not being able to convert coordinates, or points with identical point IDs already in the <b>Store points to job</b> . |

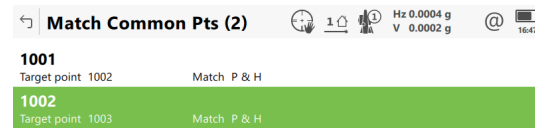
#### Next step

On the **3D viewer** page, original points are displayed in grey, calculated COGO points are displayed in black.

**OK** returns to **COGO Shift, Rotate, Scale**.

## Match Points

This panel provides a list of points chosen from the job. The points are used for the determination of the 2D Helmert transformation. The number of points matched is indicated in the title, for example (2). Unless there is no pair of matching points in the list all softkeys are available.



Fn Calculate New Edit Delete Match Resid Fn

| Key              | Description  |
|------------------|--|
| <b>Calculate</b> | To confirm the selections, compute the transformation and continue with the subsequent panel.  |
| <b>New</b>       | To match a new pair of points. This pair is added to the list. A new point can be manually measured. Refer to paragraph <a href="#">Choose Matching Points</a> or <a href="#">Edit Matching Points</a> . |
| <b>Edit</b>      | To edit the highlighted pair of matched points.  |
| <b>Delete</b>    | To delete the highlighted pair of matched points from the list.  |
| <b>Match</b>     | To change the type of match for a highlighted pair of matched points.  |
| <b>Resid</b>     | To display a list of the matched points used in the transformation calculation and their associated residuals. Refer to paragraph <a href="#">Fix Parameters</a> .                                       |
| <b>Fn Param</b>  | To define the parameters to be fixed in the 2D transformation.   |

## Description of metadata

| Metadata            | Description   |
|---------------------|---|
| -                   | The point ID of the points of origin for the calculation of the shifts and/or rotation and/or scale.  |
| <b>Target point</b> | The point ID of the target points for the calculation of the shifts and/or rotation and/or scale.   |
| <b>Match</b>        | The type of match to be made between the points. This information is used in the transformation calculation.<br><b>Position &amp; Height</b> , <b>Position only</b> , <b>Height only</b> or <b>None</b> .<br><b>None</b> removes matched common points from the transformation calculation but does not delete them from the list. This option can be used to help improve residuals. |



### Next step

| IF  | THEN   |
|---|--|
| the transformation is to be computed              | <b>Calculate.</b> The calculated shift, rotation and scale values are displayed in <b>Point Selection</b> . They cannot be edited. The remaining functionality of the calculation is similar to shift, rotate & scale (manual). Refer to <a href="#">40.8 COGO Calculation - Shift, Rotate &amp; Scale</a> . |
| a pair of points is to be matched or edited       | <b>New or Info.</b>  |
| parameters for the transformation are to be fixed | <b>Fn Param.</b>   |

### Choose Matching Points or Edit Matching Points

OK Meas app

| Key             | Description   |
|-----------------|---|
| <b>OK</b>       | To confirm the selections.  |
| <b>Meas app</b> | To measure a point manually for the COGO calculation. Available if <b>Source point</b> or <b>Target point</b> is highlighted. |

### Description of fields

| Field               | Option                  | Description   |
|---------------------|-------------------------|---|
| <b>Source point</b> | Selectable list         | A point of origin for the calculation of the shifts and/or rotation and/or scale. |
| <b>Target point</b> | Selectable list         | A target point for the calculation of the shifts and/or rotation and/or scale.    |
| <b>Match type</b>   |                         | The type of match to be made between the points selected.                         |
|                     | <b>Pos &amp; height</b> | Position and height   |
|                     | <b>Pos only</b>         | Position only   |
|                     | <b>Height only</b>      | Height only   |
|                     | <b>None</b>             | None  |

### Fix Parameters

The settings on this panel define the parameters to be used in the transformation.

| IF the value for a field is | THEN the value for this parameter is |
|-----------------------------|--------------------------------------|
| -----                       | calculated.                          |

| IF the value for a field is | THEN the value for this parameter is |
|-----------------------------|--------------------------------------|
| any number                  | fixed to that value.                 |

### Description of fields

| Field                         | Option         | Description                        |
|-------------------------------|----------------|------------------------------------|
| <b>Difference in easting</b>  | Editable field | Shift in Easting direction.        |
| <b>Difference in northing</b> | Editable field | Shift in Northing direction.       |
| <b>Height difference</b>      | Editable field | Shift in Height direction.         |
| <b>Rotation</b>               | Editable field | Rotation around the vertical axis. |
| <b>Scale</b>                  | Editable field | Scale factor.                      |

### Next step

| IF                            | AND                                    | THEN   |
|-------------------------------|--|--|
| a field displays -----        | the parameter must be fixed to a value | highlight the field. Enter the value of the parameter. <b>Fix.</b> |
| a field displays a value      | the parameter must be calculated       | highlight the field. <b>Adjust.</b>                                |
| all parameters are configured | -                                      | <b>OK</b> to return to <b>Match Points.</b>                        |

## 40.9

## COGO Calculation - Area Division

### 40.9.1

### Selecting the Division Method

#### Description

The COGO calculation area division divides an object by a defined line, by percentage or by size.

Elements that must be known for the calculation depend on the division method. At least three points are required to form an object.

#### Access

Select **Area division** from the **COGO** menu.

#### COGO Area Division

**COGO Area Division**

Division method  
**Parallel line (%)**

An area is divided by a line parallel to two selected points. The division is calculated using a defined percentage split.

OK

| Key | Description   |
|-----|---|
| OK  | To select a method and to continue with the subsequent panel. |

### Description of the division methods

| Division method                  | Description  |
|----------------------------------|--|
| <b>Parallel line (%)</b>         | The border is parallel to a line defined by two points. The division is calculated using a defined percentage split.                   |
| <b>Parallel line (area)</b>      | The border is parallel to a line defined by two points. The division is calculated using a defined size.                               |
| <b>Parallel line (line)</b>      | The border is parallel to a line defined by two points. The division is calculated by defining the position of the dividing line.      |
| <b>Perpendicular line (%)</b>    | The border is perpendicular to a line defined by two points. The division is calculated using a defined percentage split.              |
| <b>Perpendicular line (area)</b> | The border is perpendicular to a line defined by two points. The division is calculated using a defined size.                          |
| <b>Perpendicular line (line)</b> | The border is perpendicular to a line defined by two points. The division is calculated by defining the position of the dividing line. |
| <b>Swing line (%)</b>            | The border is a line rotated around a rotation point by an azimuth. The division is calculated using a defined percentage split.       |
| <b>Swing line (area)</b>         | The border is a line rotated around a rotation point by an azimuth. The division is calculated using a defined size.                   |

### Elements required

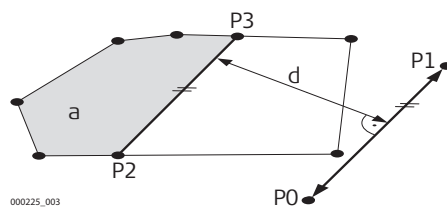
| Divide by | Using              | Elements required |  |
|-----------|--------------------|-------------------|--|
| Line      | Parallel line      | Through a point   | <ul style="list-style-type: none"> <li>Two points defining the line</li> <li>One point on the dividing line</li> </ul> |
|           |                    | By a distance     | <ul style="list-style-type: none"> <li>Two points defining the line</li> <li>Distance</li> </ul>                       |
|           | Perpendicular line | Through a point   | <ul style="list-style-type: none"> <li>Two points defining the line</li> <li>One point on the dividing line</li> </ul> |
|           |                    | By a distance     | <ul style="list-style-type: none"> <li>Two points defining the line</li> <li>Distance</li> </ul>                       |

| Divide by  | Using              |                | Elements required   |
|------------|--------------------|----------------|---|
| Percentage | Parallel line      | -              | <ul style="list-style-type: none"> <li>Percentage size of new area</li> <li>Two points defining the line</li> </ul>     |
|            | Perpendicular line | -              | <ul style="list-style-type: none"> <li>Percentage size of new area</li> <li>Two points defining the line</li> </ul>     |
|            | Swing line         | Rotation point | <ul style="list-style-type: none"> <li>Percentage size of new area</li> <li>Rotation point of the swing line</li> </ul> |
| Area       | Parallel line      | -              | <ul style="list-style-type: none"> <li>Size of new area</li> <li>Two points defining the line</li> </ul>                |
|            | Perpendicular line | -              | <ul style="list-style-type: none"> <li>Size of new area</li> <li>Two points defining the line</li> </ul>                |
|            | Swing line         | Rotation point | <ul style="list-style-type: none"> <li>Size of new area</li> <li>Rotation point of the swing line</li> </ul>            |

## Diagram

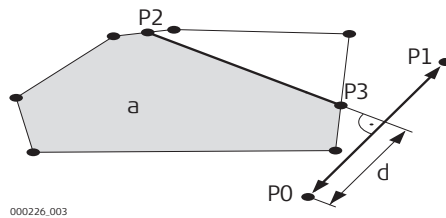
The diagrams show the division methods. Some diagrams apply to several division methods.

| Division method | Using                | Devide by           | Shift by        |
|-----------------|----------------------|---------------------|-----------------|
| 1.              | <b>Parallel Line</b> | <b>Defined Line</b> | <b>Distance</b> |
| 2.              | <b>Parallel Line</b> | <b>Percentage</b>   | -               |
| 3.              | <b>Parallel Line</b> | <b>Area</b>         | -               |



P0 **Point A** of defined line  
 P1 **Point B** of defined line  
 P2 First new COGO point  
 P3 Second new COGO point  
 d **Horizontal distance**  
 a **Area left of line**

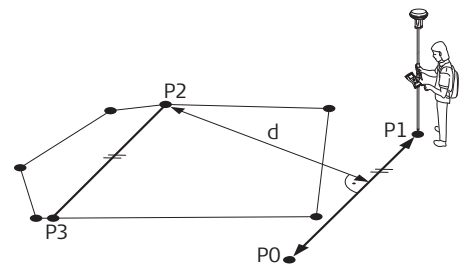
| Division method | Using                 | Devide by           | Shift by        |
|-----------------|-----------------------|---------------------|-----------------|
| 1.              | <b>Perpendic Line</b> | <b>Defined Line</b> | <b>Distance</b> |
| 2.              | <b>Perpendic Line</b> | <b>Percentage</b>   | -               |
| 3.              | <b>Perpendic Line</b> | <b>Area</b>         | -               |



000226\_003

- P0 **Point A** of defined line
- P1 **Point B** of defined line
- P2 First new COGO point
- P3 Second new COGO point
- d **Horizontal distance**
- a **Area left of line**

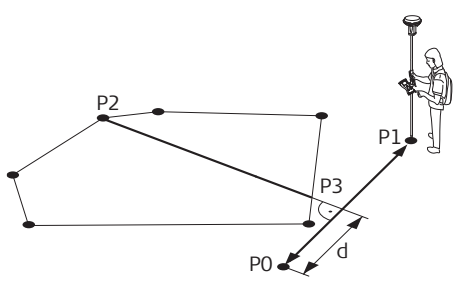
| Division method | Using         | Devide by    | Shift by      |
|-----------------|---------------|--------------|---------------|
| 1.              | Parallel Line | Defined Line | Through Point |



GS.013

- P0 **Point A** of defined line
- P1 **Point B** of defined line
- P2 **Through point**; in this case it is a known point of the existing border
- P3 New COGO point
- d **Horizontal distance**

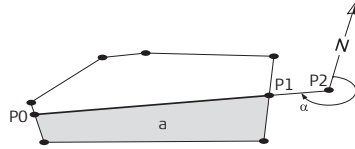
| Division method | Using          | Devide by    | Shift by      |
|-----------------|----------------|--------------|---------------|
| 1.              | Perpendic Line | Defined Line | Through Point |



GS.014

- P0 **Point A** of defined line
- P1 **Point B** of defined line
- P2 **Through point**; in this case it is a known point of the existing border
- P3 New COGO point
- d **Horizontal distance**

| Division method | Using      | Devide by  | Shift by |
|-----------------|------------|------------|----------|
| 1.              | Swing Line | Percentage | -        |
| 2.              | Swing Line | Area       | -        |



97513.007

- P0 First new COGO point
- P1 Second new COGO point
- P2 **Rotation point**
- $\alpha$  **Azimuth**
- a **Area left of line**

## 40.9.2

### Choosing an Object to be Divided

#### Choose Area Object

Choose Area Object Hz 0.0001 g  
V 0.0001 g

Choose the area (closed line object) to be divided Line0001 >

Number of points **3**

Area **1250.000 m<sup>2</sup>**

Perimeter **232.514 m**

Fn OK Fn

| Key         | Description  |
|-------------|--|
| OK          | To accept the changes and access the subsequent panel. |
| Fn Settings | To configure the COGO app.                             |

#### Description of fields

| Field  | Option          | Description                          |
|--|-----------------|--------------------------------------|
| Choose the area (closed line object) to be divided | Selectable list | To select the object to be divided.  |
| Number of points                                   | Display only    | Number of points forming the object. |
| Area   | Display only    | The size of the selected object.     |
| Perimeter  | Display only    | The perimeter of the object.         |

#### Next step

OK accesses **Define How to Divide Area**.

## 40.9.3

### Dividing an Area

#### Define How to Divide Area, Input page

After each change of parameters on this panel, the values in the display only fields are recalculated and updated.

Define How to Divide Area Hz 0.0010 g V 0.0002 g 16:30

Input 3D viewer

Area left of line **50.00 %**

Point A **Pt1**

Point B **Pt2**

Horizontal distance **10.355 m**

Fn Calculate Page Fn

| Key                | Description  |
|--------------------|--|
| <b>Calculate</b>   | To perform the area division and to continue with the subsequent panel. Calculated COGO points are not yet stored.   |
| <b>Inverse</b>     | To calculate the value for the distance from two existing points. Available if <b>Horizontal distance</b> is highlighted.  |
| <b>Size and %</b>  | To display the size and the percentage of the divided areas.   |
| <b>Last Inv</b>    | To select the value for the distance from previous COGO inverse calculations. Available if <b>Horizontal distance</b> is highlighted.                              |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available if <b>Point A</b> , <b>Point B</b> , <b>Rotation point</b> or <b>Through point</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the COGO app.   |

### Description of fields

| Field                    | Option          | Description  |
|--------------------------|-----------------|--|
| <b>Area left of line</b> | Editable field  | For dividing by percentage or area. The size must be typed either in % or in m <sup>2</sup> .<br><br>When dividing the area using a parallel or perpendicular line, a reference line is defined by <b>Point A</b> and <b>Point B</b> . The direction of the new dividing line is always the same as the direction of the reference line. The direction of a perpendicular line is the same as the reference line rotated 90° anticlockwise. The divided area is always to the left of the new dividing line.<br><br>When dividing an area using a swing line, the direction of the new dividing line is defined by the <b>Rotation point</b> and the <b>Azimuth</b> . The divided area is always to the left of the new dividing line. |
|                          | Display only    | For dividing by a line. The size of the divided area is calculated and displayed.  |
| <b>Point A</b>           | Selectable list | The first point of the line which is used as the reference for a new parallel or perpendicular border.   |

| Field   | Option                         | Description   |
|---|--------------------------------|---|
| <b>Point B</b>  | Selectable list                | The second point of the line which is used as the reference for a new parallel or perpendicular border.                                     |
| <b>Shift</b>  | <b>By distance</b>             | Available for dividing by a line.<br>The new border runs in a certain distance from the line defined by <b>Point A</b> and <b>Point B</b> . |
|   | <b>Through point</b>           | The new border runs through a point defined in <b>Through point</b> .   |
| <b>Through point</b>  | Selectable list                | Available for <b>Shift: Through point</b> . The point through which the new border runs.  |
| <b>Rotation point</b>   | Selectable list                | Available for using a swing line. The point around which the new border rotates by <b>Azimuth</b> .   |
| <b>Azimuth</b>  | Display only                   | Available for using a swing line. The angle of the new border from <b>Rotation point</b> to the new COGO point.                             |
| <b>Horizontal distance, Horizontal distance (ground) or Horizontal distance (ellipsoid)</b> | Display only or editable field | The distance from the line defined by <b>Point A</b> and <b>Point B</b> to the new border.  |

### Next step

**Calculate** performs the area division and accesses **Area Division Result**.

## 40.9.4

### Results of the Area Division

#### Area Division Result, Result page

| Area Division Result |                        |
|----------------------|------------------------|
| Result 3D viewer     |                        |
| Area ratio           | 50%:50%                |
| Area left of line    | 624.998 m <sup>2</sup> |
| Area right of line   | 625.002 m <sup>2</sup> |

|    |      |
|----|------|
| OK | Page |
|----|------|

| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept the calculation and to continue with the subsequent panel. Calculated COGO points are not yet stored. |
| <b>Page</b> | To change to another page on this panel.  |



### Description of fields

| Field              | Option       | Description  |
|--------------------|--------------|--|
| Area ratio         | Display only | The ratio of the size of the two areas in percent. |
| Area left of line  | Display only | The size of the first area in m <sup>2</sup> .     |
| Area right of line | Display only | The size of the second area in m <sup>2</sup> .    |

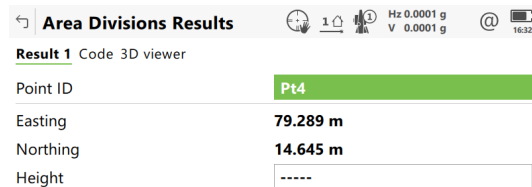
### Next step

On the **3D viewer** page, the points defining the area and the calculated COGO points are shown in black.

**OK** accesses **Area Divisions Results**.

Area Divisions Results,  
Result 1/  
Result 2 page

The coordinates of the intersection points of the new border with the original area are displayed.



| Key                  | Description  |
|----------------------|--|
| Store                | To store the two results and to return to <b>Choose Area Object</b> once both points are stored. |
| Result 1 or Result 2 | To view the first and second result.   |
| Stake                | To access the Stakeout app and stake out the calculated COGO point.                              |
| Page                 | To change to another page on this panel.   |
| Fn Tools             | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

### Next step

On the **Code** page, type in a code if desired.

On the **3D viewer** page, the points defining the area and the points of the new border are shown in black.

**Store** stores the results.

## 40.10

### COGO Calculation - Angle Method

Access

Select **Angle** from the **COGO** menu.

COGO Angle,  
Input page

For all point fields, the 3D viewer can be used to select the desired point.

To type in coordinates for a known point open a selectable list. Press **New** to create a point.

| Key              | Description   |
|------------------|---|
| <b>Calculate</b> | To calculate the result.                              |
| <b>Meas app</b>  | To measure a point manually for the COGO calculation. |
| <b>Page</b>      | To change to another page on this panel.              |

#### Description of fields

| Field             | Option          | Description   |
|-------------------|-----------------|---|
| <b>From point</b> | Selectable list | The backsight point.  |
| <b>At point</b>   | Selectable list | The point of intersection of the backsight and foresight direction. |
| <b>To point</b>   | Selectable list | The foresight point.  |

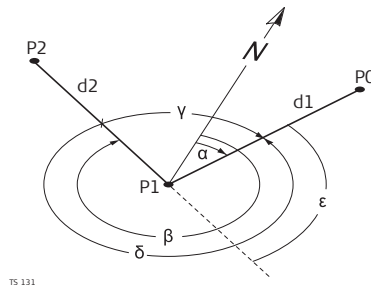
#### Next step

**Calculate** calculates the result and accesses **COGO Angle, Results** page.

#### COGO Angle, Results page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To accept changes and return to the <b>Input</b> page. |
| <b>Page</b> | To change to another page on this panel.               |

#### Description of fields



- $\alpha$  **Azimuth at-from**
- $\beta$  **Azimuth at-to**
- $\gamma$  **Deflection angle**
- $\delta$  **Angle right**
- $\epsilon$  **Angle left**
- P0 **Point ID**
- P1 **At point**
- P2 **To point**
- d1 **Horiz distance at-from**
- d2 **Horiz distance at-to**

## 40.11

### COGO Calculation - Horizontal Curve Method

#### Access

Select **Horizontal curve** from the **COGO** menu.

#### Horiz Curve Calculator, Input page

For all point fields, the 3D viewer can be used to select the desired point. To type in coordinates for a known point open a selectable list. Press **New** to create a point.

| Key              | Description   |
|------------------|---|
| <b>Calculate</b> | To calculate the result.  |
| <b>Inverse</b>   | To calculate the values for a distance and an angle from two existing points. Available when a distance field or an angle field is highlighted. |

| Key             | Description   |
|-----------------|---|
| <b>Last Inv</b> | To recall previous results from COGO inverse calculations. Available when a distance field or an angle field is highlighted.                    |
| <b>Meas app</b> | To measure a point manually for the COGO calculation. Available if <b>Start point</b> , <b>Second point</b> or <b>End point</b> is highlighted. |
| <b>Page</b>     | To change to another page on this panel.  |

#### Description of fields

| Field                           | Option                 | Description  |
|---------------------------------|------------------------|--|
| <b>Method</b>                   | Selectable list        | The horizontal curve can either be defined by three points or by two parameters.   |
| <b>Parameter 1, Parameter 2</b> |                        | Select which parameters are known. Available for <b>Method: 2 parameters</b> .   |
|                                 | <b>Radius</b>          | Radius of the curve.   |
|                                 | <b>Delta angle</b>     | Angle in the radius point.   |
|                                 | <b>DOC - Arc</b>       | The degree of curve defines the sharpness or flatness of the curve. Degree of curvature in arc definition. The central angle subtended by one station of circular arc. Used in highway design.<br>SI units: 1 station = 20 m<br>English system: 1 station = 100 ft |
|                                 | <b>DOC - Chord</b>     | The degree of curve defines the sharpness or flatness of the curve. Degree of curvature in chord definition. The central angle subtended by one station length of chord. Used in railway design.   |
|                                 | <b>Arc length</b>      | Total length of the circular curve from start point to end point measured along its arc.   |
|                                 | <b>Tangent</b>         | Length of the tangent from the tangent point to the point of intersection.   |
|                                 | <b>External secant</b> | The distance from the point of intersection to the midpoint of the curve. The external distance bisects the interior angle at the point of intersection.   |
|                                 | <b>Mid ordinate</b>    | The distance from the midpoint of the curve to the midpoint of the long chord. The extension of the middle ordinate bisects the central angle.   |
|                                 | <b>Delta angle</b>     | The angle where the two tangents intersect. The angle between the tangents is also equal to the angle at the centre of the curve   |

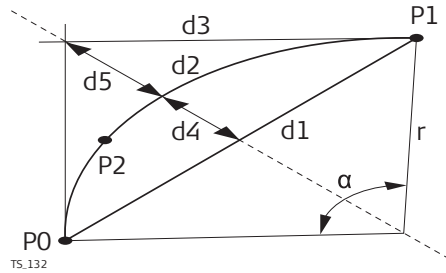
**Next step**

**Calculate** calculates the result and accesses **Horiz Curve Calculator, Results**.

Horiz Curve Calculator, Results page

| Key  | Description  |
|------|--|
| OK   | To accept changes and return to <b>Horiz Curve Calculator, Input</b> page. |
| Page | To change to another page on this panel.                                   |

**Description of fields**

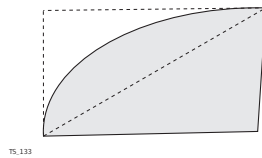


- $\alpha$  **Delta angle**
- P0 **Start point**
- P1 **End point**
- P2 **Second point**
- r **Radius**
- d1 **Chord length**
- d2 **Arc length**
- d3 **Tangent**
- d4 **Mid ordinate**
- d5 **External secant**

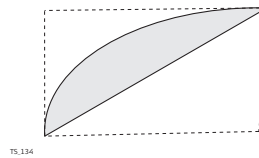
Horiz Curve Calculator, Areas page

| Key  | Description  |
|------|--|
| OK   | To accept changes and return to the <b>Input</b> page. |
| Page | To change to another page on this panel.               |

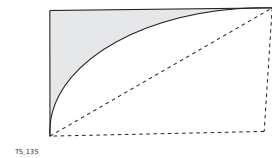
**Description of fields**



**Sec  
tor**



**Seg  
me  
nt**



**Fil-  
let**

**Next step**

On the **3D viewer** page, original points are displayed in grey. The calculated curve through the defined COGO points is displayed in black.

**40.12**

**COGO Calculation - Triangle Method**

**Access**

Select **Triangle** from the **COGO** menu.

COGO Triangle, Input page

For all point fields, the 3D viewer can be used to select the desired point. To type in coordinates for a known point open a selectable list. Press **New** to create a point.

| Key              | Description              |
|------------------|--------------------------|
| <b>Calculate</b> | To calculate the result. |

| Key             | Description   |
|-----------------|---|
| <b>Inverse</b>  | To calculate the values for a distance and an angle from two existing points. Available when a distance field or an angle field is highlighted. |
| <b>Last Inv</b> | To recall previous results from COGO inverse calculations. Available when a distance field or an angle field is highlighted.                    |
| <b>Meas app</b> | To measure a point manually for the COGO calculation. Available if <b>Point A</b> , <b>Point B</b> or <b>Point C</b> is highlighted.            |
| <b>Page</b>     | To change to another page on this panel.  |

#### Description of fields

| Field                                    | Option          | Description  |
|--|-----------------|--|
| <b>Method</b>                            | Selectable list | The triangle can either be defined by three points or by three parameters.                                     |
| <b>Parameters</b>                        | Selectable list | Select which combination of angle value and side length are known. Available for <b>Method: 3 parameters</b> . |
| <b>Side a,<br/>Side b,<br/>Side c</b>    | Editable field  | The side lengths of the triangle.  |
| <b>Angle A,<br/>Angle C</b>              | Editable field  | The angle values of the triangle.  |
| <b>Point A,<br/>Point B,<br/>Point C</b> | Selectable list | The points forming the triangle.   |

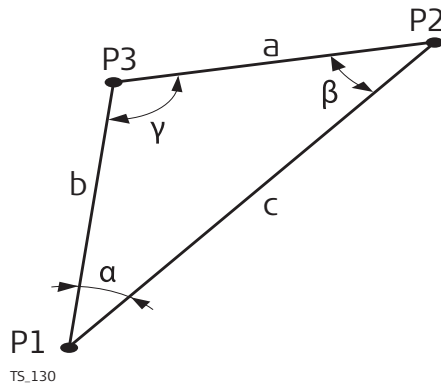
#### Next step

**Calculate** calculates the result and accesses **COGO Triangle, Results** page.

#### COGO Triangle, Results page

| Key                                   | Description  |
|---------------------------------------|--|
| <b>OK</b>                             | To accept changes and return to the <b>Input</b> page. |
| <b>Result 1</b> or<br><b>Result 2</b> | To view the first and second result.                   |
| <b>Page</b>                           | To change to another page on this panel.               |

## Description of fields



- $\alpha$  Angle A
- $\beta$  Angle B
- $\gamma$  Angle C
- P1 Point A
- P2 Point B
- P3 Point C
- a Side a
- b Side b
- c Side c

## 40.13

## COGO Calculation - Rectangle Method

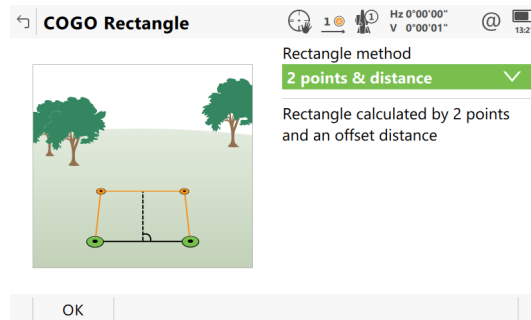
### 40.13.1

### Selecting the Rectangle Method

#### Access

Select **Rectangle** from the **COGO** menu.

#### COGO Rectangle



| Key | Description   |
|-----|---|
| OK  | To select a method and to continue with the subsequent panel. |

#### Description of the Rectangle methods

| Intersection methods           | Description  |
|--------------------------------|--|
| <b>2 points &amp; distance</b> | <p>Calculates the coordinates of points forming a rectangle.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>the coordinates of two points defining one side of the rectangle.</li> <li>the perpendicular distance to the second parallel side.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>can be taken from the job.</li> <li>can be manually measured during the COGO calculation.</li> <li>can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used. Position only calculated, height can be typed in.</p> |

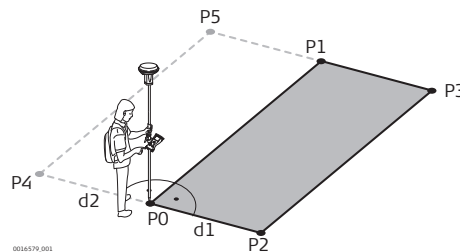
| Intersection methods            | Description  |
|---------------------------------|--|
| <b>2 points (baseline)</b>      | <p>Calculates the coordinates of points forming a square.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• the coordinates of two points defining the baseline of the square.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.</p>   |
| <b>2 points (diagonal)</b>      | <p>Calculates the coordinates of points forming a square.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• the coordinates of two points defining the diagonal of the square.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.</p>   |
| <b>3 points (perpendicular)</b> | <p>Calculates the coordinates of points forming a rectangle.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>• three points with right angles. Two points define one side of the rectangle. The third point defines the perpendicular distance to the second parallel side.</li> <li>•</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>• can be taken from the job.</li> <li>• can be manually measured during the COGO calculation.</li> <li>• can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.</p> |

| Intersection methods            | Description   |
|---------------------------------|---|
| <b>3 points (parallelogram)</b> | <p>Calculates the coordinates of points forming a parallelogram.</p> <p>Elements that must be known are</p> <ul style="list-style-type: none"> <li>three points. The first and second point define the first side of the parallelogram. The second and third point define the second side of the parallelogram.</li> </ul> <p>The coordinates of the known points</p> <ul style="list-style-type: none"> <li>can be taken from the job.</li> <li>can be manually measured during the COGO calculation.</li> <li>can be entered.</li> </ul> <p>Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.</p> |

### 40.13.2

### Rectangle with Two Points and Distance

#### Diagram



#### Known

- P0 First known point
- P1 Second known point
- d1 Distance between P0 and P1, entered as positive value
- OR
- d2 Distance between P0 and P1, entered as negative value

#### Unknown

- P2 First COGO point with d1
- P3 Second COGO point with d1
- OR
- P4 First COGO point with d2
- P5 Second COGO point with d2

#### 2 Points & Distance, Input page

For all point fields, the 3D viewer can be used to select the desired point. To type in coordinates for a known point, open a selectable list. Press **New** to create a point.

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate the result.  |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>Point 1</b> or <b>Point 2</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |

#### Description of fields

| Field          | Option          | Description   |
|----------------|-----------------|---|
| <b>Point 1</b> | Selectable list | The point ID of the first known point of the rectangle. |



**COGO Rectangle,  
Result 1/Result 2  
page**

| Field           | Option          | Description   |
|-----------------|-----------------|---|
| <b>Point 2</b>  | Selectable list | The point ID of the second known point of the rectangle |
| <b>Distance</b> | Editable field  | The perpendicular distance to the second parallel side. |

**Next step**

**Calculate** calculates the result and accesses **COGO Rectangle**.

| Key                            | Description  |
|--------------------------------|--|
| <b>Store</b>                   | To store the result. A closed line between all four points of the rectangle is created.        |
| <b>Result 1 and Result 2</b>   | To view the first and second result.   |
| <b>Stake</b>                   | To access the Stakeout app and stake out the calculated COGO point.                            |
| <b>Page</b>                    | To change to another page on this panel.   |
| <b>Fn Coord</b>                | To view other coordinate types.  |
| <b>Fn Ell Ht and Fn Height</b> | To change between the ellipsoidal and the orthometric height. Available for local coordinates. |
| <b>Fn Tools</b>                | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

**Description of fields**

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Point ID</b>             | Editable field | The identifier for the COGO point depending on the point ID template configured for <b>Auxiliary points in ID Templates</b> . The point ID can be changed. |
| <b>Easting and Northing</b> | Display only   | The calculated coordinates.  |
| <b>Height</b>               | Display only   | The height of the calculated point.  |

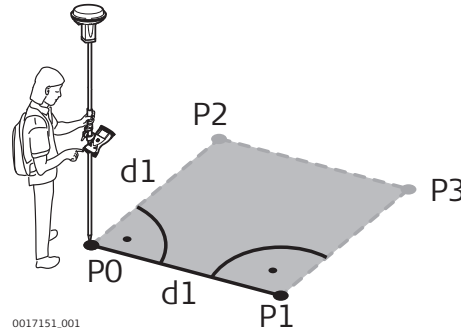
**Next step**

On the **Code** page, type in a code if desired.

On the **3D viewer** page, the rectangle is displayed with the known and the calculated COGO points.

**Store** stores the result.

## Diagram

**Known**

- P0 First known point
- P1 Second known point
- d1 Distance between P0 and P1

**Unknown**

- P2 First COGO point with d1
- P3 Second COGO point with d1

**2 Pts Square Baseline,  
Input page**

For all point fields, the 3D viewer can be used to select the desired point.

To type in coordinates for a known point, open a selectable list. Press **New** to create a point.

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate the result.  |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>Point 1</b> or <b>Point 2</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |

**Description of fields**

| Field                            | Option          | Description   |
|----------------------------------|-----------------|---|
| <b>Point 1</b>                   | Selectable list | The point ID of the first known point of the rectangle.   |
| <b>Point 2</b>                   | Selectable list | The point ID of the second known point of the rectangle   |
| <b>Create square on the left</b> | Check box       | When this box is not checked, the square is created on the right side of the baseline. That is in the direction of <b>Point 1</b> to <b>Point 2</b> .<br>When this box is checked, the square is created on the left side of the baseline. That is in the direction of <b>Point 2</b> to <b>Point 1</b> . |

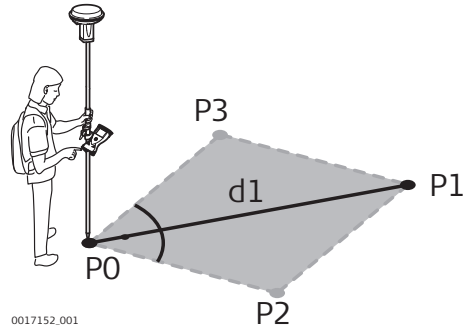
**Next step**

**Calculate** calculates the result and accesses **COGO Rectangle**. Refer to [COGO Rectangle, Result 1/Result 2 page](#).

### 40.13.4

### Rectangle with Two Points (Diagonal)

#### Diagram



#### Known

- P0 First known point
- P1 Second known point
- d1 Distance between P0 and P1 as diagonal

#### Unknown

- P2 First COGO point
- P3 Second COGO point

#### 2 Pts Square Diagonal, Input page

For all point fields, the 3D viewer can be used to select the desired point. To type in coordinates for a known point, open a selectable list. Press **New** to create a point.

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate the result.  |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. Available when <b>Point 1</b> or <b>Point 2</b> is highlighted. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the COGO app.  |

#### Description of fields

| Field          | Option          | Description   |
|----------------|-----------------|---|
| <b>Point 1</b> | Selectable list | The point ID of the first known point of the rectangle. |
| <b>Point 2</b> | Selectable list | The point ID of the second known point of the rectangle |

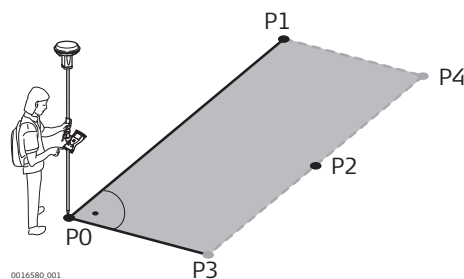
#### Next step

**Calculate** calculates the result and accesses **COGO Rectangle**. Refer to [COGO Rectangle, Result 1/Result 2 page](#).

### 40.13.5

### Rectangle with Three Points (Rectangle and Parallelogram)

#### Diagram Rectangle



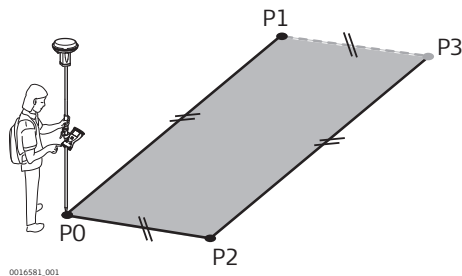
#### Known

- P0 First known point
- P1 Second known point
- P2 Third known point

#### Unknown

- P3 First COGO point
- P4 Second COGO point

## Diagram Parallelogram



### Known

- P0 First known point
- P1 Second known point
- P2 Third known point

### Unknown

- P3 First COGO point
- P4 Second COGO point

## 3 Pt Perpendicular/ 3 Pt Parallelogram, Input page

For all point fields, the 3D viewer can be used to select the desired point.

To type in coordinates for a known point, open a selectable list. Press **New** to create a point.

| Key                | Description   |
|--------------------|---|
| <b>Calculate</b>   | To calculate the result.                              |
| <b>Meas app</b>    | To measure a point manually for the COGO calculation. |
| <b>Page</b>        | To change to another page on this panel.              |
| <b>Fn Settings</b> | To configure the COGO app.                            |

### Description of fields

| Field  | Option             | Description   |
|--|--------------------|---|
| <b>Point 1,</b><br><b>Point 2,</b><br><b>Point 3</b> | Selectable<br>list | The point IDs of the three known point used for the calculation of the rectangle or parallelogram. Refer to <a href="#">DiagramRectangle</a> and <a href="#">DiagramParallelogram</a> . |

### Next step

**Calculate** calculates the result and accesses **COGO Rectangle**. Refer to [COGO Rectangle, Result 1/Result 2 page](#).

## 40.14

## Selecting a Result from Previous COGO Inverse Calculations

### Description

Azimuths, distances and offsets required within the COGO traverse and intersection calculations can be selected from previously calculated inverse results.

### Access

In Traverse or Intersection, highlight **Azimuth**, **Horizontal distance** or **Offset** and press **Last Inv**.

### Last Inverse Calculations

All previous COGO inverse calculations stored in the job are displayed, sorted by time with the most recent at the top. This panel consists of three columns. The information displayed can vary. ----- is displayed for unavailable information, for example the **Azimuth** cannot be calculated if a height only point is used.

| Key       | Description                      |
|-----------|----------------------------------|
| <b>OK</b> | To return to the previous panel. |

| Key           | Description  |
|---------------|--|
| <b>View</b>   | To view all calculated values for the highlighted COGO inverse calculation. Includes the height difference, the slope distance, the grade and the coordinate differences between the two known points. |
| <b>Delete</b> | To delete the highlighted COGO inverse calculation.  |
| <b>More</b>   | To display other information in the third column.  |

#### Description of metadata

| Metadata             | Description  |
|----------------------|--|
| -                    | The point ID of the first known point for the COGO inverse calculation.  |
| <b>To</b>            | The point ID of the second known point for the COGO inverse calculation. |
| <b>Azimuth</b>       | The direction from the first to the second known point.                  |
| <b>Horiz Dist</b>    | The horizontal distance between the two known points.                    |
| <b>Date and Time</b> | When the COGO inverse calculation was stored.                            |

#### Next step

Highlight the COGO inverse calculation of which a result is to be taken over.

**OK.** The relevant result of the highlighted COGO inverse calculation is copied into the field which was initially highlighted on the **Input** page.

## 40.15

### Modifying Values for Azimuths, Distances and Offsets

#### Description

The values for the azimuth, the distance and the offset required within the COGO traverse and intersection calculation can be mathematically modified.

#### Access

In Traverse or Intersection, highlight **Azimuth**, **Horizontal distance** or **Offset** and press **Fn Modify**.

#### Modify Value

On this panel, numbers can be typed in for the multiplication, division, addition and subtraction with the original azimuth, distance or offset value. The standard rules of mathematical operations apply.

**Modify Value** Hz 0.0010 g V 0.0002 g 16:50

|          |         |
|----------|---------|
| Offset   | 0.000 m |
| Multiply | -----   |
| Divide   | -----   |
| Add      | -----   |
| Subtract | -----   |
| Offset   | 0.000 m |

Fn OK Fn

| Key | Description   |
|-----|---|
| OK  | To accept the modified value and to return to the panel from where this panel was accessed. The modified value is copied into the field which was initially highlighted on the <b>Input</b> page. |


#### Description of fields

| Field   | Option         | Description  |
|---|----------------|--|
| <b>Azimuth, Horizontal distance or Offset</b> | Display only   | The name of the field and the value which was highlighted before accessing <b>Modify Value</b> .   |
| <b>Multiply</b>                               | Editable field | The number to multiply by. <ul style="list-style-type: none"> <li>• Minimum: -3000</li> <li>• Maximum: 3000</li> <li>• ---- multiplies by 1.</li> </ul>  |
| <b>Divide</b>                                 | Editable field | The number to divide by. <ul style="list-style-type: none"> <li>• Minimum: -3000</li> <li>• Maximum: 3000</li> <li>• ---- divides by 1.</li> </ul>   |
| <b>Add</b>                                    | Editable field | The number to be added. <ul style="list-style-type: none"> <li>• For azimuths<br/>Minimum: 0<br/>Maximum: Full circle</li> <li>• For distances and offsets<br/>Minimum: 0 m<br/>Maximum: 30000000 m</li> <li>• ---- adds 0.000.</li> </ul>           |
| <b>Subtract</b>                               | Editable field | The number to be subtracted. <ul style="list-style-type: none"> <li>• For azimuths<br/>Minimum: 0<br/>Maximum: Full circle</li> <li>• For distances and offsets<br/>Minimum: 0 m<br/>Maximum: 30000000 m</li> <li>• ---- subtracts 0.000.</li> </ul> |
| <b>Azimuth, Horizontal distance or Offset</b> | Display only   | The modified value for the field in the first line. This field is updated with every mathematical operation. Angles greater than the full circle are reduced accordingly.  |

#### Next step

OK accepts the modified value and returns to the panel from where this panel was accessed.


#### Example: Calculations for an azimuth

| Step  | Editable field     | Value as calculated | Value as displayed         |
|---|--------------------|---------------------|----------------------------|
|  |                    |                     | <b>Azimuth: 250.0000 g</b> |
| 1.  | <b>Multiply: 2</b> | 500                 | <b>Azimuth: 100.0000 g</b> |

| Step | Editable field       | Value as calculated | Value as displayed         |
|------|----------------------|---------------------|----------------------------|
| 2.   | <b>Divide: 3</b>     | 166.667             | <b>Azimuth: 166.6670 g</b> |
| 3.   | <b>Add: 300</b>      | 466.667             | <b>Azimuth: 66.6670 g</b>  |
| 4.   | <b>Subtract: 100</b> | 366.667             | <b>Azimuth: 366.6670 g</b> |

**Example: Calculations for a distance**

The behaviour for an offset is identical.

| Step | Editable field  | Value as calculated | Value as displayed                    |
|------|---|---------------------|---------------------------------------|
|      |  |                     | <b>Horizontal distance: 250.000 m</b> |
| 1.   | <b>Multiply: 2</b>  | 500                 | <b>Horizontal distance: 500.000 m</b> |
| 2.   | <b>Divide: 3</b>  | 166.667             | <b>Horizontal distance: 166.667 m</b> |
| 3.   | <b>Add: 300</b>   | 466.667             | <b>Horizontal distance: 466.667 m</b> |
| 4.   | <b>Subtract: 100</b>  | 366.667             | <b>Horizontal distance: 366.667 m</b> |

## 41

## Determine Coordinate System

### 41.1

### Overview

#### Description

GNSS measured points are always stored based on the global geocentric datum known as WGS 1984. Most surveys require coordinates in a local grid system. For example, based on a country's official mapping datum or an arbitrary grid system used in a particular area such as a construction site. To convert the WGS 1984 coordinates into local coordinates a coordinate system must be created. Part of the coordinate system is the transformation used to convert coordinates from the WGS 1984 datum to the local datum.

The Determine Coordinate System app allows:

- the parameters of a new transformation to be determined.
- the parameters of an existing transformation to be recomputed.



With one common control point, it is still possible to calculate a Classic 3D transformation, as long as the rotations and the scale parameter are fixed. Such a transformation fits perfectly in the vicinity of the common control point, but is degraded by the distance from that point. This degradation is because the orientation of the local reference frame or any scale factor within the local datum cannot be taken into account.

#### Requirements to determine a transformation

To determine a transformation it is necessary to have common control points whose positions are known in both WGS1984 coordinates and local coordinates. The more points that are common between datum, the more accurately the transformation parameters can be calculated. Depending on the type of transformation used, details about the map projection, the local ellipsoid and a local geoid model can also be needed.

#### Requirements for control points

- The control points used for the transformation should surround the area for which the transformation is to be applied. It is not good practice to survey or convert coordinates outside of the area covered by the control points as extrapolation errors can be introduced.
- When a geoid field file, and/or a CSCS field file is used in the determination of a coordinate system, the control points for the calculation must fall within the areas of the field files.

### 41.2

### Selecting the Transformation Method

#### Description

Determine Coordinate System is the conventional method of determining a coordinate system. Parameters such as the height mode must be set by the user.

One or more control points for both the WGS 1984 and the local datum are needed.

Depending on the number of control points and available information, a Onestep, Twostep or Classic 3D transformation can be used.

#### Access

Select **Create coord sys** from the **Leica Captivate - Home** menu.



## Determine Coord System

### Description of fields

| Field      | Option  | Description  |
|------------|---------|--|
| Method     |         | The type of transformation to be used when determining a coordinate system.  |
|            | Onestep | <p>Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure:</p> <p>The WGS 1984 coordinates are projected onto a temporary Transverse Mercator Projection. The central meridian of this projection passes through the centre of gravity of the common control points.</p> <p>The results of 1. are preliminary grid coordinates for the WGS 1984 points.</p> <p>These preliminary grid coordinates are matched with the local grid control points. The Easting and Northing shifts, the rotation and the scale factor between these two sets of points are then computed. This process is known as a classic 2D transformation.</p> <p>The height transformation is a single dimension height approximation.</p> <p>Refer to <a href="#">I Glossary</a>.</p> |
|            | Twostep | <p>Combines the advantages of the Onestep and the Classic 3D transformation. It allows treating position and height separately, but is not restricted to smaller areas. Procedure:</p> <p>The WGS 1984 coordinates of the common control points are shifted closely to the local datum using a given Classic 3D pre-transformation. This Classic 3D transformation is typically a rough transformation valid for the country of the local datum.</p> <p>The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points.</p> <p>A 2D transformation is applied, exactly as with the Onestep transformation.</p> <p>Refer to <a href="#">I Glossary</a>.</p>   |
| Classic 3D |         | <p>Also known as Helmert transformation. Transforms coordinates from WGS 1984 cartesian to local cartesian coordinates and vice versa. A map projection can then be applied to obtain grid coordinates. As a similarity transformation, it is the most rigorous transformation type and keeps the full geometrical information. Refer to <a href="#">I Glossary</a>.</p>   |

| Field | Option                 | Description  |
|-------|------------------------|--|
|       | <b>Modify existing</b> | To modify an existing determine coordinate system. Refer to <a href="#">41.3.3 Modifying a Coordinate System</a> . |


### Next step

| IF the selected method is             | THEN  |
|---------------------------------------|---|
| <b>Onestep, Twostep or Classic 3D</b> | <b>OK</b> to access <b>Choose Jobs</b> . Refer to the following paragraph: <b>Choose Jobs</b> .                 |
| <b>Modify existing</b>                | <b>OK</b> to access <b>Coordinate Systems</b> . Refer to <a href="#">41.3.3 Modifying a Coordinate System</a> . |

## Choose Jobs

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To confirm the selections and to continue with the subsequent panel. |
| <b>Fn Settings</b> | To configure the selected coordinate system determination method.    |

### Description of fields

| Field                                    | Option          | Description   |
|--|-----------------|---|
| <b>Name</b>                              | Editable field  | A unique name for the coordinate system. The name can be up to 16 characters in length and can include spaces. Input is mandatory.<br> Entering the name of a coordinate system allows that existing system to be updated. |
| <b>Job where WGS84 points are stored</b> | Selectable list | The job from which the points with WGS 1984 coordinates are taken.  |
| <b>Job where local points are stored</b> | Selectable list | The job from which the points with local coordinates are taken.   |

| Field                                    | Option    | Description  |
|--|-----------|--|
| <b>Use one point localisation method</b> | Check box | Number of control points needed: One control point for both the WGS 1984 and the local datum.<br>Transformation to use: <ul style="list-style-type: none"> <li>• Onestep or Twostep when information about the necessary rotations and scale factor is known.</li> <li>• Classic 3D when the rotations are set to zero and the scale factor to one.</li> </ul> |

### Next step

Press **Fn Settings** with **Use one point localisation method** NOT checked to access **Settings**.

## 41.3

## The Normal Method

### 41.3.1

### Configuring the Normal Method

#### Description

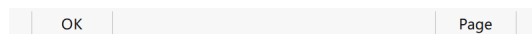
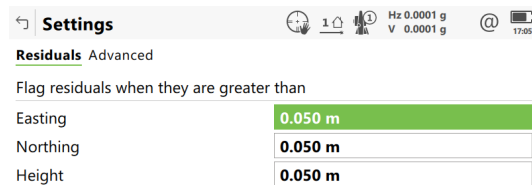
The setting allows options to be set, which are used in the Determine Coordinate System app. These settings are stored within the active working style.

#### Access

Press **Fn Settings** in **Choose Jobs** with **Use one point localisation method** NOT checked.

#### Settings, Residuals page

The explanations for the softkeys given here are valid for all pages, unless otherwise stated.



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.                                      |

#### Description of fields

| Field           | Option         | Description  |
|-----------------|----------------|--|
| <b>Easting</b>  | Editable field | The limit above which Easting residuals are flagged as possible outliers.  |
| <b>Northing</b> | Editable field | The limit above which Northing residuals are flagged as possible outliers. |

| Field  | Option         | Description  |
|--------|----------------|--|
| Height | Editable field | The limit above which Height residuals are flagged as possible outliers. |

#### Next step

Page changes to the **Advanced** page.

### Settings, Advanced page

#### Description of fields

| Field  | Option                           | Description  |
|--|----------------------------------|--|
| Model  | Bursa-Wolf or Molodensky-Badekas | The transformation model to be used. Refer to standard surveying literature for details on the models.   |
| Prompt me to enter fixed transformation parameters | Check box                        | To configure the transformation parameters during the process of calculation. A separate panel is displayed where the parameters can be entered. |

#### Next step

OK returns to **Choose Jobs**.

### 41.3.2

#### Determining a New Coordinate System

#### Access

Press **OK** in **Choose Jobs** with **Use one point localisation method** NOT checked.

#### Choose Height Mode

| Key | Description  |
|-----|--|
| OK  | To confirm the selections and to continue with the subsequent panel. |

#### Description of fields

| Field               | Option         | Description   |
|---------------------|----------------|---|
| Transformation name | Editable field | A unique name for the transformation. The name can be up to 16 characters in length and include spaces. If a coordinate system is being updated then its name is displayed. |
| Transformation type | Display only   | The type of transformation to be used when determining a coordinate system.   |

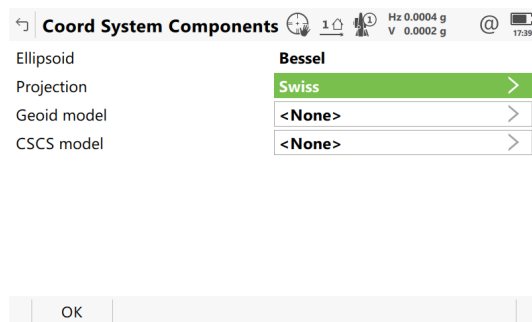
| Field              | Option   | Description   |
|--------------------|--|---|
| <b>Height mode</b> |  | The height mode to be used in the determination of a coordinate system.   |
|                    | <b>Orthometric</b><br>or<br><b>Ellipsoidal</b> | Available when determining a new coordinate system.   |
|                    | Display only                                   | Available when updating a coordinate system. The height mode shown is the same as the mode used in the existing system. |

### Next step

OK continues to **Coord System Components**.

## Coord System Components

This panel contains different fields, depending on what method was chosen in **Determine Coord System**.



| Key       | Description  |
|-----------|--|
| <b>OK</b> | To confirm the selections and to continue with the subsequent panel. |

### For Onestep

#### Description of fields

| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Geoid model</b>        | Selectable list | The geoid model to be used in the transformation.   |
| <b>Pre-transformation</b> | Selectable list | For Twostep: The pre-transformation to use for the preliminary 3D transformation.                         |
| <b>Ellipsoid</b>          | Selectable list | For Twostep and Classic 3D: The ellipsoid to use in the transformation.                                   |
|                           | Display only    | For Twostep and Classic 3D: The ellipsoid used by a fixed projection when selected in <b>Projection</b> . |
| <b>Projection</b>         | Selectable list | For Twostep and Classic 3D: The projection to use in the transformation.                                  |
| <b>CSCS model</b>         | Selectable list | For Classic 3D: The CSCS model to use in the transformation.  |

## Next step


OK continues to **Matched Points (n)**.

## Matched Points (n)

This panel provides a list of points chosen from **Job where WGS84 points are stored** and **Job where local points are stored**. The number of control points matched between both jobs is indicated in the title. Unless there is no pair of matching points in the list all softkeys are available. Refer to [41.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points](#) for information on how to match points.



Fn Calculate New Edit Delete Match Auto Fn

| Key              | Description   |
|------------------|---|
| <b>Calculate</b> | To confirm the selections, compute the transformation and continue with the subsequent panel.   |
| <b>New</b>       | To match a new pair of points. This pair is added to the list. A new point can be manually occupied. Refer to <a href="#">Choose Matching Points/Edit Matching Points</a> .   |
| <b>Edit</b>      | To edit the highlighted pair of matched points. Refer to <a href="#">Choose Matching Points/Edit Matching Points</a> .<br> If a coordinate system to be updated contains a point that was deleted from the job and a new point was created in that job with the same point ID but different coordinates, the coordinates of the old point are still used for the calculation. Pressing <b>Edit</b> to edit a highlighted pair of matched points containing the deleted point, overwrites the coordinates of the old point. The coordinates of the new point are used in the calculation. |
| <b>Delete</b>    | To delete the highlighted pair of matched points from the list.   |
| <b>Match</b>     | To change the type of match for a highlighted pair of matched points. Refer to <a href="#">41.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points</a> .   |
| <b>Auto</b>      | To scan both jobs for points that have the same point ID. Points with matching point IDs are added to the list.   |

## Description of metadata

| Metadata | Description   |
|----------|---|
| -        | The point ID of the points chosen from <b>Job where WGS84 points are stored</b> . |

| Metadata           | Description   |
|--------------------|---|
| <b>Local point</b> | The point ID of the points chosen from <b>Job where local points are stored</b> .   |
| <b>Match</b>       | <p>The type of match to be made between the points. This information is used in the transformation calculation.</p> <ul style="list-style-type: none"> <li>For Onestep or Twostep possible options are <b>Position &amp; height, Position only, Height only</b> or <b>None</b>.</li> <li>For Classic 3D, possible options are <b>Position &amp; height</b> or <b>None</b>.</li> </ul> <p><b>None</b> removes matched common points from the transformation calculation but does not delete them from the list. This option can be used to help improve residuals.</p> |

### Next step

**Calculate** computes the transformation and continues to **Residuals** or to **Classic 3D Parameters** if **Prompt me to enter fixed transformation parameters** was checked.

## Classic 3D Parameters

The settings on this page define the parameters to be used in a Classic 3D transformation. Refer to [I Glossary](#) for more information about how many transformation parameters are computed, based on the number of points common to both datum.

| IF the value for a field is | THEN the value for this parameter will be |
|-----------------------------|---|
| -----                       | calculated.                               |
| any number                  | fixed to that value.                      |

### Description of fields

| Field             | Option   | Description  |
|-------------------|--|--|
| <b>Model</b>      | <b>Bursa-Wolf</b><br>or<br><b>Molodensky-Badekas</b> | The transformation model to be used. Refer to standard surveying literature for details on the models. |
| <b>Shift dX</b>   | Editable field                                       | Shift in X direction.  |
| <b>Shift dY</b>   | Editable field                                       | Shift in Y direction.  |
| <b>Shift dZ</b>   | Editable field                                       | Shift in Z direction.  |
| <b>Rotation X</b> | Editable field                                       | Rotation around the X axis.  |
| <b>Rotation Y</b> | Editable field                                       | Rotation around the Y axis.  |
| <b>Rotation Z</b> | Editable field                                       | Rotation around the Z axis.  |
| <b>Scale</b>      | Editable field                                       | Scale factor.  |

### Next step

| IF                     | AND                                    | THEN  |
|------------------------|--|---|
| a field displays ----- | the parameter must be fixed to a value | highlight the field. <b>Fix</b> . Enter the value of the parameter. |

| IF                            | AND                              | THEN   |
|-------------------------------|----------------------------------|--|
| a field displays a value      | the parameter must be calculated | highlight the field.<br><b>Adjust.</b>                                   |
| all parameters are configured | -                                | <b>OK</b> computes the transformation and continues to <b>Residuals.</b> |

## 2D & Height Parameters



This panel is only displayed when **Prompt me to enter fixed transformation parameters** is checked in **Settings, Advanced** page.

The settings on this page define the parameters to be used in a Onestep or Twostep transformation.

| IF the value for a field is | THEN the value for this parameter will be |
|-----------------------------|---|
| -----                       | calculated.                               |
| any number                  | fixed to that value.                      |

| Key           | Description  |
|---------------|--|
| <b>Adjust</b> | To leave the value of the highlighted free for calculation.      |
| <b>Fix</b>    | To set the value of the highlighted field to the entered number. |

### Description of fields

| Field           | Option         | Description                 |
|-----------------|----------------|-----------------------------|
| <b>dEast</b>    | Editable field | Shift in East direction.    |
| <b>dNorth</b>   | Editable field | Shift in North direction.   |
| <b>Rotation</b> | Editable field | Rotation around the Z axis. |
| <b>Scale</b>    | Editable field | Scale factor.               |

### Height shift Model

Both methods compute the difference between the GNSS measured ellipsoid height and the "site datum" height at all control points in the data set.

The number of available control points has an influence on how the methods work:



One control point:

The computed difference between ellipsoid height and "site datum" height at that point is used throughout the entire site. This "constant shift" is applied regardless of which height transformation method is selected.

Two control points:

The average of the computed difference between ellipsoid height and "site datum" height at those control points are used throughout the entire site. This "constant shift" is applied regardless of which height transformation method is selected.



| Field | Option                      | Description  |
|-------|-----------------------------|--|
|       |                             | <p>Three control points:<br/>Both methods work as described. The best fit plane computed in the <b>Average plane</b> method fits perfectly the "site grid" datum at all three control points and does not produce residuals. Therefore, any errors in the height of the GNSS measurements, or in the height values supplied for the control points, are not found and incorrect "site datum" heights may be computed by the new coordinate system.</p> <p>Four or more control points:<br/>Both methods work as described. The <b>Average plane</b> method is not able to fit a plane perfectly through more than three points, so residuals are produced. That means any height errors in the GNSS measurements or in the height values supplied for the control points are highlighted.</p> <p> The control points used must surround the work area, so that the <b>Average plane</b> method accurately estimates the "site datum" everywhere on site.</p> <p>The control points used must not be in a straight line when using the <b>Average plane</b> method, as this could easily tilt the plane in the transverse direction.</p> |
|       | <b>Average plane</b>        | <p>A best fit plane is computed through the "site datum" height positions of zero at the control points. Using the inclined plane, different height transformation values are calculated for GNSS rover positions, depending on which part of the site they are on.</p> <p> Even though the method is called <b>Average plane</b>, the datum for the new coordinate system is still ellipsoidal. The inclined plane is used to compute the height transformation values which are applied to the ellipsoid heights.</p>   |
|       | <b>Average height shift</b> | <p>To compute the average of the difference values. The average value is used as a constant shift from ellipsoid height to "site datum" height for the whole site.<br/>This method can be used for small sites.</p>  |

## Next step

| IF                            | AND                                    | THEN  |
|-------------------------------|--|---|
| a field displays -----        | the parameter must be fixed to a value | highlight the field. <b>Fix.</b> Enter the value of the parameter.        |
| a field displays a value      | the parameter must be calculated       | highlight the field. <b>Adjust.</b>                                       |
| all parameters are configured | -                                      | <b>OK</b> computes the transformation and continues to <b>Residuals</b> . |

## Residuals

Displays a list of the matched points used in the transformation calculation and their associated residuals.

| Point ID | East[m] | North[m] | Height[m] |
|----------|---------|----------|-----------|
| 101      | -0.060! | 0.067!   | -0.002    |
| 200      | -0.004  | -0.057!  | -0.003    |
| 300      | 0.050   | 0.002    | 0.001     |
| 400      | 0.014   | -0.011   | 0.004!    |

|    |    |        |    |
|----|----|--------|----|
| Fn | OK | Result | Fn |
|----|----|--------|----|

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To accept the residuals and to continue with the subsequent panel.  |
| <b>Result</b> | To view results of the transformation. Refer to <a href="#">41.3.5 Transformation Results for Onestep and Twostep</a> . |

## Description of metadata

| Metadata      | Description   |
|---------------|---|
| -             | The point ID of the points chosen from <b>Job where WGS84 points are stored</b> .                           |
| <b>East</b>   | The Easting residual. If positions are not used in the transformation calculation then ----- is displayed.  |
| <b>North</b>  | The Northing residual. If positions are not used in the transformation calculation then ----- is displayed. |
| <b>Height</b> | The Height residual. If heights are not used in the transformation calculation then ----- is displayed.     |
| !             | Indicates residuals that exceed the residual limit defined in <b>Settings, Residuals</b> page.              |
| !             | Indicates the largest residual in <b>East, North</b> and <b>Height</b> .                                    |

### Next step

| IF the residuals are | THEN   |
|----------------------|--|
| unacceptable         | <b>ESC</b> returns to <b>Matched Points (n)</b> .<br>Matched points can be edited, deleted or temporarily removed from the list and the transformation recalculated. |
| acceptable           | <b>OK</b> continues to <b>Store Coordinate System</b> .  |

### Store Coordinate System, Summary page

**Store Coordinate System** Coordinate system

Name: 33

Transformation type: Classic 3D

Number of matched points: 4

Largest residuals:

- Easting: 0.009 m
- Northing: 0.004 m
- Height: 0.004 m

Store Page

| Key          | Description   |
|--------------|---|
| <b>Store</b> | To store the coordinate system to the DBX and return to <b>Leica Captivate - Home</b> . |
| <b>Page</b>  | To change to another page on this panel.  |

### Description of fields

| Field                           | Option         | Description   |
|---------------------------------|----------------|---|
| <b>Name</b>                     | Editable field | The name of the coordinate system can be changed. The name can be up to 16 characters in length and include spaces. |
| <b>Transformation type</b>      | Display only   | The type of transformation used.  |
| <b>Number of matched points</b> | Display only   | Number of matched points.   |
| <b>Easting</b>                  | Display only   | Largest Easting residual from the transformation calculation.   |
| <b>Northing</b>                 | Display only   | Largest Northing residual from the transformation calculation.  |
| <b>Height</b>                   | Display only   | Largest Height residual from the transformation calculation.  |

### Next step

**Page** changes to the **Coordinate system** page.

## Store Coordinate System, Coordinate system page

### Description of fields

| Field                     | Option  | Description   |
|---------------------------|---|---|
| <b>Residuals</b>          | <b>None</b> ,<br><b>1/distance</b> ,<br><b>1/distance<sup>2</sup></b> ,<br><b>1/distance<sup>3/2</sup></b><br>or<br><b>Multiquadratic</b> | The method by which the residuals of the control points are distributed throughout the transformation area. |
| <b>Geoid model</b>        | Display only  | Name of geoid model used.   |
| <b>Pre-transformation</b> | Display only  | For Twostep: Name of the pre-transformation used.   |
| <b>Transformation</b>     | Display only  | For Classic 3D: Name of transformation used.  |
| <b>Ellipsoid</b>          | Display only  | For Twostep and Classic 3D: Name of ellipsoid used.   |
| <b>Projection</b>         | Display only  | For Twostep and Classic 3D: Name of projection used.  |
| <b>CSCS model</b>         | Display only  | For Classic 3D: Name of CSCS model used.  |

### Next step

**Store** stores the coordinate system to the DBX and attaches it to the **Job where WGS84 points are stored** selected in **Choose Jobs**, replacing any coordinate system attached to this job. **Job where WGS84 points are stored** becomes the job.

## 41.3.3

### Modifying a Coordinate System

#### Access

**OK** in **Determine Coord System** when **Method: Modify existing**.

#### Coordinate Systems

Select an existing coordinate system and press **OK**.

All the following steps are identical with the determination of a new coordinate system from the **Matched Points (n)** panel onwards. Refer to [41.3.2 Determining a New Coordinate System](#)

## 41.3.4

### Matching Points: Selecting/ Editing a Pair of Matching Points

#### Description

Before calculating a transformation, it must be defined which points in **Job where WGS84 points are stored** and **Job where local points are stored** are to be matched. Pairs of matched points are displayed in one line in **Matched Points (n)**. New pairs of matched points can be created, existing pairs of matched points can be edited and pairs of matched points can be deleted.

#### Access

Press **New** or **Edit** in **Matched Points (n)**.

## Choose Matching Points/ Edit Matching Points

OK

| Key             | Description   |
|-----------------|---|
| <b>OK</b>       | To return to <b>Matched Points (n)</b> and to adds a line of matched points to the matched points list.                         |
| <b>Meas app</b> | To measure a point and store it in <b>Job where local points are stored</b> . Available when <b>Local point</b> is highlighted. |

### Description of fields

| Field              | Option   | Description   |
|--------------------|--|---|
| <b>WGS84 point</b> | Selectable list  | A WGS 1984 control point.                                 |
| <b>Local point</b> | Selectable list  | A local control point.                                    |
| <b>Match in</b>    |  | The type of match to be made between the points selected. |
|                    | <b>Position &amp; height, Position only, Height only</b><br>or<br><b>None.</b> | Available for <b>Onestep</b> and <b>Twostep</b> .         |
|                    | <b>Position &amp; height</b> or<br><b>None</b>                                 | Available for <b>Classic 3D</b> .                         |

### 41.3.5

### Transformation Results for Onestep and Twostep

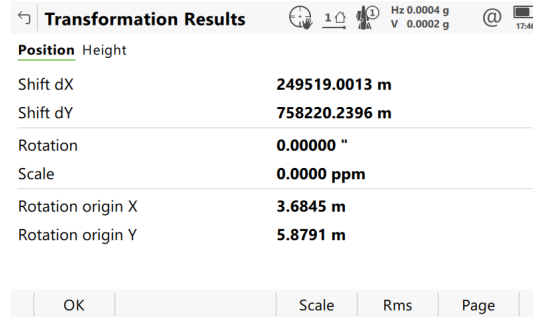
#### Access

Press **Result** in **Residuals**.

#### Transformation Results, Position page

Results of the transformation between the WGS1984 datum and the local datum are shown for each of the transformation parameters. This panel con-

sists of the **Position** page and the **Height** page. The explanations for the softkeys given here are valid for the pages as indicated.



| Key                            | Description   |
|--------------------------------|---|
| <b>OK</b>                      | To return to <b>Residuals</b> .   |
| <b>Scale</b> or <b>Ppm</b>     | Available on the <b>Position</b> page. To switch between displaying the true scale and displaying the ppm.  |
| <b>Rms</b> or <b>Parameter</b> | To switch between the root mean square values of the parameters and the current parameter values. The name of the panel changes to <b>Results Rms</b> when displaying rms values. |
| <b>Page</b>                    | To change to another page on this panel.  |

#### Description of fields

| Field                    | Option       | Description  |
|--------------------------|--------------|--|
| <b>Shift dX</b>          | Display only | Shift in X direction.  |
| <b>Shift dY</b>          | Display only | Shift in Y direction.  |
| <b>Rotation</b>          | Display only | Rotation of transformation.                                    |
| <b>Scale</b>             | Display only | Scale factor used in transformation. Either true scale or ppm. |
| <b>Rotation origin X</b> | Display only | Position in the X direction of the origin of rotation.         |
| <b>Rotation origin Y</b> | Display only | Position in the Y direction of the origin of rotation.         |

#### Next step

**Page** changes to the **Height** page.

#### Transformation Results, Height page

#### Description of fields

| Field               | Option       | Description   |
|---------------------|--------------|---|
| <b>Slope in X</b>   | Display only | Tilt of the transformation in the X direction.          |
| <b>Slope in Y</b>   | Display only | Tilt of the transformation in the Y direction.          |
| <b>Height shift</b> | Display only | Shift in height between WGS 1984 datum and local datum. |

#### Next step

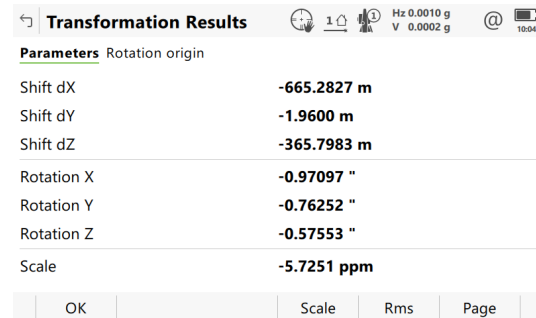
**OK** returns to **Residuals**.

## Access

Press **Result** in **Residuals**.

Transformation Results,  
Parameters page

Results of the transformation between the WGS 1984 datum and the local datum are shown for each of the transformation parameters. This panel consists of the **Parameters** page and the **Rotation origin** page. The explanations for the softkeys given here are valid for the pages as indicated.



| Key                            | Description   |
|--------------------------------|---|
| <b>OK</b>                      | To return to <b>Residuals</b> .   |
| <b>Scale</b> or <b>Ppm</b>     | Available on the <b>Parameters</b> page. To switch between displaying the true scale and displaying the ppm.  |
| <b>Rms</b> or <b>Parameter</b> | To switch between the root mean square values of the parameters and the current parameter values. The name of the panel changes to <b>Results Rms</b> when displaying rms values. |
| <b>Page</b>                    | To change to another page on this panel.  |

## Description of fields

| Field             | Option       | Description  |
|-------------------|--------------|--|
| <b>Shift dX</b>   | Display only | Shift in X direction.  |
| <b>Shift dY</b>   | Display only | Shift in Y direction.  |
| <b>Shift dZ</b>   | Display only | Shift in Z direction.  |
| <b>Rotation X</b> | Display only | Rotation around the X axis.                                    |
| <b>Rotation Y</b> | Display only | Rotation around the Y axis.                                    |
| <b>Rotation Z</b> | Display only | Rotation around the Z axis.                                    |
| <b>Scale</b>      | Display only | Scale factor used in transformation. Either true scale or ppm. |

## Next step

**Page** changes to the **Rotation origin** page.

Transformation Results,  
Rotation origin page

## Description of fields

| Field        | Option       | Description  |
|--------------|--------------|--|
| <b>Model</b> | Display only | Classic 3D transformation model used for the transformation. |

| Field                    | Option       | Description   |
|--------------------------|--------------|---|
| <b>Rotation origin X</b> | Display only | Available for <b>Model: Molodensky-Badekas</b> . Position in the X direction of the origin of rotation. |
| <b>Rotation origin Y</b> | Display only | Available for <b>Model: Molodensky-Badekas</b> . Position in the Y direction of the origin of rotation. |
| <b>Rotation origin Z</b> | Display only | Available for <b>Model: Molodensky-Badekas</b> . Position in the Z direction of the origin of rotation. |

#### Next step

OK returns to **Residuals**.

## 41.4

## The One Point Localisation Method

### 41.4.1

### Determining a New Coordinate System

#### Access

Press **OK** in **Choose Jobs** with **Use one point localisation method** being checked.

#### Choose Height Mode

Choose Height Mode

Transformation name: 22

Transformation type: Onestep

Height mode: Ellipsoidal

OK

| Key       | Description  |
|-----------|--|
| <b>OK</b> | To confirm the selections and to continue with the subsequent panel. |

#### Description of fields

| Field                      | Option   | Description   |
|----------------------------|--|---|
| <b>Transformation name</b> | Editable field                                 | A unique name for the transformation. The name can be up to 16 characters in length and include spaces. If a coordinate system is being updated then its name is displayed. |
| <b>Transformation type</b> | Display only                                   | The type of transformation to be used when determining a coordinate system.   |
| <b>Height mode</b>         | <b>Orthometric</b><br>or<br><b>Ellipsoidal</b> | The height mode to be used in the determination of a coordinate system.<br>Available when determining a new coordinate system.  |



| Field | Option       | Description   |
|-------|--------------|---|
|       | Display only | Available when updating a coordinate system. The height mode shown is the same as the mode used in the existing system. |

### Next step

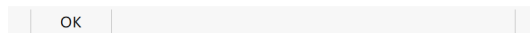
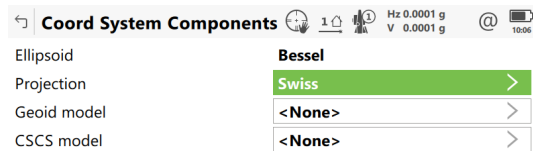
**OK** continues to **Coord System Components**.



## Coord System Components

**Azimuth** is used throughout this chapter. This term should also always be considered to mean **Bearing**.

This panel contains different fields, depending on what method was chosen in **Determine Coord System**.



| Key       | Description  |
|-----------|--|
| <b>OK</b> | To confirm the selections and to continue with the subsequent panel. |

### For Onestep

#### Description of fields

| Field                     | Option          | Description  |
|---------------------------|-----------------|--|
| <b>Geoid model</b>        | Selectable list | The geoid model to be used in the transformation.  |
| <b>Pre-transformation</b> | Selectable list | For Twostep: The pre-transformation to be used for the preliminary 3D transformation.      |
| <b>Ellipsoid</b>          | Selectable list | For Twostep and Classic 3D: The ellipsoid to be used in the transformation.                |
|                           | Display only    | For Twostep: The ellipsoid used by a fixed projection when selected in <b>Projection</b> . |
| <b>Projection</b>         | Selectable list | For Twostep and Classic 3D: The projection to be used in the transformation.               |
| <b>CSCS model</b>         | Selectable list | For Classic 3D: The CSCS model to be used in the transformation.                           |

### Next step

**OK** continues to **Choose Common Point**.

## Choose Common Point

OK

| Key             | Description   |
|-----------------|---|
| <b>OK</b>       | To confirm the selections and to continue with the subsequent panel.  |
| <b>Meas app</b> | Available for <b>Local point</b> being highlighted. To occupy a point manually and store it in <b>Job where local points are stored</b> . |

### Description of fields

| Field               | Option   | Description  |
|---------------------|--|--|
| <b>Match in</b>     |  | For Onestep and Twostep: How the horizontal and vertical shifts of the transformation is computed.   |
|                     | <b>Position &amp; height</b>                                   | Position and height are taken from the same pair of matching points.   |
|                     | <b>Position only</b>   | Position is taken from one pair of matching points. The height can be taken from another pair of matching points.  |
| <b>WGS84 point</b>  | Selectable list  | The point ID of the horizontal and/or vertical control point chosen from <b>Job where WGS84 points are stored</b> .  |
| <b>Local point</b>  | Selectable list  | The point ID of the horizontal and/or vertical control point chosen from <b>Job where local points are stored</b> .  |
| <b>Match height</b> | Check box  | For Onestep and Twostep: Available for <b>Match in: Position only</b> . Activates the determination of the vertical shift from a separate pair of matching points. |
| <b>Local height</b> | <b>Use WGS84 point height</b> or <b>Use Local point height</b> | For Classic 3D: The source of the height information to use in the transformation.   |

### Next step

For Onestep and Twostep: **OK** continues to **Determine Rotation**.

For Classic 3D: **OK** continues to **Store Coordinate System**.

## Determine Rotation

For Onestep and Twostep only.

OK Inverse

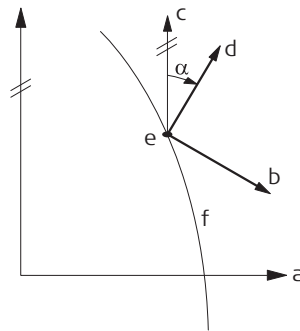
| Key             | Description  |
|-----------------|--|
| <b>OK</b>       | To confirm the selections and to continue with the subsequent panel.   |
| <b>Inverse</b>  | Available for <b>Method: Two WGS84 points</b> and <b>Method: User entered</b> . To compute an azimuth between two local points. Refer to <a href="#">41.4.2 Computing Required Azimuth</a> .   |
| <b>Meas app</b> | To measure a point and store it in <b>Job where WGS84 points are stored</b> . Available when <b>Point 1</b> or <b>Point 2</b> are highlighted for <b>Method: Two WGS84 points</b> or when <b>WGS84 point</b> is highlighted for <b>Method: Convergence angle</b> . |

### Description of fields

| Field           | Option   | Description  |
|-----------------|--|--|
| <b>Method</b>   | <b>Use WGS84 north,</b><br><b>User entered,</b><br><b>Convergence angle</b><br>or<br><b>Two WGS84 points</b> | Method by which the rotation angle for the transformation is determined.   |
| <b>Rotation</b> | Display only   | <ul style="list-style-type: none"> <li>For <b>Method: Use WGS84 north</b>: Transformation is rotated to North as defined by the WGS 1984 datum. North is 0.00000 °.</li> <li>For <b>Method: Convergence angle</b>: The rotation of the transformation calculated as 0.00000 ° minus the computed convergence angle. The field is updated as <b>Coordinate system</b> and <b>WGS84 point</b> are changed.</li> <li>For <b>Method: Two WGS84 points</b>: The rotation of the transformation calculated as required azimuth minus azimuth. The field is updated as <b>Point 1</b>, <b>Point 2</b> and <b>Required azimuth</b> are changed.</li> </ul> |

| Field                    | Option          | Description   |
|--------------------------|-----------------|---|
|                          | Editable field  | <ul style="list-style-type: none"> <li>For <b>Method: User entered</b>: To manually type in the orientation of the transformation or to calculated in <b>Compute Reqr Azimuth</b>.</li> </ul>               |
| <b>Coordinate system</b> | Selectable list | Coordinate system to provide the direction of grid North in the area where the control point used for determining the local coordinate system, is located. Available for <b>Method: Convergence angle</b> . |
| <b>WGS84 point</b>       | Selectable list | WGS 1984 point of which the convergence angle is calculated. Available for <b>Method: Convergence angle</b> .   |
| <b>Point 1</b>           | Selectable list | First point to use for computation of <b>Azimuth</b> . Available for <b>Method: Two WGS84 points</b> .  |
| <b>Point 2</b>           | Selectable list | Second point to use for computation of <b>Azimuth</b> . Available for <b>Method: Two WGS84 points</b> .   |
| <b>Azimuth</b>           | Display only    | Computed azimuth between <b>Point 1</b> and <b>Point 2</b> . Available for <b>Method: Two WGS84 points</b> .  |
| <b>Required azimuth</b>  | Editable field  | The required grid azimuth, computed between two local points. Refer to <a href="#">41.4.2 Computing Required Azimuth</a> . Available for <b>Method: Two WGS84 points</b> .                                  |

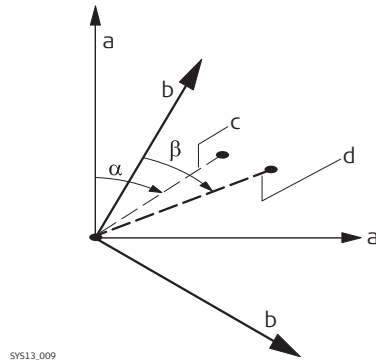
Diagram for Onestep, Method: Convergence angle



SYS13\_008

- a WGS 1984 coordinate system
- b Local coordinate system
- c Geodetic North
- d Grid North
- e Point on WGS 1984 datum
- f Meridian
- $\alpha$  Convergence angle

## Diagram for Onestep, Method: Two WGS84 points



- a WGS 1984 coordinate system
- b Local coordinate system
- c Line between two WGS 1984 points
- d Line between two local points
- $\alpha$  Azimuth of two WGS 1984 points
- $\beta$  Known azimuth or azimuth of two local points

### Next step

OK continues to **Determine Scale**.

## Determine Scale

For Onestep and Twostep only.

The scale is calculated using the formula  $(r + h)/r$  where

$r$  is the distance from the centre of the ellipsoid to the WGS 1984 point selected in **Choose Common Point**, and

$h$  is the height of this point above the WGS 1984 ellipsoid.

← Determine Scale
Hz 0.0001 g  
V 0.0001 g
10:16

Method Known WGS84 point ▾

WGS84 point 400 >

Scale 0.999926160

(Reducing points to the ground)

OK      Ppm

| Key          | Description  |
|--------------|--|
| OK           | To confirm the selections and to continue with the subsequent panel.   |
| Grid         | Available Twostep and for <b>Method: Combined scale factor</b> . To compute the grid scale factor. Refer to <a href="#">41.4.3 Computing the Grid Scale Factor</a> .     |
| Height       | Available Twostep and for <b>Method: Combined scale factor</b> . To compute the height scale factor. Refer to <a href="#">41.4.4 Computing the Height Scale Factor</a> . |
| Scale or Ppm | To switch between displaying the true scale and displaying the ppm.  |
| Meas app     | To measure a point and store it in <b>Job where WGS84 points are stored. Method: Convergence angle</b> when <b>WGS84 point</b> is highlighted.                           |

## Description of fields

| Field                                       | Option   | Description  |
|---|--|--|
| <b>Method</b>                               | <b>Known WGS84 point, Known WGS84 height or User entered</b> | Available for Onestep: Method of determining the scale factor of the transformation.   |
|   | <b>User entered or Combined scale factor</b>                 | Available for Twostep. The default method for determining the <b>Combined Scale Factor</b> to be used in the transformation process.   |
| <b>Scale(Reducing points to the ground)</b> | Editable field   | Available for Onestep. Allows the scale factor to be typed in manually. Available for <b>Method: User entered</b> .  |
|   | Display only   | Available for Onestep. The calculated scale factor. Available for <b>Method: Known WGS84 point</b> and <b>Method: Known WGS84 height</b> .   |
| <b>WGS84 point</b>                          | Selectable list  | Available for Onestep. WGS 1984 point from which the scale factor is calculated. The scale factor is calculated using the height of the known WGS 1984 point. Available for <b>Method: Known WGS84 point</b> . |
| <b>Known height</b>                         | Editable field   | Available for Onestep. The WGS 1984 height of a point can be typed in. The scale factor is calculated using this height. Available for <b>Method: Known WGS84 height</b> .                                     |
| <b>Grid scale factor</b>                    | Display only   | Available for Twostep and <b>Method: Combined scale factor</b> . The grid scale factor as computed in <b>Compute Grid Scale Factor</b> . Refer to <a href="#">41.4.3 Computing the Grid Scale Factor</a> .     |
| <b>Height scale factor</b>                  | Display only   | Available for Twostep and <b>Method: Combined scale factor</b> . The height scale factor as computed in <b>Compute Ht Scale Factor</b> . Refer to <a href="#">41.4.4 Computing the Height Scale Factor</a> .   |
| <b>Combined scale factor</b>                |  | Available for Twostep. The combined scale factor of the transformation.  |
|   | Editable field   | Available for <b>Method: User entered</b> . The scale factor can be typed in.  |
|   | Display only   | Available for <b>Method: Combined scale factor</b> . The product of the grid scale factor and the height scale factor.   |

## Next step

OK continues to **Store Coordinate System**.

## Store Coordinate System

← **Store Coordinate System** Hz 0.0004 g V 0.0002 g 17:40

**Summary** Coordinate system

|                          |            |
|--------------------------|------------|
| Name                     | 33         |
| Transformation type      | Classic 3D |
| Number of matched points | 4          |
| Largest residuals        |            |
| Easting                  | 0.009 m    |
| Northing                 | 0.004 m    |
| Height                   | 0.004 m    |

Store Page

| Key                 | Description  |
|---------------------|--|
| <b>Store</b>        | To store the coordinate system to the DBX, attach the system to <b>Job where WGS84 points are stored</b> that was selected in <b>Choose Jobs</b> and return to <b>Leica Captivate - Home</b> . |
| <b>Scale or Ppm</b> | For Onestep and Twostep. To switch between displaying the true scale and displaying the ppm.   |
| <b>Coord</b>        | For Classic 3D: To view other coordinate types.  |

### Description of fields

| Field                    | Option         | Description  |
|--------------------------|----------------|--|
| <b>Name</b>              | Editable field | A unique name for the coordinate system. The name can be up to 16 characters in length and include spaces. |
| <b>Shift dX</b>          | Display only   | For Onestep, Twostep and Classic 3D: Shift in X direction.   |
| <b>Shift dY</b>          | Display only   | For Onestep, Twostep and Classic 3D: Shift in Y direction.   |
| <b>Shift dZ</b>          | Display only   | For Classic 3D: Shift in Z direction.  |
| <b>Rotation</b>          | Display only   | For Onestep and Twostep: Rotation of transformation.   |
| <b>Scale</b>             | Display only   | For Onestep and Twostep: Scale factor of transformation.   |
| <b>Rotation origin X</b> | Display only   | For Onestep and Twostep: Position in the X direction of the origin of rotation.                            |
| <b>Rotation origin Y</b> | Display only   | For Onestep and Twostep: Position in the Y direction of the origin of rotation.                            |

## Next step

**Store** stores the coordinate system and returns to **Leica Captivate - Home**.

## 41.4.2

## Computing Required Azimuth

### Description

Available for:

- One Point Localisation method with Onestep or Twostep transformation.
- **Method: Two WGS84 points** and **Method: User entered** in **Determine Rotation**.

Allows two local points to be chosen from local job between which the required azimuth is computed. This azimuth is then used with an azimuth computed between two WGS 1984 points chosen from the WGS84 job to calculate the rotation of the transformation.

The computed required azimuth appears in the **Required azimuth** field for **Method: Two WGS84 points** and the **Rotation** field for **Method: User entered** in **Determine Rotation**.

## Access

Press **Inverse** in **Determine Rotation**.

## Compute Reqrd Azimuth

OK

| Key | Description   |
|-----|---|
| OK  | To calculate the required azimuth and return to the panel from where this panel was accessed. |

### Description of fields

| Field          | Option          | Description   |
|----------------|-----------------|---|
| <b>From</b>    | Selectable list | The point ID of the first known point for the azimuth calculation.  |
| <b>To</b>      | Selectable list | The point ID of the second known point for the azimuth calculation. |
| <b>Azimuth</b> | Display only    | The calculated azimuth.   |

### Next step

OK returns to **Determine Rotation**.

## 41.4.3

### Computing the Grid Scale Factor

## Description

For One Step Localisation method with Twostep transformation. Calculates the grid scale factor. The grid scale factor is the scale factor of the point chosen, relative to the projection being used.

## Access

Press **Grid** in **Determine Scale**.



## Compute Grid Scale Factor


 The dialog box has a title bar with a back arrow, the text "Compute Grid Scale Factor", and several icons (a hand, a scale, a battery, and a clock). Below the title bar, there are three rows: "Method" with a dropdown menu showing "Known local point", "Local point" with a text input field containing "400", and "Grid scale factor" with a display field showing "-----".


 A row of buttons: "OK", "Ppm", and a partially visible button on the right.

| Key          | Description   |
|--------------|---|
| OK           | To confirm the selections and return to the panel from where this panel was accessed. |
| Scale or Ppm | To switch between displaying the true scale and displaying the ppm.                   |

### Description of fields

| Field             | Option            | Description  |
|-------------------|-------------------|--|
| Method            |                   | Method by which the grid scale factor is calculated.   |
|                   | User entered      | Grid scale factor can be manually typed in.  |
|                   | Known local point | Grid scale factor is computed using the position of a known local point.   |
| Local point       | Selectable list   | Available for <b>Method: Known local point</b> . The point ID of the point chosen from the local job from which the grid scale factor is computed using the projection selected. |
| Grid scale factor |                   | The grid scale factor.   |
|                   | Editable field    | Available for <b>Method: User entered</b> . To type in the grid scale factor.  |
|                   | Display only      | Available for <b>Method: Known local point</b> . The computed grid scale factor.   |

### Next step

OK returns to **Determine Scale**.

## 41.4.4

### Computing the Height Scale Factor


#### Description





For One Point Localisation method with Twostep transformation. Calculates the height scale factor of the point chosen.

#### Access

Press **Height** in **Determine Scale**.

## Compute Ht Scale Factor


**Compute Ht Scale Factor**




 Hz 0.0004 g  
 V 0.0002 g  
 10:22

|                     |                   |
|---------------------|-------------------|
| Method              | Known local point |
| Local point         | 400               |
| Height scale factor | 0.999933190       |

(Reducing points to the ground)

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To confirm the selections and return to the panel from where this panel was accessed. |
| <b>Scale or Ppm</b> | To switch between displaying the true scale and displaying the ppm.                   |

### Description of fields

| Field                      | Option                    | Description  |
|----------------------------|---------------------------|--|
| <b>Method</b>              |                           | Method by which the height scale factor is calculated.   |
|                            | <b>User entered</b>       | Height scale factor can be manually typed in.  |
|                            | <b>Known local point</b>  | Height scale factor is computed using the position of a known local point.   |
|                            | <b>Known local height</b> | Height scale factor is computed using an entered height value.   |
| <b>Local point</b>         | Selectable list           | Available for <b>Method: Known local point</b> . The point ID of the point chosen from the local job from which the height scale factor is computed. |
| <b>Known height</b>        | Editable field            | Available for <b>Method: Known local height</b> . A known local height.  |
| <b>Height scale factor</b> |                           | The height scale factor.   |
|                            | Editable field            | Available for <b>Method: User entered</b> . To type in the height scale factor.  |
|                            | Display only              | Available for <b>Method: Known local point</b> and <b>Method: Known local height</b> . The computed height scale factor.                             |

### Next step

**OK** returns to **Determine Scale**.



For an overview of determine coordinate systems, refer to [41.1 Overview](#)

### Description

QuickGrid is designed to allow for quick coordinate system determination on site. Particularly for those users who must combine GS and TS data. All points must be measured by GS. QuickGrid is not available in TS mode. There are several methods to choose from.

### Access

Select **QuickGrid** from the **Leica Captivate - Home** menu.

### Choose QuickGrid Method

#### Description of fields

| Field  | Option                   | Description   |
|--------|--------------------------|---|
| Method | <b>Single point</b>      | This method is fast and targeted at the basic customer who wants to set up a local coordinate system based on a single point. The orientation is fixed to WGS 1984 north. A height scale is applied to bring GS distances to "ground" using measured point WGS 1984 height.   |
|        | <b>Multiple points</b>   | This method is fast and targeted at the more rigorous customer who wants to set up a local coordinate system based on multiple points. Rotation and scale are as calculated.  |
|        | <b>Single point base</b> | This method is fast and targeted at the basic customer who wants to set up a local coordinate system based on the base station position. The orientation is fixed to WGS 1984 north. A height scale is applied to bring GS distances to "ground" using measured point WGS 1984 height.  |
|        | <b>Orientate to line</b> | This method is fast and targeted at the more advanced customer who wants to set up a local coordinate system based on a single point, but set the orientation of the resulting grid by measuring a second point. The rotation is as calculated. A height scale is applied to bring GS distances to "ground" using measured point WGS 1984 height. |
|        | <b>QuickShift</b>        | This method is fast and targeted at the more advanced customer who wants to shift their existing coordinate system based on a single point. A 3D transformation is calculated.  |

### Next step

| IF the selected method is   | THEN   |
|---|--|
| Single point, Multiple points, Single point base or Orientate to line | OK to access <b>Define Local Quickgrid Pt.</b> |
| QuickShift  | OK to access <b>Choose Coordinate System.</b>  |

### Choose Coordinate System

This panel is only available for **Method: QuickShift.**

| Key | Description  |
|-----|--|
| OK  | To confirm the selections and to continue with the subsequent panel. |

### Description of fields

| Field                    | Option          | Description                                   |
|--------------------------|-----------------|---|
| <b>Coordinate system</b> | Selectable list | Select the coordinate system to be shifted.   |
| <b>Transformation</b>    | Display only    | The type of transformation.                   |
| <b>Ellipsoid</b>         | Display only    | The coordinates are based on this ellipsoid.  |
| <b>Projection</b>        | Display only    | The map projection.                           |
| <b>Geoid model</b>       | Display only    | The geoid model.                              |
| <b>CSCS model</b>        | Display only    | The Country Specific Coordinate System model. |

### Next step

OK accesses **Define Local Quickgrid Pt.**

### Define Local Quickgrid Pt

| Key | Description  |
|-----|--|
| OK  | To confirm the selections and to continue with the subsequent panel. |

#### Description of fields

| Field   | Option                            | Description   |
|---|-----------------------------------|---|
| <b>Local point</b>                                | <b>User entered</b>               | The local point is entered manually.  |
|   | <b>From working job</b>           | The local point is selected from the job.   |
|   | <b>From design job</b>            | The local point is selected from the design job.  |
| <b>Point ID</b>                                   |                                   | The point ID of the local point.  |
|   | Editable field<br>Selectable list | For <b>Local point: User entered</b> .<br>For <b>Local point: From working job</b> and <b>Local point: From design job</b> .      |
| <b>Easting</b>                                    |                                   | The Easting coordinate of the local point.  |
|   | Editable field<br>Display only    | For <b>Local point: User entered</b> .<br>For <b>Local point: From working job</b> and <b>Local point: From design job</b> .      |
| <b>Northing</b>                                   |                                   | The Northing coordinate of the local point.   |
|   | Editable field<br>Display only    | For <b>Local point: User entered</b> .<br>For <b>Local point: From working job</b> and <b>Local point: From design job</b> .      |
| <b>Height</b>                                     |                                   | The orthometric height of the local point.  |
|   | Editable field<br>Display only    | For <b>Local point: User entered</b> .<br>For <b>Local point: From working job</b> and <b>Local point: From design job</b> .      |
| <b>Ignore local height &amp; use WGS84 height</b> | Check box                         | When this box is checked, no height adjustment is calculated.<br>When this box is not checked, a height adjustment is calculated. |
| <b>Use geoid</b>                                  | Check box                         | Check this box to select a geoid model for the calculation.   |
| <b>Geoid model</b>                                | Selectable list                   | Available when <b>Use geoid</b> is checked. To select a geoid model.  |

#### Next step

OK accesses **Measure QuickGrid Point**.

## 42.2

### Determining a New Coordinate System

#### Access

Press **OK** in **Define Local Quickgrid Pt.**

#### Measure QuickGrid Point

This panel is similar to the standard Measure panel. Refer to [57.1.2 Real-Time Rover Operations](#).

### Next step

- For **Method: Multiple points**: After measuring and storing a point, **Matched Pts & Residuals** is accessed.
- For **Method: Orientate to line**: Measure the points of the line. Then **Store Coordinate System** is accessed.
- For all other methods: After measuring and storing a point, **Store Coordinate System** is accessed.

## Matched Pts & Residuals

This panel shows what points have been matched so far. More points can be added, matched points can be deleted.



| Key    | Description   |
|--------|---|
| OK     | To confirm the selections, compute the transformation and continue with the subsequent panel. |
| New    | To survey another point and return to the Measure panel.                                      |
| Match  | To change the type of match for the highlighted point.  |
| Remove | To delete the highlighted point from the list.  |
| More   | To display information about height residuals.  |

### Description of metadata

| Metadata               | Description   |
|------------------------|---|
| -                      | The point ID of the points chosen from the job.   |
| Match                  | The type of match to be made between the point and the surveyed point. This information is used in the transformation calculation. Position and height, position only, height only or none. |
| East, North and Height | The residuals of the matched points.  |

### Next step

Press **New** to survey another point for the calculation.

Press **OK** to continue with **Store Coordinate System**.

## Store Coordinate System, Summary page

The available fields, keys and pages depend on the selected method.

**Store Coordinate System** 2D 0.0055 m 1D 0.0075 m 12:29

**Summary** Coordinate system

Name -----

Number of matched points **1**

Largest residuals

Easting **0.000 m**

Northing **0.000 m**

Height **0.000 m**

|       |      |
|-------|------|
| Store | Page |
|-------|------|

| Key          | Description   |
|--------------|---|
| <b>Store</b> | To store the coordinate system and to exit the Determine Coordinate System app. |
| <b>Page</b>  | To change to another page on this panel.  |

### Description of fields

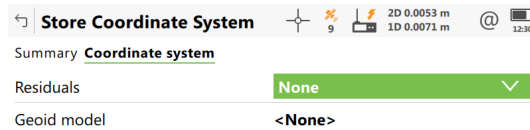
| Field   | Option         | Description  |
|---|----------------|--|
| <b>Name</b>   | Editable field | The name of the new coordinate system.   |
| <b>Number of matched points</b>                       | Display only   | Available for <b>Multiple points</b> .<br>The number of matched points.                          |
| <b>Largest residuals Easting, Northing and Height</b> | Display only   | Available for <b>Multiple points</b> .<br>The largest residuals of the transformation.           |
| <b>Rotation from north</b>                            | Display only   | Available for <b>Orientate to line</b> .<br>The rotation is shown in the configured angle units. |
| <b>Shift dX</b>                                       | Display only   | Available for <b>QuickShift</b> .<br>Shift in X direction.                                       |
| <b>Shift dY</b>                                       | Display only   | Available for <b>QuickShift</b> .<br>Shift in Y direction.                                       |
| <b>Shift dZ</b>                                       | Display only   | Available for <b>QuickShift</b> .<br>Shift in Z direction.                                       |

### Next step

**Page** changes to the **Coordinate system** page.

## Store Coordinate System, Coordinate system page

The available fields, keys and pages depend on the selected method.



| Store | Page |
|-------|------|
|-------|------|

| Key          | Description   |
|--------------|---|
| <b>Store</b> | To store the coordinate system and to exit the Determine Coordinate System app. |
| <b>Page</b>  | To change to another page on this panel.  |

### Description of fields

| Field              | Option  | Description  |
|--------------------|---|--|
| <b>Residuals</b>   | <b>None</b>   | For <b>Multiple points</b> .<br>The method by which the residuals of the control points are distributed throughout the transformation area.<br>No distribution is made. Residuals remain with their associated points. |
|                    | <b>1/distance, 1/distance<sup>2</sup> or 1/distance<sup>3/2</sup></b> | Distributes the residuals according to the distance between each control point and the newly transformed point.  |
|                    | <b>Multiquadratic</b>   | Distributes the residuals using a multiquadratic interpolation approach.   |
|                    | <b>Transformation</b>   | Display only<br>Available for <b>QuickShift</b> .<br>The type of transformation.   |
| <b>Ellipsoid</b>   | Display only  | Available for <b>QuickShift</b> .<br>The coordinates are based on this ellipsoid.  |
| <b>Projection</b>  | Display only  | Available for <b>QuickShift</b> .<br>The map projection.   |
| <b>Geoid model</b> | Display only  | Available for <b>Multiple points</b> and <b>QuickShift</b> .<br>The geoid model used.  |
| <b>CSCS model</b>  | Display only  | Available for <b>QuickShift</b> .<br>The Country Specific Coordinate System model.   |

### Next step

**Store** saves the new coordinate system.



## 43.1

## Overview

## Description


The Disto app allows to measure distances from the integrated Disto sensor of the CS20.

The app provides:

- Survey methods to calculate specific results such as height difference, slope, distance difference, distance summation, area and volume
- Measurement coding and annotation assignment
- Storage of all measurements and results in the current job database
- Export of measurements and results


The range of the measured slope distance is 150 m with an accuracy of  $\pm 1$  mm plus a deviation of  $\pm 0.2$  mm per meter.


The tilt sensor accuracy is  $\pm 0.2^\circ$  with an extra deviation of  $\pm 0.01^\circ$  per degree up to  $\pm 45^\circ$ .


 Be aware of the accuracy degradation over elevation angle of  $10^\circ$  where the computed horizontal distance and height difference values become approximate.

| Typical accuracy* with elevation angle below $10^\circ$ |                             |                            |
|---|-----------------------------|----------------------------|
| Distance  | Horizontal distance         | Height difference          |
| 1 m/3.3 ft  | $\pm 0.2$ cm/ $\pm 1/12$ in | $\pm 0.5$ cm/ $\pm 1/5$ in |
| 5 m/16.5 ft   | $\pm 0.7$ cm/ $\pm 1/4$ in  | $\pm 2.6$ cm/ $\pm 1$ in   |
| 10 m/33 ft  | $\pm 1.2$ cm/ $\pm 1/2$ in  | $\pm 5.2$ cm/ $\pm 2$ in   |

\* After calibration

 For accurate indirect results, the use of a bipod is recommended.

 For accurate elevation angle measurement, a transverse tilt should be avoided.

 The Disto compass measurements are neither used nor stored in this app.

## Requirements

The following items need to be completed before the operation of a Disto can take place:

- Installation of Leica Captivate version 6.50 firmware or higher on the CS20

If you do not have the above firmware, please contact your local sales representative or visit <https://myworld.leica-geosystems.com>.

## 43.2

## Accessing the Disto App

## Access

In order to use the Disto app, first configure the Disto connection.

1. Select **Leica Captivate - Home: Settings\Connections\All other connections**.  
Select the **CS connections** page.
2. Select **Disto**.  
Press **Edit**.

3. Set the parameters as follow:  
 Check **Use a device to measure distances**.  
**Connect using: Internal Disto.**  
**Measure distance from: Front of CS20, Back of CS20, Front of pole or Back of pole.**  
 Refer to [19.5 Disto](#).
- 
4. Press **OK**.

A calibration of the Disto sensor is required in these cases:

- Before using the application for the first time.
- If the CS20 has been dropped.
- If the CS20 has not been used since few days.

There are two calibration steps: Internal sensors and Disto tilt sensor.

1. Start with the calibration of the internal sensor.  
 Select **Leica Captivate - Home: Settings\System\Calibrate internal sensors**.
- 
2. Follow the wizard instructions.
- 
3. Thereafter start the Disto tilt calibration.  
 Select **Leica Captivate - Home: Settings\System\Calibrate Disto tilt sensor**.
- 
4. Follow the wizard instructions.

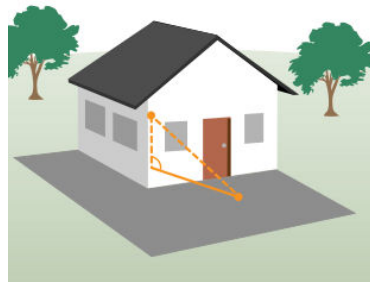
Start the app.

1. Select **Disto** from the **Leica Captivate - Home** menu.
- 
2. Select a measurement method.
- 
3. Press **OK**.

## Disto measuring methods

### Description of the Disto measuring methods

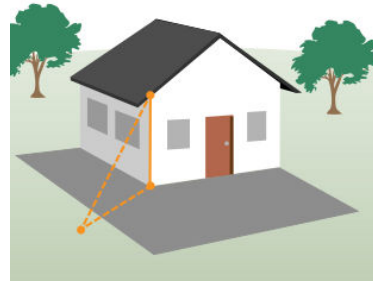
| Disto calculation methods | Description   |
|---------------------------|---|
| <b>Single distance</b>    | Measuring and storing one or more single distances. |



| Disto calculation methods | Description |
|---------------------------|-------------|
|---------------------------|-------------|

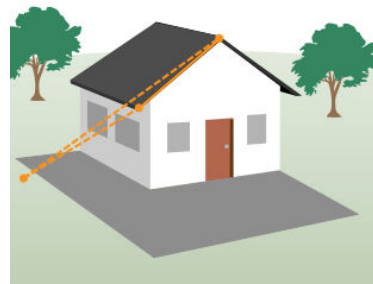
**Height difference**

Measuring two points from the same position to calculate the difference in height. The highest point must be measured first to compute a positive height difference value.



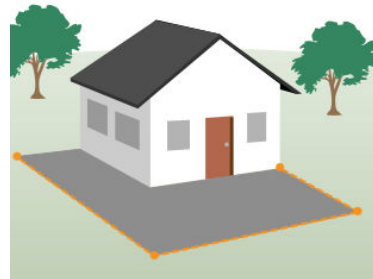
**Slope**

Measuring two points in the same direction from the same position to calculate the slope from the first to the second point. The slope distance, horizontal distance and height difference between both points are also calculated.



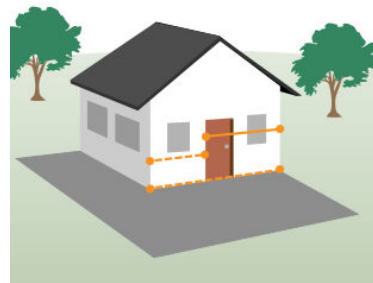
**Sum distances**

Measuring two or more distances to calculate the sum of the slope distances, horizontal distances and height differences.



**Subtract distances**

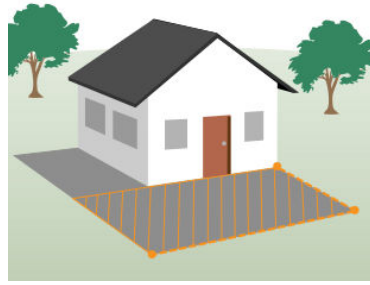
Measuring two distances to calculate the difference of the slope distances, horizontal distances and height differences.



| Disto calculation methods | Description |
|---------------------------|-------------|
|---------------------------|-------------|

**Area**

Measuring two sides of a rectangle to calculate its area and circumference.



**Volume**

Measuring both sides and the height of a rectangular prism to calculate its volume. The circumference, floor and walls areas are also calculated.



**43.3**

**Configuring the Disto App**

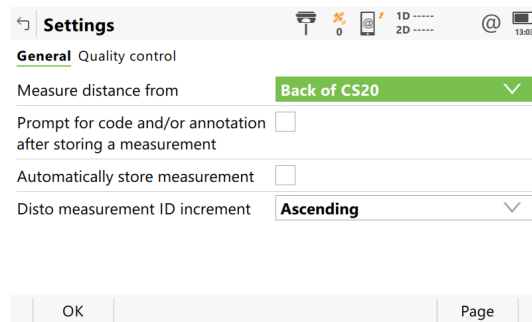
**Access**

Press **Fn Settings** in the input panel of a measurement method.

**Settings, General page**


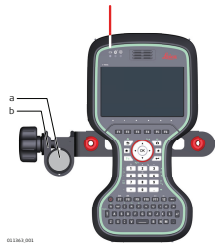

This panel consists of several pages. The explanations given for the softkeys are valid for all pages.

The parameters of this page are applied at survey time.



| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Page | To change to another page on this panel.                                      |

## Description of fields

| Field                        | Option   | Description   |
|------------------------------|--|---|
| <b>Measure distance from</b> |  | Specifies the starting reference point of the measured slope distance.  |
|                              |  | Review the setting before each survey since it impacts the measured slope distance and the calculated components of the Disto measurement, that is horizontal distance and difference in height.                                  |
|                              | <b>Front of CS20</b>   | The distance is measured from the front frame of the CS20.  |
|                              | <b>Front of pole</b>   | Defines if the holder is fixed in front of the pole.<br>Right-handed setup  |
|                              |  |  <p>a Pole<br/>b Clamp</p>  |
|                              | <b>Back of CS20</b>  | The distance is measured from the back frame of the CS20.   |
|                              | <b>Back of pole</b>  | Defines if the holder is fixed behind the pole.<br>Right-handed setup   |
|                              |  |  <p>a Pole<br/>b Clamp</p>   |
| <b>Left-handed setup</b>     | Check box  | Available when <b>Measure distance from: Front of pole</b> or <b>Measure distance from: Back of pole</b> is selected.<br>Indicates the Disto side from the pole.<br>When this box is not checked, the right-handed setup is used. |

| Field  | Option              | Description  |
|--|---------------------|--|
| <b>Prompt for code and/or annotation after storing a measurement</b> | Check box           | When this box is checked, code and/or annotations can be assigned to measurements after it has been stored to the database at survey time. |
| <b>Automatically store measurement</b>                               | Check box           | Stores the measurements automatically without the need to press <b>Store</b> .   |
| <b>Disto measurement ID increment</b>                                |                     | Sets behaviour after a measurement is stored.  |
|  | <b>&lt;None&gt;</b> | Sets the field for the measurement ID empty after a measurement is stored.   |
|  | <b>Ascending</b>    | Sets the field for the measurement ID to the next available ID after a measurement is stored.  |
|  | <b>Descending</b>   | Set the field for the measurement ID to the previous available ID after a measurement is stored.   |

#### Next step

**Page** changes to the **Quality control** page.

#### Settings, Quality control page

#### Description of fields

| Field                              | Option    | Description   |
|------------------------------------|-----------|---|
| <b>Use 2 measurements' average</b> | Check box | <p>The averaging mode can give more confidence in some cases where the measured point is far.</p> <p>When this box is checked, a wizard is enabled to take two measurements, check the measurements differences and compute an average measurement. Only the average is stored. If one of the measurement difference checks fails, then choose to accept and store the average measurement or to retake two new measurements.</p> <p>In the main measurement panel, it is indicated when the averaging mode is enabled.</p> |

| Field                            | Option   | Description   |
|----------------------------------|--|---|
| <b>Differences to check</b>      | <b>Horizontal distance, Hz distance &amp; height, Slope distance</b><br>or<br><b>Slope distance &amp; height</b> | Differences between both measurements to be checked before computing and storing the average. |
| <b>Horizontal distance limit</b> | Editabile list   | Horizontal distance difference value over which a warning message is shown.                   |
| <b>Slope distance limit</b>      | Editabile list   | Slope distance difference value over which a warning message is shown.                        |
| <b>Height limit</b>              | Editabile list   | Height difference value over which a warning message is shown.                                |

## 43.4

### Disto Methods

**Name of Disto method, Measurement page**

The explanations for the softkeys given here are valid for all pages, unless otherwise stated.

| Key                    | Description  |
|------------------------|--|
| <b>Measure</b>         | To measure a point with the Disto.   |
| <b>Laser on</b>        | To turn the red laser of the Disto on.   |
| <b>Laser off</b>       | To turn the red laser of the Disto off.  |
| <b>% v:h h:v Angle</b> | To switch between <b>Slope % (v/h x 100)</b> , <b>Slope v:h</b> , <b>Slope h:v</b> and <b>Elevation angle with °</b> .   |
| <b>Done</b>            | Available for <b>Method: Sum distances</b> when at least two distances were measured and stored.<br>To indicate that no more distance will be added, to start the calculation and to display the result. |
| <b>Page</b>            | To change to another page on this panel.   |
| <b>Fn Settings</b>     | To configure the Disto app. Refer to <a href="#">43.3 Configuring the Disto App</a> .  |

#### Description of fields

| Field                                     | Option          | Description  |
|---|-----------------|--|
| <b>Distance ID</b>                        | Editabile field | Available for <b>Method: Single distance</b> . The identifier of the measured distance.                          |
| <b>First point ID<br/>Second point ID</b> | Editabile field | Available for <b>Method: Height difference</b> and <b>Method: Slope</b> . The identifier of the measured points. |

| Field   | Option         | Description   |
|---|----------------|---|
| <b>First distance ID</b><br><b>Second distance ID</b><br>and more | Editable field | Available for <b>Method: Sum distances</b> and <b>Method: Subtract distances</b> .<br>The identifier of the measured single distances.        |
| <b>First side ID</b><br><b>Second side ID</b><br>and more         | Editable field | Available for <b>Method: Area</b> and <b>Method: Volume</b> .<br>The identifier of the measured side of the rectangle for the area or volume. |
| <b>Slope distance</b>   | Display only   | The measured slope distance between the starting reference point ( <b>Measured from</b> ) and the measured point.                             |
| <b>Elevation angle</b>  | Display only   | Elevation angle   |
| <b>Slope % (v/h x 100)</b>  | Display only   | Percentage of vertical by horizontal distance   |
| <b>Slope v:h</b>  | Display only   | Vertical by horizontal distance   |
| <b>Slope h:v</b>  | Display only   | Horizontal by vertical distance   |
| <b>Horizontal distance</b>  | Display only   | The calculated horizontal distance between the starting reference point ( <b>Measured from</b> ) and the measured point.                      |
| <b>Difference in height</b>                                       | Display only   | The calculated positive or negative height difference between the starting reference point and the measured point.                            |
| <b>Apply slope distance</b>                                       | Check box      | Available for <b>Method: Area</b> .<br>When this box is checked, the slope distance is used for the area calculation.                         |

### Name of Disto method, Results page



This panel is displayed for all methods except **Method: Single distance**.

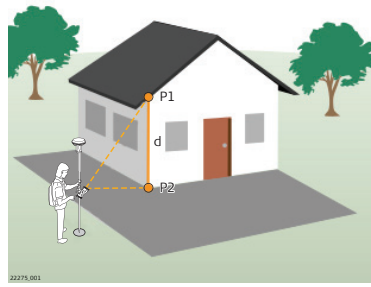
The explanations for the softkeys given here are valid for all pages, unless otherwise stated.

| Key                | Description  |
|--------------------|--|
| <b>Store</b>       | To store/update results. Returns to the panel from where this panel was accessed or to <b>Leica Captivate - Home</b> . |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the Disto app. Refer to <a href="#">43.3 Configuring the Disto App</a> .                                  |

### Description of fields



### For Method: Height difference

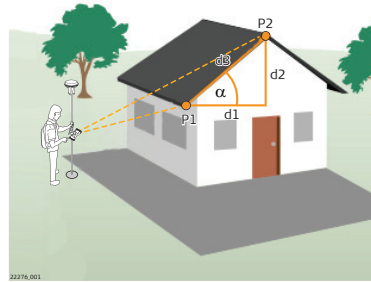


- P1 First measured point. This is the highest point.
- P2 Second measured point
- d **Height difference**


 The height difference is computed with the assumption that both Disto measurements were taken from the same elevation.

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Height difference ID</b> | Editable field | The identifier of the resulting height difference.               |
| <b>Height difference</b>    | Display only   | Calculated height difference from the first to the second point. |

### For Method: Slope



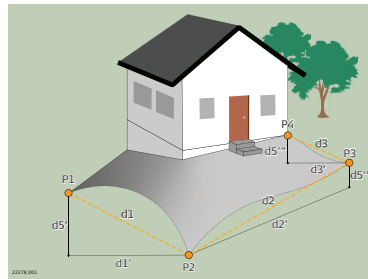
- P1 First measured point
- P2 Second measured point
- d1 **Horizontal distance difference**
- d2 **Height difference**
- d3 **Slope distance**
- $\alpha$  **Elevation angle**

 The slope results are computed with the assumption that both Disto measurements were taken from the same position and in the same direction. That is inline with the slope direction to be calculated.

| Field                                 | Option         | Description   |
|---------------------------------------|----------------|---|
| <b>Slope ID</b>                       | Editable field | The identifier of the resulting slope.  |
| <b>Horizontal distance difference</b> | Display only   | The calculated horizontal distance between the starting reference point and the measured point. |
| <b>Height difference</b>              | Display only   | The calculated height difference from the second to the first point.                            |
| <b>Slope distance</b>                 | Display only   | The calculated slope distance between the two measured points.                                  |
| <b>Elevation angle</b>                | Display only   | Elevation angle   |
| <b>Slope % (v/h x 100)</b>            | Display only   | Percentage of vertical by horizontal distance   |

| Field     | Option       | Description                     |
|-----------|--------------|---------------------------------|
| Slope v:h | Display only | Vertical by horizontal distance |
| Slope h:v | Display only | Horizontal by vertical distance |

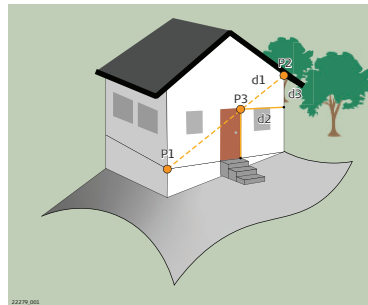
#### For Method: Sum distances



- P1, P2, d1 First and second point defining the first distance
- P2, P3, d2 Second and third point defining the second distance
- P3, P4, d3 Third and fourth point defining the third distance
- d4 **Slope distance sum**  
= d1 + d2 + d3
- d4' **Horizontal distance sum**  
= d1' + d2' + d3'
- d5 **Height sum**  
= d5' + d5'' + d5'''

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| Sum ID                  | Editable field | The identifier of the resulting sum                     |
| Slope distance sum      | Display only   | The sum of the slope distances of all measurements      |
| Horizontal distance sum | Display only   | The sum of the horizontal distances of all measurements |
| Height sum              | Display only   | The sum of the height differences of all measurements   |

#### For Method: Subtract distances

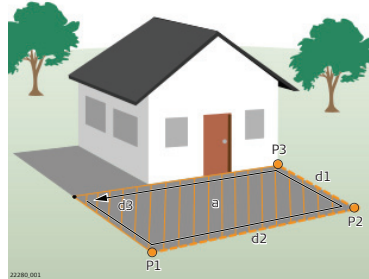


- P1, P2 First and second point defining the first distance
- P1, P3 Points defining the second distance
- d1 **Slope distance difference**
- d2 **Horizontal distance difference**
- d3 **Height difference**

| Field                          | Option         | Description  |
|--------------------------------|----------------|--|
| Difference ID                  | Editable field | The identifier of the resulting difference   |
| Slope distance difference      | Display only   | The calculated slope distance difference between the first and second measurements       |
| Horizontal distance difference | Display only   | The calculated horizontal distances difference between the first and second measurements |

| Field                    | Option       | Description  |
|--------------------------|--------------|--|
| <b>Height difference</b> | Display only | The calculated height difference between the first and second measurements |

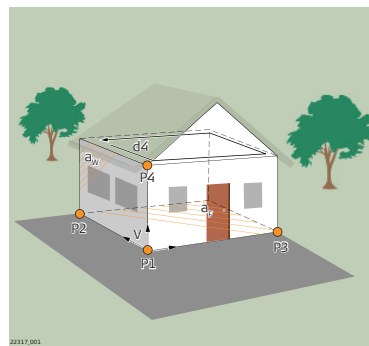
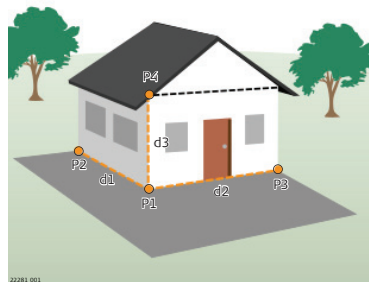
**For Method: Area**



- P1, P2, d2 First and second point defining the first side of the rectangle
- P2, P3, d1 Second and third point defining the second side of the rectangle
- d1 **Width**
- d2 **Length**
- d3 **Circumference**
- a **Area**

| Field                | Option         | Description                                   |
|----------------------|----------------|---|
| <b>Area ID</b>       | Editable field | The identifier of the resulting area          |
| <b>Length</b>        | Display only   | The longest side of the rectangle             |
| <b>Width</b>         | Display only   | The shortest side of the rectangle            |
| <b>Area</b>          | Display only   | The calculated area of the rectangle          |
| <b>Circumference</b> | Display only   | The calculated circumference of the rectangle |

**For Method: Volume**



- P1, P2, d1 The longest side of the bottom rectangle
- P1, P3, d2 The shortest side of the bottom rectangle
- P1, P4, d3 Height of the rectangular prism
- d1 **Length**
- d2 **Width**
- d3 **Height**
- d4 **Circumference**
- v **Volume**
- a<sub>F</sub> **Floor area**
- a<sub>W</sub> **Walls area**

| Field            | Option         | Description                            |
|------------------|----------------|--|
| <b>Volume ID</b> | Editable field | The identifier of the resulting volume |

| Field                | Option       | Description   |
|----------------------|--------------|---|
| <b>Length</b>        | Display only | The longest side of the bottom rectangle                  |
| <b>Width</b>         | Display only | The shortest side of the bottom rectangle                 |
| <b>Height</b>        | Display only | The height of the vertical sides (walls)                  |
| <b>Volume</b>        | Display only | The calculated volume of the rectangular prism            |
| <b>Circumference</b> | Display only | The calculated circumference of the bottom rectangle      |
| <b>Floor area</b>    | Display only | The calculated area of the bottom rectangle               |
| <b>Walls area</b>    | Display only | The sum of the areas of the four vertical side rectangles |

### Next step

**Page** to change to the **Measurements** page where the measurements belonging to the highlighted result are displayed. The behaviour of the page is similar to **Disto Data, Measurements** page. Refer to [43.5 Data and Results](#).

## 43.5

### Data and Results

#### Access

Press **Data** in the Disto panel, the input panel of a Disto measurement method.

#### Disto Data, Measurements page and Results page

This panel consists of two pages. The explanations given for the softkeys are valid for all pages.

The **Measurements** page displays a list of all distances measured with **Method: Single distance** and which are included in the current measurement code filter.

The **Results** page displays a list of all stored results from all methods that have specific results: **Height difference, Slope, Sum distances, Subtract distances, Area, Volume**.

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To return to the previous panel.  |
| <b>Edit</b>        | To view/edit details of the measurement selected on the <b>Disto Data, Measurements page</b> . Refer to <a href="#">Name of Disto measurement, Measurements page</a> .<br>To view/edit details of the result selected on the <b>Disto Data: Results</b> page. Refer to <a href="#">Name of Disto method, Results page</a> . |
| <b>Delete</b>      | To delete the highlighted measurement or result from current job database.  |
| <b>More</b>        | Available on the <b>Measurements</b> page.<br>To display additional information.  |
| <b>Fn Settings</b> | To configure the Disto app. Refer to <a href="#">43.3 Configuring the Disto App</a> .   |
| <b>Fn Export</b>   | To export Disto data to a new created *.csv file. Refer to <a href="#">Export Disto Data</a> .  |

| Key              | Description  |
|------------------|--|
| <b>Fn Filter</b> | To define a display filter based on measurement code value. Refer to <a href="#">Code Filter</a> . |

#### Description of metadata

| Metadata                    | Description  |
|-----------------------------|--|
| -                           | The IDs of the measured distances or the IDs of the results.   |
| <b>Code</b>                 | Available on the <b>Measurements</b> page.<br>The code assigned to the measurement.  |
| <b>Slope distance</b>       | Available on the <b>Measurements</b> page.<br>The slope distance from the Disto to the measured point considering the value of the <b>Measure distance from</b> setting when measured/stored.      |
| <b>Elevation angle</b>      | Available on the <b>Measurements</b> page.<br>The elevation angle from the Disto to the measured point considering the value of the <b>Measure distance from</b> setting when measured/stored.     |
| <b>Horizontal distance</b>  | Available on the <b>Measurements</b> page.<br>The horizontal distance from the Disto to the measured point considering the value of the <b>Measure distance from</b> setting when measured/stored. |
| <b>Difference in height</b> | Available on the <b>Measurements</b> page.<br>The height difference from the Disto to the measured point considering the value of the <b>Measure distance from</b> setting when measured/stored.   |
| <b>Method</b>               | Available on the <b>Results</b> page.<br>The method used for measuring.  |
| <b>Date and Time</b>        | When the Disto measurement or result was stored.   |

#### Next step

Highlight a measurement and press **Edit**. Refer to [Name of Disto measurement, Measurements page](#).

Highlight a result and press **Edit**. The fields are identical with the **Results** page displayed after a measurement. Refer to [Name of Disto method, Results page](#).

#### Name of Disto measurement, Measurements page

This panel displays the stored components of a measurement.

| Key                                | Description   |
|------------------------------------|---|
| <b>Store</b>                       | To store and update distance ID, code, attributes and annotations values to the job database.<br>To return to the panel from where this panel was accessed. |
| <b>%<br/>v:h<br/>h:v<br/>Angle</b> | To switch between <b>Slope % (v/h x 100)</b> , <b>Slope v:h</b> , <b>Slope h:v</b> and <b>Elevation angle</b> in °.   |
| <b>More</b>                        | To change between the date, the time, horizontal distance and difference in height.   |

| Key                | Description   |
|--------------------|---|
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the Disto app. Refer to <a href="#">43.3 Configuring the Disto App</a> . |

#### Description of fields



| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Distance ID</b>          | Editable field | The identifier of the measured distance.  |
| <b>Measured from</b>        | Display only   | Starting reference point of the measured slope distance ( <b>Front of CS20, Back of CS20, Front of pole, Back of pole</b> ).                |
| <b>Slope distance</b>       | Display only   | The measured slope distance between the starting reference point ( <b>Measured from</b> ) and the measured point.                           |
| <b>Elevation angle</b>      | Display only   | Elevation angle   |
| <b>Slope % (v/h x 100)</b>  | Display only   | Percentage of vertical by horizontal distance   |
| <b>Slope v:h</b>            | Display only   | Vertical by horizontal distance   |
| <b>Slope h:v</b>            | Display only   | Horizontal by vertical distance   |
| <b>Horizontal distance</b>  | Display only   | The calculated horizontal distance between the starting reference point ( <b>Measured from</b> ) and the measured point.                    |
| <b>Difference in height</b> | Display only   | The calculated positive or negative height difference between the starting reference point ( <b>Measured from</b> ) and the measured point. |

#### Next step

| IF you want to   | THEN  |
|------------------|---|
| edit a code      | <b>Page</b> to change to the <b>Code</b> page. Change a code or add an annotation. <b>Store</b> to return to the <b>Disto Data</b> panel. |
| save the changes | <b>Store</b> to return to the panel from where this panel was accessed.   |

## Export Disto Data

This panel provides the functionality to export Disto data to a \*.csv file.

-  to create an HTML data report, use the Captivate export data functionality in combination with a Disto app stylesheet.
-  The filter defined for the app is applied at export time.

The \*.csv file is divided into two sections:

- First section:  
Listing of all measurements from the **Method: Single distance**
- Second section:  
Listing of all results of all methods that have specific results:  
**Height difference, Slope, Sum distances, Subtract distances, Area, Volume**

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To check for already existing export files with the same name, to create the export file and to export the Disto data. To return to the panel from where this panel was accessed. |
| <b>Fn Settings</b> | To configure the Disto app. Refer to <a href="#">43.3 Configuring the Disto App</a> .   |

#### Description of fields

| Field  | Option          | Description  |
|--|-----------------|--|
| <b>To device</b>                                   | Selectable list | Defines where the exported data is saved to.   |
| <b>To folder</b>                                   | Selectable list | The data can be exported to the \DATA directory or to the folder where the selected job is located.  |
| <b>Output file name</b>                            | Editable field  | The name of the file to which the data is exported. The name can be with or without file extension.  |
| <b>Include single distance method measurements</b> | Check box       | When this box is checked, then the measurements from <b>Method: Single distance</b> are included in the export file.<br><br>Export format:<br>Distance ID, Date, Time, Slope distance, Elevation angle, Horizontal distance, Difference in height, Annotation1, Annotation2, Annotation3, Annotation4, Code, Attribute1, Attribute2, Attribute3, ... |
| <b>Include Disto results</b>                       | Check box       | When this box is checked, then the results from all methods that have specific results are included in the export file: <b>Height difference, Slope, Sum distances, Subtract distances, Area, Volume</b><br><br>Export format:<br>Result ID: ID<br>Date: Date<br>Time: Time<br>Method: Method<br>Result1: Value1<br>Result2: Value2                  |

| Field                    | Option                 | Description  |
|--------------------------|------------------------|--|
|                          |                        | Example for <b>Method: Area</b> :<br>Result ID: DST0003-DST0004<br>Date: 10.04.2020<br>Time: 14:12:49<br>Method: Area<br>Length: 4.665 m<br>Width: 2.898 m<br>Area: 13.522 m <sup>2</sup><br>Circumference: 15.127 m |
| <b>Slope unit format</b> |                        | The input and output format for grades   |
|                          | <b>h:v</b>             | Horizontal by vertical distance  |
|                          | <b>v:h</b>             | Vertical by horizontal distance  |
|                          | <b>%(v/h x 100)</b>    | Percentage of vertical by horizontal distance  |
|                          | <b>Elevation angle</b> | Elevation angle  |

### Example for a standard \*.csv export file

```

Distance ID,Date,Time,Slope distance,Elevation angle,Horizontal distance,Difference in height,...
DST0002,26.04.2019,13:13:09,10.143,2.2,10.135,0.384,,,,,FENCE
DST0001,26.04.2019,13:11:13,7.615,4.7,7.589,0.631
DST0003,26.04.2019,13:19:43,6.802,1.6,6.799,0.150

Result ID: DST0004-DST0005
Date: 26.04.2019
Time: 13:21:15
Method: Area
Length: 31.868 m
Width: 23.023 m
Area: 733.702 m²
Circumference: 109.782 m

Result ID: DST0009-DST0011
Date: 26.04.2019
Time: 13:24:57
Method: Sum Distances
Slope distance sum: 23.540 m
Horizontal distance sum: 23.536 m
Height sum: -0.204 m

Result ID: Room123
Date: 26.04.2019
Time: 13:51:20
Method: Volume
Length: 5.618 m
Width: 3.097 m
Height: 2.155 m
Volume: 37.495 m³
Circumference: 17.429 m
Floor area: 17.359 m²
Walls area: 37.565 m²

```

### Example for an \*.html export file using a stylesheet

#### Disto Data Report

##### Single Distance

| Distance ID | Date/Time           | Slope Distance (m) | Elevation Angle (deg) | Horiz. Distance (m) | Diff. in Height (m) | Code |
|-------------|---------------------|--------------------|-----------------------|---------------------|---------------------|------|
| DST0004     | 15-10-2020 16:32:54 | 6.354              | 3.7                   | 6.341               | 0.410               | CP   |
| DST0014     | 15-10-2020 17:03:28 | 6.354              | 3.7                   | 6.341               | 0.410               | CP   |

##### Height Difference

| Height Difference ID | Date/Time           | Height Difference (m) |
|----------------------|---------------------|-----------------------|
| DST0012-DST0013      | 15-10-2020 16:43:46 | -0.220                |

##### Slope

| Slope ID        | Date/Time           | HZ Distance Difference (m) | Height Difference (m) | Slope Distance (m) | Slope (%) |
|-----------------|---------------------|----------------------------|-----------------------|--------------------|-----------|
| DST0001-DST0002 | 15-10-2020 15:19:17 | 0.527                      | 0.220                 | 0.571              | 41.7      |

##### Sum Distances

| Sum ID          | Date/Time           | Slope Distance Sum (m) | HZ Distance Sum (m) | Height Sum (m) |
|-----------------|---------------------|------------------------|---------------------|----------------|
| DST0009-DST0011 | 15-10-2020 16:43:11 | 20.691                 | 20.597              | 1.919          |



## Code Filter

This panel allows the definition of a filter based on code value for the measurements displayed in the **Disto Data** panel. This filter is also applied at export time by the **Export Disto Data** panel.

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To close the panel and return to the <b>Disto Data</b> panel. The defined code filter is applied.   |
| <b>Add</b>         | Available if <b>Include multiple codes</b> is checked and if the selected code is already in the filter.<br>To add the highlighted code to the filter.    |
| <b>Remove</b>      | Available if <b>Include multiple codes</b> is checked and if the selected code is already in the filter.<br>To remove the highlighted code from the list. |
| <b>Clear</b>       | Available if <b>Include multiple codes</b> is checked and if the filter is not empty.<br>To remove all codes from the filter.                             |
| <b>Fn Settings</b> | To configure the Disto app. Refer to <a href="#">43.3 Configuring the Disto App</a> .   |

### Description of fields

| Field                         | Option          | Description   |
|-------------------------------|-----------------|---|
| <b>Code</b>                   | Selectable list | All codes from the codelist of the current working job are listed.  |
| <b>Include multiple codes</b> | Check box       | When this box is checked, several codes can be added to the filter. |
| Code names                    | Display only    | The multiple code values according to the filter.                   |

44.1

Overview

Description

The Measure to line/Stake to line app can be used to stake out or measure points relative to a line.

Tasks

The Measure to line/Stake to line app can be used for the following tasks:

- Measuring to a line where the coordinates of a design point can be calculated from its position relative to the defined line.
- Staking to a line where the position of a design point is known and instructions to locate the point are given relative to the line.
- Gridstaking a line where a grid can be staked relative to a line.
- Viewing the position relative to a slope defined from the line.

Other functionality available includes:

- Shifting the line with parallel offsets.
- Referencing to a specific segment of a line.
- Reversing the direction of a line.

Activating the app

If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).

Point types

Lines/arcs can be created from points stored as:


- WGS 1984 geodetic
- Local grid


A local grid must always be available when using the app.

Linked jobs and global data

Linked jobs will overwrite the points and lines from the global design job selected in **Design Data**.



Terms

| Term            | Description  |
|-----------------|--|
| Reference point | Used in this chapter to refer to the location on the line that is perpendicular to the measured position.  |
| Design point    | The design point. <ul style="list-style-type: none"> <li>• For measuring to a line, this term refers to the point with the coordinates of the current position and the designed or calculated height.</li> <li>• For staking or grid staking to a line, this term refers to the point to be staked, defined by the user</li> </ul>                         |
| Measured point  | The current position.  |
| Line            |  <p>A line can be a straight line between two points, an arc or a multi-point line made up of multiple individual line sections. It may be constructed by joining many "point to points", by creating the sections segment-by-segment, or by creating an alignment.</p> |

| Term         | Description   |
|--------------|---|
| Line segment |  <p>A line segment is an individual component of a multi-line such as a polyline or an alignment. The segment can be a straight or an arc.</p> |

## Preparing the data

Create line data by one of the following methods:

| Method  | Description  |
|---|--|
| <b>Create lines onboard</b>   |  |
|  | The Measure to line/Stake to line app supports DBX polylines. DBX areas can be also used as closed polylines.  |
| Data management   | Refer to <a href="#">7 Job Menu - View &amp; edit data</a> .   |
| Create Control Data   | Lines can be created using the Create line function. Refer to <a href="#">Create new line/arc</a> .  |
| 3D viewer   | From 3D viewer, lines can be created, imported or selected to be used in Measure to line/Stake to line. Refer to <a href="#">37.6 Context Menu</a> .   |
| Survey linework   | Lines can be created by measuring points in the field. Lines can be made using the line-work commands.   |
| Road data in Alignment Editor   | Using the Alignment Editor app, a simple centreline alignment can be created and be imported.<br> Only straight and curve elements are supported. The alignment created with the Alignment Editor app must be converted to a Roads Job. |
| <b>Import lines</b>   |  |
| Import an individual line from DXF background map                                 | Using a DXF file attached as a background map, lines can be selected and imported within 3D viewer, Measure or Measure to line/Stake to line apps.   |
| Import all objects including lines from DXF                                       | Copy the DXF files to the \DATA directory on the data storage device of the instrument. Once the card is back in the instrument the DXF import program can be used to bring the lines into the job.  |
| Import from XML   | Copy the DXF files to the \DATA directory on the data storage device of the instrument. Once the card is back in the instrument the XML import program can be used to bring the lines into the job.  |
| Import Road alignments  | <b>Alignment in Import data</b> supports various different formats like dxf, LandXml, MxGenio, Terramodel, Carlson.  |
| <b>Create lines externally</b>  |  |

| Method   | Description   |
|--|---|
| Infinity   | Refer to Infinity Online Help.  |
| Design to Field  | Using the Design to Field tool of Infinity, you are able to bring in lines from multitudes of formats. For example, XML, DXF, Microstation XML and many more. Refer to Infinity Online Help for information on Design to Field. |
| Some 3 <sup>rd</sup> party software export to Leica database | -   |



Refer to [B Directory Structure of the Memory Device](#) for the placements of the data files on the data storage device.

### Defining chainage

The chainage of the start point of a line can be defined.

### Coordinate systems

Lines and points defining the lines can be read from the design job using the active coordinate system. For this reason, the coordinate system in the design job must match the active one in the job.

If using TS, select the **<None>** or a local grid coordinate system.

If using GS, a local grid coordinate system must be used. Working in WGS84 coordinates is not supported. Measured WGS84 coordinates are converted to grid using the active coordinate system.

It is possible to use a valid coordinate system, but have the line or part of it lying outside the projection or CSCS model being used.

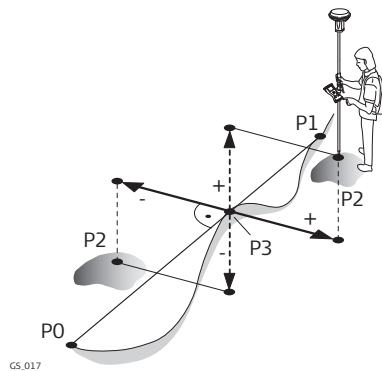
In these cases, the field values relating to the difference in coordinates between the design point and current position are shown as -----.



**Azimuth** is used throughout this chapter. This term should also always be considered to mean **Bearing**.

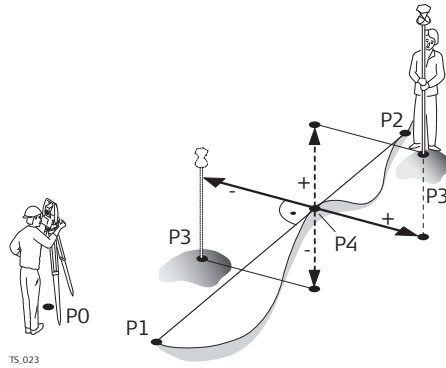
### Direction of values

The following diagram shows the direction of positive and negative values for distance and height differences between the design point and the measured point.



#### For GS:

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point

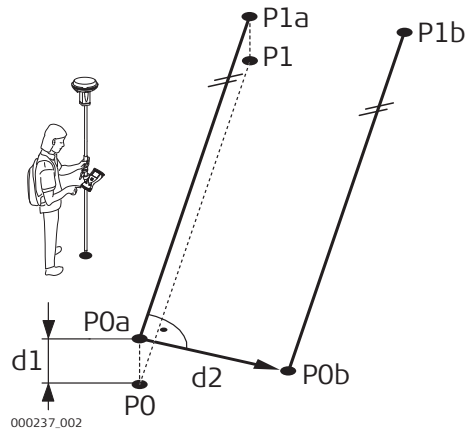


**For TS:**

- P0 Instrument setup
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point

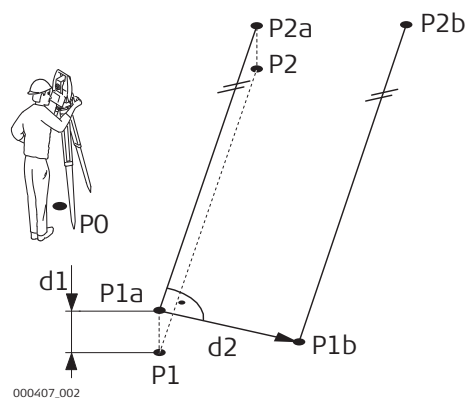
**Shifts**

A line can be shifted. A shift is permanently applied to the line during of the Measure to line/Stake to line task.



**For GS:**

- P0 Start point
- P1 End point
- P0a Start point with **Vertical** shift
- P1a End point with **Vertical** shift
- P0b Start point with **Horizontal** shift
- P1b End point with **Horizontal** shift
- d1 **Vertical** shift
- d2 **Horizontal**



**For TS:**

- P0 Instrument setup
- P1 Start point
- P2 End point
- P1a Start point with **Vertical** shift
- P2a End point with **Vertical** shift
- P1b Start point with **Horizontal** shift
- P2b End point with **Horizontal** shift
- d1 **Vertical**
- d2 **Horizontal**

**44.2**

**Accessing Measure to line/Stake to line**

**Access**

- For measuring tasks:  
Select **Leica Captivate - Home: Measure to line.**
- For staking tasks:  
Select **Leica Captivate - Home: Stake to line.**

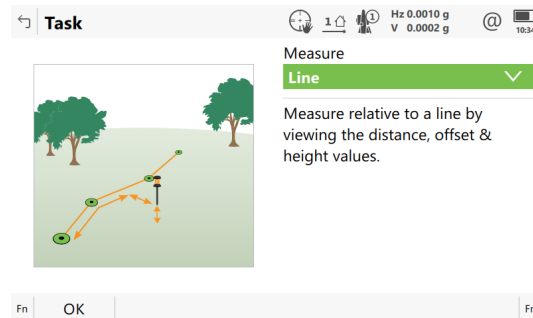


The lines are stored in the selected design job.

The measurements are stored to the selected job.

The coordinate systems in the design job and in the job must match, otherwise a warning message appears to prevent any further step.

## Task



| Key         | Description   |
|-------------|---|
| OK          | To select the highlighted option and to continue with the subsequent panel. |
| Fn Settings | To configure the Measure to line/Stake to line app.                         |

### Description of the Measure to line/Stake to line tasks

#### For Measure to line

| Task               | Description   |
|--------------------|---|
| Line               | Measure relative to a line by viewing the distance, offset & height values.   |
| Line with slope    | Measure relative to a line by viewing the distance, offset & height values. Additionally view position relative to a defined slope from the line.               |
| Segment            | Measure relative to a line segment by viewing the distance, offset & height values. A segment may be an individual straight or arc, or a segment within a line. |
| Segment with slope | Measure relative to a line segment by viewing the distance, offset & height values. Additionally view position relative to a defined slope from the line.       |
| Quick Line         | Create a temporary line from 2 points & measure relative to it by viewing the distance, offset & height values.   |

#### For Stake to line

| Task            | Description   |
|-----------------|---|
| Line            | Stakeout relative to a line by defining the distance, offset & height.  |
| Line with slope | Stakeout relative to a line by defining the distance, offset & height. Additionally view position relative to a defined slope from the line.                |
| Grid            | Define & stakeout a grid of points relative to a line.  |
| Segment         | Stakeout relative to a line segment, by defining the distance, offset & height. A segment may be an individual straight or arc, or a segment within a line. |

| Task                      | Description   |
|---------------------------|---|
| <b>Segment with slope</b> | Stakeout relative to a line segment, by defining the distance, offset & height. Additionally view position relative to a defined slope from the line. |
| <b>Quick Line</b>         | Create a temporary line from 2 points & stakeout relative to it by defining the distance, offset & height.  |
| <b>Quick Arc</b>          | Create a temporary arc & stakeout relative to it by defining the distance, offset & height.   |

#### Next step

OK accesses **Define Line**.

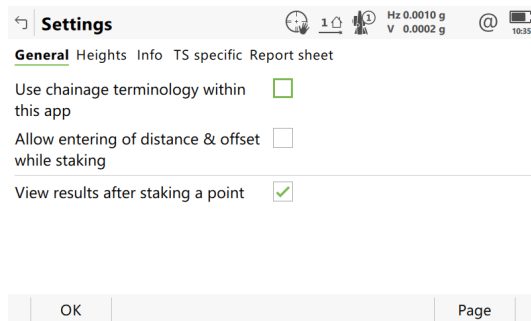
## 44.3

### Configuring Measure to line/Stake to line

#### Access

Press **Fn Settings** in the input panels of the Measure to line/Stake to line app.

#### Settings, General page



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.                                      |

#### Description of fields

| Field  | Option    | Description   |
|--|-----------|---|
| <b>Use chainage terminology within this app</b>              | Check box | Activates the use of chainages within the Measure to line/Stake to line app. If the box is not checked, <b>Distance along line</b> is used for data input purposes.   |
| <b>Allow entering of distance &amp; offset while staking</b> | Check box | When this box is checked, stake values can be defined while staking out.  |
| <b>Do not write stakeout values to annotation fields</b>     | Check box | When this box is not checked, fixed value for certain software packages are recorded into an annotation field. The values include offsets and distances values. They can be used to double-check if the measured point has been edited.<br>When this box is checked, no information is written into the annotation field. |

| Field                                     | Option    | Description  |
|---|-----------|--|
| <b>View results after staking a point</b> | Check box | When this box is checked, the stake results are displayed after staking a point. |

**Next step**

Page changes to the **Graphics** page.

This page is only available for staking operations.

**Description of fields**

| Field                   | Option                            | Description   |
|-------------------------|-----------------------------------|---|
| <b>Help me navigate</b> |                                   | The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Measure to line/Stake to line app are based on this selection.  |
|                         | <b>Using line being staked</b>    | The direction of the orientation is parallel to the line.   |
|                         | <b>From behind instrument</b>     | Available for TS.<br>The direction of the orientation is from the instrument to the point to be staked.<br>When this setting is used in combination with <b>Navigational arrow types: Direction &amp; distance</b> , then the direction and distance to the next Stakeout point is displayed without the need of a measurement.<br>Distance = Horizontal distance from instrument station to stakeout point.<br>Direction = Direction from the current telescope position to the point to be staked.<br>When turning the instrument, the direction changes according to the telescope position of the instrument whereas the distance does not change. When a measurement is done, direction and distance are updated according to the measurement results. |
|                         | <b>Facing instrument</b>          | Available for TS.<br>The direction of the orientation is from the current position relative to the instrument.  |
|                         | <b>Facing last measured point</b> | The direction of the orientation is from the current position relative to the last recorded point.  |
|                         | <b>Facing point (design data)</b> | The direction of the orientation is from the current position relative to a point from the design job.  |
|                         | <b>Facing point</b>               | The direction of the orientation is from the current position relative to a point from the job.   |



| Field   | Option                          | Description   |
|---|---------------------------------|---|
|   | <b>Facing north</b>             | Available for GS.<br>The direction of the orientation is from the current position relative to North.   |
|   | <b>Following arrow</b>          | The direction of the orientation is from the current moving direction to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked. The current position must have moved at least 0.5 m for the orientation to be calculated.  |
|   | <b>Facing sun</b>               | Available for GS.<br>The position of the sun calculated from the current position, the time and the date.   |
| <b>Point ID</b>   | Selectable list                 | Available for <b>Help me navigate: Facing point (design data)</b> and <b>Help me navigate: Facing point</b> . To select the point to be used for orientation.   |
| <b>Navigational arrow types</b>                         |                                 | The method of staking out.  |
|   | <b>Direction &amp; distance</b> | The direction from the orientation reference, the horizontal distance and the cut/fill are displayed.<br><br>When this setting is used in combination with <b>Help me navigate: From behind instrument</b> , then the direction and distance to the next Stakeout point is displayed without the need of a measurement.<br>Distance = Horizontal distance from instrument station to stakeout point.<br>Direction = Direction from the current telescope position to the point to be staked.<br>When turning the instrument, the direction changes according to the telescope position of the instrument whereas the distance does not change. When a measurement is done, direction and distance are updated according to the measurement results. |
|   | <b>In/out, left/right</b>       | The distance forwards/backwards to the point, the distance right/left to the point and the cut/fill is displayed.   |
| <b>Switch to bulls-eye when 0.5m (1.5ft) from point</b> | Check box                       | When this box is checked, a bulls eye bubble is shown in any view when less than half metre from the point being staked.  |

| Field  | Option                       | Description   |
|--|------------------------------|---|
|  |                              |   |
| <b>Beep faster when getting close to point</b> | Check box                    | The instrument beeps when the horizontal radial distance from the current position to the point to be staked, is equal to or less than defined in <b>Start within</b> . |
| <b>Distance to use</b>                         | <b>Height</b>                | The distance in height is used as beep threshold.   |
|  | <b>Horizontal distance</b>   | The distance from Easting and Northing is used as beep threshold.   |
|  | <b>Position &amp; height</b> | The distance from Easting, Northing and Height are used as beep threshold.  |
| <b>Start within</b>                            | Editable field               | The horizontal radial distance from the current position to the point to be staked when a beep is heard.  |

### Next step

**Page** changes to the **Quality control** page.


## Settings, Quality control page

### Description

Especially when checking points it is useful to enable the **Quality control** criteria available. For every point stored, the chosen parameters are checked. When **Quality control** criteria is fulfilled, the difference icons are turning green, and the measured point can be directly stored. If the check limits are exceeded a warning is shown. This function guarantees a higher productivity as it is no longer necessary to check the values for every shot taken.

### Description of fields

| Field                                   | Option    | Description  |
|---|-----------|--|
| <b>Check differences before storing</b> | Check box | When this box is checked, a position check is done when storing a staked point. When the defined tolerance is exceeded, the stakeout can be repeated, skipped or stored. When this box is not checked, no quality check is done during stakeout of points. |

| Field                       | Option                               | Description   |
|-----------------------------|--------------------------------------|---|
| <b>Differences to check</b> |                                      |  Depending on this selection the following lines are enabled/disabled. |
|                             | <b>Chainage, offset &amp; height</b> | Check for chainage, horizontal offset and height.   |
|                             | <b>Chainage &amp; offset</b>         | Check for chainage and horizontal offset.   |
|                             | <b>Position &amp; height</b>         | Check for 2D position and height.   |
|                             | <b>Position</b>                      | Check for 2D position.  |
|                             | <b>Height</b>                        | Check for height.   |
| <b>Chainage limit</b>       | From <b>0.001</b> to <b>100</b>      | Maximum difference in chainage.   |
| <b>Offset limit</b>         | From <b>0.001</b> to <b>100</b>      | Maximum horizontal offset from defined position.  |
| <b>Position limit</b>       | From <b>0.001</b> to <b>100</b>      | Maximum radial horizontal distance.   |
| <b>Height limit</b>         | From <b>0.001</b> to <b>100</b>      | Maximum height difference.  |

#### Next step

Page changes to the **Heights** page.

#### Settings, Heights page

#### Description of fields

| Field  | Option    | Description  |
|--|-----------|--|
| <b>Allow editing the height of the location being staked</b> | Check box | When this box is checked, the design height can be changed manually for <b>Height: From line</b> or <b>Height: Start point of line</b> . |

#### Next step

Page changes to the **Design** page.

#### Settings, Design page

On this page, additional design points to be staked are set. Refer to [44.6 Staking to a Line](#) for a graphic.

## Description of fields


| Field                                       | Option                        | Description  |
|---|-------------------------------|--|
| <b>Project to segment of stake position</b> | Check box                     | When staking on offset line based on a polyline, there are situations where no valid offset information can be calculated and displayed. This situation appears at offset bisected points (BP).<br>When this box is checked, a line is defined to orientate to so that stake values can be calculated and displayed. |
| <b>Segment to use at Angle Points</b>       | <b>Back</b> or <b>Forward</b> | Refer to <a href="#">Points of interest</a> for a diagram showing angle points.<br>Defines if the segment used as reference for the stakeout values is in backwards or forwards direction.   |
| <b>Horizontal (PC, PT, AP)</b>              | Check box                     | Horizontal type points occur at the junction between two segments in a line.   |
| <b>Mid curve (MCP)</b>                      | Check box                     | Occurs in arc segments.  |
| <b>Curve radius (RP)</b>                    | Check box                     | Occurs in arc segments.  |
| <b>Offset bisected point (BP)</b>           | Check box                     | Occurs when the junction between two segments in a line is not tangent AND when offsets are active.  |
| <b>Offset in average direction (Avg)</b>    | Check box                     | Occurs when the junction between two segments in a line is not tangent AND when offsets are active.  |
| <b>Vertical (VPI, Low, High, VPC, VPT)</b>  | Check box                     | Vertical type points occur at the junction between two segments in the vertical alignment of the line, or when a high or low element is found. Example: In a curve between two grades  |

## Next step

**Page** changes to the **Info** page.


## Settings, Info page

Two things can be configured on this page:

1. The required information for the stake or measure method to be displayed on the  page.
2. If and which user-defined page is displayed.

| Key               | Description                             |
|-------------------|---|
| <b>OK</b>         | To confirm the changes and continue.    |
| <b>Clear</b>      | To clear all parameters from all lines. |
| <b>Fn Default</b> | To set the default value for all lines. |

## Description of fields





| Field                         | Option          | Description  |
|-------------------------------|-----------------|--|
| <b>Show user defined page</b> | Check box       | Shows a selectable list for the pages.   |
| <b>Page to show</b>           | Selectable list | The user-defined page to be shown.   |
| <b>Method</b>                 | Display only    | The method is based on the selected Measure to line/Stake to line task. The settings in the following lines can only be changed for the current task.<br>The method defines the parameters available to view on the  page of the app. Different combinations of the parameters to view can be stored. |
| <b>1st line to 16th line</b>  | Selectable list | Define which parameters are viewed on each line. Up to 16 lines of parameters can be defined.  |



Some of the options are explained in graphics in the following chapters.

### Always available

|                                      |  |
|--------------------------------------|--|
| <b>Point ID</b>                      | To enter the point ID.   |
| <b>Antenna height</b>                | For GS:<br>To enter the antenna height.  |
| <b>Target height</b>                 | For TS:<br>To enter the target height.   |
| <b>Code</b>                          | Editable field for codes.  |
| <b>Attribute 01 and Attribute 02</b> | Editable field for attributes for codes.   |
| <b>Chainage</b>                      | Displays the current chainage.   |
| <b>Distance along line</b>           | Displays the horizontal distance from the start point to the reference point along the line. |
| <b>Line offset</b>                   | Displays the horizontal offset perpendicular from the line to the current position.          |
| <b>Line height difference</b><br>or  | Displays the height difference from the defined line to the current position.                |
| <b>Line name</b>                     | Displays the name of the line.   |
| <b>Line type</b>                     | Displays the line type as straight, arc or polyline.   |
| <b>Easting</b>                       | Displays the Easting coordinate of the current position.                                     |
| <b>Northing</b>                      | Displays the Northing coordinate of the current position.                                    |

| Field | Option   | Description  |
|-------|--|--|
|       | <b>Height</b>  | Displays the height of the current position.   |
|       | <b>3D quality</b>                                    | For GS:<br>Display only field for the current 3D coordinate quality of computed position.                                |
|       | <b>Cut/fill</b>                                      | Displays the height difference between the design height and the measured height.<br>C = cut, F = fill                   |
|       | <b>Go forward/backward</b>                           | Distance to point.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:                |
|       |  |   |
|       | <b>Go left/right</b>                                 | Distance to point.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:                |
|       |  |   |
|       | <b>Go</b>  | Distance to point.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:          |
|       |  |                                       |
|       | <b>Turn left/right</b>                               | Direction to point.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:         |
|       |  |                                       |
|       | <b>Unused line Separator</b>                         | Insert full line space.<br>Insert half line space.   |
|       | <b>For measure with/without slope also available</b> |  |
|       | <b>Distance to start point</b>                       | Displays the horizontal distance from the measured point to the start point of the line.                                 |
|       | <b>Distance to end point</b>                         | Displays the horizontal distance from the measured point to the end point of the line.                                   |
|       | <b>Line distance to end</b>                          | Displays the horizontal distance from the end point of the line to the base point of the measured point, along the line. |

| Field | Option   | Description   |
|-------|--|---|
|       | <b>Distance to 3D chainage point</b>               | Displays the slope distance between the reference point and the measured point, perpendicular to the line. Not displayed when shifts are applied. |
|       | <b>Height difference at 3D chainage</b>            | Displays the height difference perpendicular from the line to the horizontal base point. Not displayed when shifts are applied.                   |
|       | <b>3D chainage</b>                                 | Displays the slope distance between the start point and the reference point. Not displayed when shifts are applied.                               |
|       | <b>For stake with/without slope also available</b> |   |
|       | <b>Difference in distance along line</b>           | Displays the horizontal distance along the line from the current position to the defined design point.  |
|       | <b>Difference in chainage</b>                      | Displays the difference between the defined chainage and the current chainage.  |
|       | <b>Difference in height</b>                        | Displays the vertical offset between the defined position and the current position.   |
|       | <b>Design Chainage</b>                             | Displays the defined chainage of the point to be staked out.  |
|       | <b>Defined line distance</b>                       | Displays the defined horizontal distance along the line from the start point to the design point.   |
|       | <b>Defined offset</b>                              | Displays the defined horizontal offset perpendicular from the line to design point.   |
|       | <b>Direction to point</b>                          | Displays the direction from the current position to the design point.   |
|       | <b>Distance to point</b>                           | Displays the distance from the current position to the design point.  |
|       | <b>Design easting</b>                              | Displays the Easting of the design point.   |
|       | <b>Design North</b>                                | Displays the Northing of the design point.  |
|       | <b>Design height</b>                               | Displays the height of the design point, depending on the defined heights to use.   |
|       | <b>For slope only also available</b>               |   |
|       | <b>Current slope ratio</b>                         | Displays the ratio of the slope from the current position to the hinge.   |
|       | <b>Slope design ratio</b>                          | Displays the defined ratio of the slope from the design point to the hinge.   |
|       | <b>Slope distance to hinge</b>                     | Displays the slope distance offset from the hinge to measured point.  |
|       | <b>Slope distance to line</b>                      | Displays the slope distance offset from line to measured point.   |

| Field | Option                            | Description  |
|-------|-----------------------------------|--|
|       | <b>Height difference to slope</b> | Displays the height difference between the current position and the height of the slope at that position. A cut is above the slope. A fill is below the slope. |
|       | <b>Hinge offset</b>               | Displays the horizontal offset from the hinge point of the slope to the current position.  |
|       | <b>Hinge height diff</b>          | Displays the height difference from the hinge point of the slope to the current position.  |

#### Next step

**Page** changes to the **TS specific** page.

Settings,  
TS specific page

#### Description of fields

| Field  | Option                       | Description   |
|--|------------------------------|---|
| <b>Do not update stakeout values between distance measurements</b> | Check box                    | When this box is checked, angles and stakeout values are updated after a distance was measured. Then all values are frozen until the next distance is taken.  |
| <b>Automatically aim instrument to point being staked</b>          | Check box                    | When this box is checked, the instrument positions automatically to the point to be staked.   |
| <b>Automatic behaviour</b>   |                              | Available when <b>Automatically aim instrument to point being staked</b> is checked.  |
|  | <b>Position only</b>         | Instrument positions horizontally to the point to be staked.  |
|  | <b>Position &amp; height</b> | Instrument positions horizontally and vertically to the point to be staked.   |
| <b>Use two face measurements</b>                                   | Check box                    | To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When an instrument has auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |

#### Next step

**Page** changes to the **Report sheet** page. Refer to [38 Apps - General](#).



## 44.4

## Defining the Line

### 44.4.1

### Overview

#### Description

The definition of the line to be used can require up to three steps, depending on the selected task:

| Task                            | Define Line | Define Segment | Define Slope |
|---------------------------------|-------------|----------------|--------------|
| Line<br>Quick Line<br>Quick Arc | ✓           | -              | -            |
| Segment<br>Grid                 | ✓           | ✓              | -            |
| Line with slope                 | ✓           | -              | ✓            |
| Segment with slope              | ✓           | ✓              | ✓            |

### 44.4.2

### Defining the Line

#### Access

1. Select **Leica Captivate - Home: Measure to line** or **Stake to line**.
2. In **Task**, select the required task and press **OK**.

#### Define Line, Line page

Define Line

Line 3D viewer

Line: Line 1049

Type: Line (polyline)

Length: 23.635 m

Height: From line

OK Create Shifts Page Fn

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To accept changes and continue with the subsequent panel.   |
| <b>Create</b>      | To create a line. Refer to <a href="#">12 Creating Points and Lines</a> .   |
| <b>Shifts</b>      | To apply horizontal and vertical shifts to the selected line. Refer to <a href="#">Define Shifts</a> . Available for lines only. If using line segments, shifts are applied in the <b>Define Segment</b> panel. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the Measure to line/Stake to line app.   |
| <b>Fn Report</b>   | To view an alignment report. Refer to <a href="#">Save Line Report, Points page</a> .   |

#### Description of fields

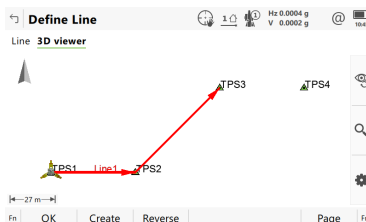
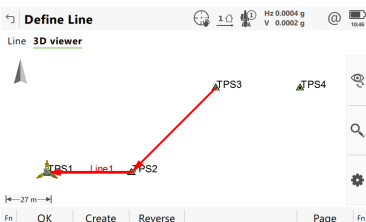
| Field       | Option          | Description  |
|-------------|-----------------|--|
| <b>Line</b> | Selectable list | To select a line. Open the selectable list to access the <b>Line Selection</b> panel showing all selectable lines from the design job. |

| Field          | Option              | Description   |
|----------------|---------------------|---|
| Type           | Display only        | The selected line type as straight, arc or polyline.  |
| Length         | Display only        | The horizontal grid distance between the two points of the line.  |
| Start chainage | Display only        | The beginning chainage of the line.   |
| Height         | Selectable list     | Depending on the task chosen this parameter determines the design height. <ul style="list-style-type: none"> <li>When measuring to a line, it affects the height difference value.</li> <li>When staking, it affects the delta height value.</li> </ul> |
|                | From line           | Heights are computed along the line.  |
|                | User entered        | Heights are typed in manually into the <b>Height</b> field.   |
|                | Start point of line | Heights are computed relative to the height of the starting point of the line.  |
|                | DTM                 | The height computed from the DTM at the current position.   |

### Next step

OK accesses **Define Slope**, **Define Segment**, **Measure to Line** or **Define Stake**.

### Define Line, 3D viewer page

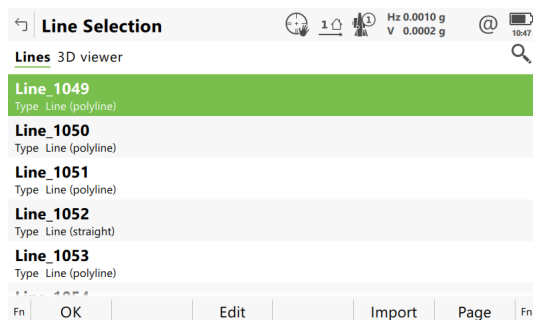
| Key     | Description  |
|---------|--|
| Reverse | To reverse the direction of the lines, so that the distance along line/chainage increment is in the opposite direction to the original:<br>Original:  Reverse:  |

### Line selection and importing lines

#### Selecting lines

In **Define Line**, open the selectable list for **Line**.



The list contains all selectable lines from the design job. The line ID and the start chainages of lines can be edited.



| Key    | Description   |
|--------|---|
| OK     | To select the highlighted line and to return to the panel from where this panel was accessed. |
| Edit   | To edit line ID and the start chainage.   |
| Import | To import a line from a Road/Rail job or from an external job.                                |

### Importing lines

Press **Import** to import a single alignment from a Road or Rail job, or a line from another job, to a line to be used in the app. The **Import Line** panel opens.

-  Only alignment geometry that contains lines and simple curves are supported. Clothoids are not supported and cannot be imported.
-  If the source job for the import is the same as the design job, for example when you want to import areas, the imported element is converted to a line with the suffix `_001`.

| Key | Description  |
|-----|--|
| OK  | To import the selected alignment data to active raw alignment. |

### Description of fields

| Field                     | Option             | Description  |
|---------------------------|--------------------|--|
| <b>From</b>               |                    | The file type of the data source.  |
|                           | <b>Job</b>         | To import lines from an existing job.  |
|                           | <b>Road design</b> | To import lines from an existing Road job.   |
|                           | <b>Rail design</b> | To import lines from an existing Rail job.   |
| <b>Road+ (GSI format)</b> |                    | To import lines from an existing Road job defined in GSI format.   |
|                           |                    |  |
| <b>From job</b>           | Selectable list    | All jobs are available for selection.  |
| <b>Line</b>               | Selectable list    | Line from the selected Road job. The line must be stored in the \DBX folder of the data storage device to be selectable. |

### Define Quick Line, Line page

When **Quick Line** is the selected task, the line is defined by two points from the design job, instead of an existing line.



When the task is finished or a new quick line is defined, the previously defined quick line is automatically deleted from the database.

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To accept changes and continue with the subsequent panel.   |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Rotate line</b> is highlighted. |
| <b>Shifts</b>      | To apply horizontal and vertical shifts to the defined line. Refer to <a href="#">Define Shifts</a> .                               |
| <b>Meas app</b>    | To measure a point. Available when <b>Start point</b> or <b>End point</b> is highlighted.   |
| <b>Fn Settings</b> | To configure the Measure to line/Stake to line app.   |

#### Description of fields

| Field                      | Option                     | Description   |
|----------------------------|----------------------------|---|
| <b>Start point</b>         | Selectable list            | The first point forming the line.   |
| <b>End point</b>           | Selectable list            | The last point forming the line.  |
| <b>Rotate line</b>         | Editable field             | To rotate the line by the defined angle value - clockwise if not defined otherwise in <b>Regional</b> .   |
| <b>Azimuth</b>             | Display only               | The direction from the first to the second known point.   |
| <b>Horizontal distance</b> | Display only               | The horizontal distance between the two known points.   |
| <b>Height difference</b>   | Display only               | The height difference between the two known points.   |
| <b>Slope distance</b>      | Display only               | The slope distance between the two known points.  |
| <b>Grade</b>               | Display only               | The grade between the two known points.   |
| <b>Height</b>              | Selectable list            | Depending on the task chosen this parameter determines the design height. <ul style="list-style-type: none"> <li>When measuring to a line, it affects the height difference value.</li> <li>When staking, it affects the delta height value.</li> </ul> |
|                            | <b>From line</b>           | Heights are computed along the line.  |
|                            | <b>User entered</b>        | Heights are typed in manually into the <b>Height</b> field.   |
|                            | <b>Start point of line</b> | Heights are computed relative to the height of the starting point of the line.  |
|                            | <b>DTM</b>                 | The height computed from the DTM at the current position.   |

### Next step

Page changes to the **Define Quick Line, Stake** page.

### Define Quick Arc, Arc page

| Key        | Description   |
|------------|---|
| OK         | To accept changes and continue with the subsequent panel.   |
| Shifts     | To apply horizontal and vertical shifts to the defined line. Refer to <a href="#">Define Shifts</a> . |
| Meas app   | To measure a point. Available when <b>Start point</b> or <b>End point</b> is highlighted.             |
| FnSettings | To configure the Measure to line/Stake to line app.   |

### Description of fields

| Field                   | Option                               | Description   |
|-------------------------|--------------------------------------|---|
| <b>Create arc using</b> |                                      | The method by which the arc is defined.   |
|                         | <b>3 points</b>                      | Uses three known points to define the arc.  |
|                         | <b>2 points &amp; radius</b>         | Defines the arc using two known points and a radius of the arc.   |
|                         | <b>2 tangents &amp; radius</b>       | Defines the arc using two tangents and a radius of the arc.   |
|                         | <b>2 tangents &amp; arc length</b>   | Defines the arc using two tangents and the length of the arc.   |
|                         | <b>2 tangents &amp; chord length</b> | Defines the arc using two tangents and the chord of the arc.  |
| <b>Start point</b>      | Selectable list                      | The start point of the arc. Available for <b>Create arc using: 3 points</b> and <b>Create arc using: 2 points &amp; radius</b> .  |
| <b>Second point</b>     | Selectable list                      | The second point of the arc. Available for <b>Create arc using: 3 points</b> .  |
| <b>End point</b>        | Selectable list                      | The end point of the arc. Available for <b>Create arc using: 3 points</b> and <b>Create arc using: 2 tangents &amp; radius</b> .  |
| <b>Point 1</b>          | Selectable list                      | A point on the first tangent. Available for <b>Create arc using: 2 tangents &amp; radius</b> , <b>Create arc using: 2 tangents &amp; arc length</b> and <b>Create arc using: 2 tangents &amp; chord length</b> .                  |
| <b>PI point</b>         | Selectable list                      | The point of intersection of the two tangents. Available for <b>Create arc using: 2 tangents &amp; radius</b> , <b>Create arc using: 2 tangents &amp; arc length</b> and <b>Create arc using: 2 tangents &amp; chord length</b> . |

| Field        | Option          | Description   |
|--------------|-----------------|---|
| Point 2      | Selectable list | A point on the second tangent. Available for <b>Create arc using: 2 tangents &amp; radius</b> , <b>Create arc using: 2 tangents &amp; arc length</b> and <b>Create arc using: 2 tangents &amp; chord length</b> . |
| Radius       | Editable field  | The radius of the arc. Available for <b>Create arc using: 2 points &amp; radius</b> and <b>Create arc using: 2 tangents &amp; radius</b> .  |
| Arc length   | Editable field  | The length of the arc. Available for <b>Create arc using: 2 tangents &amp; arc length</b> .   |
| Chord length | Editable field  | The length of the chord. Available for <b>Create arc using: 2 tangents &amp; chord length</b> .   |

### Next step

Page changes to the **Define Quick Arc, Stake** page.

Define Quick Line/  
Define Quick Arc,  
Stake page

| Key                 | Description   |
|---------------------|---|
| OK                  | To confirm the selections and to continue with the subsequent panel.  |
| Shifts              | To apply horizontal and vertical shifts to the defined line. Refer to <a href="#">Define Shifts</a> .                         |
| Stake -/Ch-         | To decrease the distance along line/the chainage by <b>Increment</b> .  |
| Stake +/Ch+         | To increase the distance along line/the chainage by <b>Increment</b> .  |
| Fn Settings         | To configure the Measure to line/Stake to line app. Refer to <a href="#">44.3 Configuring Measure to line/Stake to line</a> . |
| Fn Start and Fn End | To change between the start point and the end point of the line.  |

### Description of fields

| Field               | Option         | Description   |
|---------------------|----------------|---|
| Distance along line | Editable field | The chainage of the start point of a line.  |
| Offset              | Editable field | The offset from the line to the design point.   |
| Height offset       | Editable field | The height offset of the design point. <ul style="list-style-type: none"> <li>For <b>Height:Start point of line</b><br/>The height of the design point is calculated as the height of the start point plus <b>Height offset</b>.</li> <li>For <b>Height:From line</b><br/>The height of the design point is calculated as the height of the reference point plus <b>Height offset</b>.</li> </ul> |

| Field  | Option          | Description   |
|--|-----------------|---|
| <b>Use stake increments/<br/>Use chainage increments</b> | Check box       | Activates the use of stake/chainage increments.   |
| <b>Increment</b>   | Editable field  | Available when <b>Use stake increments</b> is checked. Stake/chainage increment to be used. |
| <b>Increment after storing</b>                           |                 | Sets behaviour of the stake/chainage after a point is stored.                               |
|  | <b>No</b>       | Does not change the stake/chainage after a point is stored.                                 |
|  | <b>Increase</b> | Proceeds to the next point up stake/chainage after each stored staked point.                |
|  | <b>Decrease</b> | Proceeds to the next point down stake/chainage after each stored staked point.              |

### Save Line Report, Points page


The report displays information on the points that have been measured with the current selected design job, and current select line.

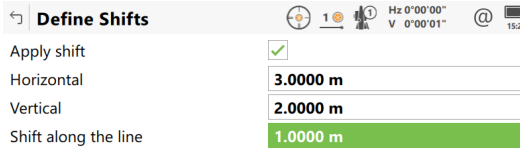
| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To return to the panel from which this panel was accessed.  |
| <b>Edit</b> | To edit details of the highlighted point.   |
| <b>Save</b> | To save the alignment report.   |
| <b>More</b> | To change the values displayed between <b>Offset, Cut/fill, Measured height, Design ht, Point ID</b> and <b>Pt code</b> . |
| <b>Page</b> | To change to another page on this panel.  |

### Next step

**Page** changes to the **3D viewer** page. Use **Ch-** and **Ch+** to the previous or next measured point.

### Define Shifts

 **3D viewer** is not updated with shifts.




| Key       | Description  |
|-----------|--|
| <b>OK</b> | To confirm the selections and to return to the previous panel. |

| Key                                | Description  |
|------------------------------------|--|
| <b>Ground</b><br>or<br><b>Grid</b> | To switch between ground and grid for the input values.<br>The values in the entered format can be exported in HeXML 2.0 and higher. |

#### Description of fields

| Field   | Option         | Description   |
|---|----------------|---|
| <b>Apply shift</b>  | Check box      | Check to apply a shift.   |
| <b>Horizontal (ground)</b><br>or<br><b>Horizontal</b>                     | Editable field | Distance to shift the line horizontally to the left or right.           |
| <b>Vertical</b>   | Editable field | The vertical shift of the line.   |
| <b>Shift along the line (ground)</b><br>or<br><b>Shift along the line</b> | Editable field | Available for <b>Measure: Quick Line</b> .<br>The shift along the line. |

### 44.4.3

#### Defining a Segment of a Line

#### Description

**Define Segment**, **Segment** page appears when the selected method is **Segment**, **Segment with slope** or **Grid**. A segment can be a straight or an arc.

#### Define Segment, Segment page

| Key  | Description   |
|--|---|
| <b>OK</b>                                  | To accept changes and continue with the subsequent panel.   |
| <b>Shifts</b>                              | To apply horizontal and vertical shifts to the selected segment. Refer to <a href="#">Define Shifts</a> . |
| <b>Segment -</b><br>or<br><b>Segment +</b> | To select the previous/next segment in the line.  |
| <b>Page</b>                                | To change to another page on this panel.  |
| <b>Fn Settings</b>                         | To configure the Measure to line/Stake to line app.   |

#### Description of fields

| Field                 | Option         | Description   |
|-----------------------|----------------|---|
| <b>Line</b>           | Display only   | The current line.   |
| <b>Segment number</b> | Editable field | The line segment number to work with. A polyline is split into segments, naming from 1 upwards. |
| <b>Segment type</b>   | Display only   | The selected line type as straight or arc.  |
| <b>Segment length</b> | Display only   | The horizontal grid distance between the two points of the line segment.                        |
| <b>Start chainage</b> | Display only   | The beginning chainage of the line segment.   |



**Description**

It is possible to define slopes for line. When measuring or staking to the line, additional information about the position relative to the slope is displayed.

Stakeout values still refer to the line. For the **i** page, additional information relative to the slope can be configured in **Settings, Info** page.

**Define Slope**

| Key         | Description  |
|-------------|--|
| OK          | To accept changes and to continue with the subsequent panel. |
| Fn Settings | To configure the Measure to line/Stake to line app.          |

**Description of fields**

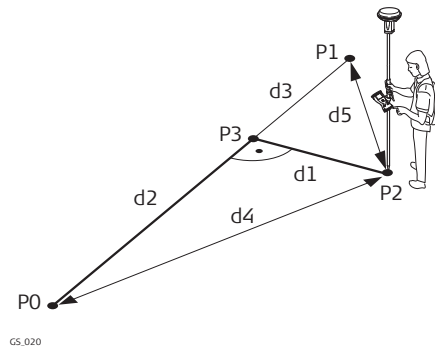
| Field                   | Option         | Description  |
|-------------------------|----------------|--|
| Line                    | Display only   | The current line.  |
| Slope direction         | Left down      | Creates a downward plane extending to the left of the defined line.  |
|                         | Right down     | Creates a downward plane extending to the right of the defined line. |
|                         | Left up        | Creates an upward plane extending to the left of the defined line.   |
|                         | Right up       | Creates an upward plane extending to the right of the defined line.  |
| Slope                   | Editable field | Inclination of the slope.  |
| Hinge horizontal offset | Editable field | Horizontal offset from the line that sets where the slope starts.    |
| Hinge vertical offset   | Editable field | Vertical offset from the line that sets where the slope starts.      |

**Description**

The horizontal and vertical position and the distance along line/chainage of a manually measured point can be calculated relative to the defined line.

Information can be measured and displayed in the **i** page, and then exported. Refer to [Settings, Info page](#).

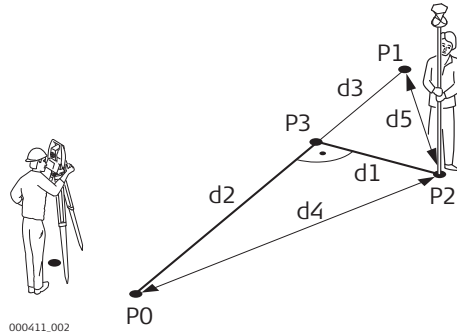
**Measure to line - straight segment - horizontal measurements**



GS\_020

**For GS:**

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 **Line offset**
- d2 **Distance along line**
- d3 **Line distance to end**
- d4 **Distance to start point**
- d5 **Distance to end point**

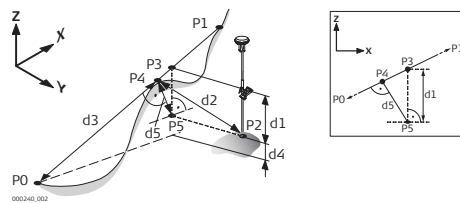


000411\_002

**For TS:**

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 **Line offset**
- d2 **Distance along line**
- d3 **Line distance to end**
- d4 **Distance to start point**
- d5 **Distance to end point**

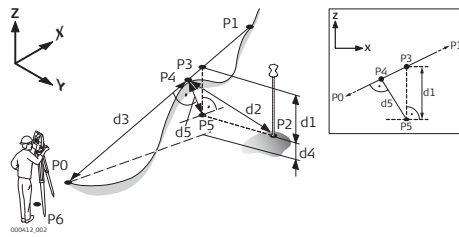
**Measure to line - straight segment - vertical measurements**



000240\_002

**For GS:**

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- P4 Perpendicular point
- P5 Horizontal base point
- d1 **Line height difference**
- d2 **Distance to 3D chainage point**
- d3 **3D chainage**
- d4 **Difference in height**
- d5 **Height difference at 3D chainage**

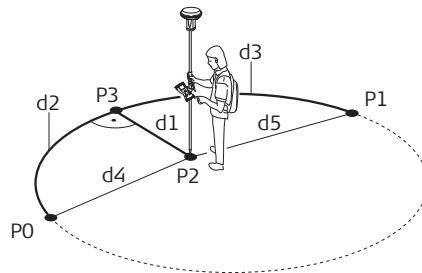


**For TS:**

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- P4 Perpendicular point
- P5 Horizontal base point
- P6 Instrument setup
- d1 **Line height difference**
- d2 **Distance to 3D chainage point**
- d3 **3D chainage**
- d4 **Difference in height**
- d5 **Height difference at 3D chainage**

**Measure to line - arc segment - horizontal measurements**

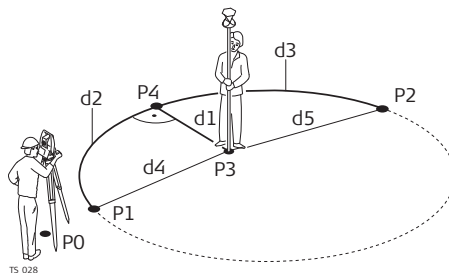
**Design point inside arc**



GS.022

**For GS:**

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 **Line offset**
- d2 **Distance along line**
- d3 **Line distance to end**
- d4 **Distance to start point**
- d5 **Distance to end point**

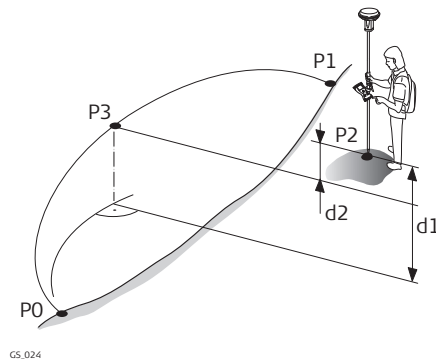


TS.028

**For TS:**

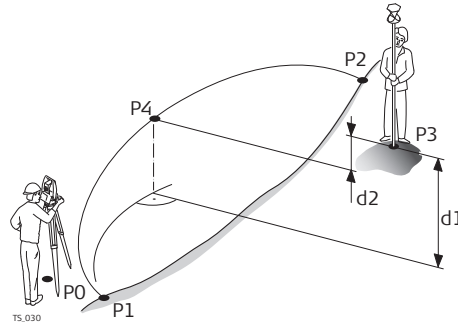
- P0 Instrument setup
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- d1 **Line offset**
- d2 **Distance along line**
- d3 **Line distance to end**
- d4 **Distance to start point**
- d5 **Distance to end point**

## Measure to line - arc segment - vertical measurements



### For GS:

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 **Difference in height**
- d2 **Line height difference**



### For TS:

- P0 Instrument setup
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- d1 **Difference in height**
- d2 **Line height difference**



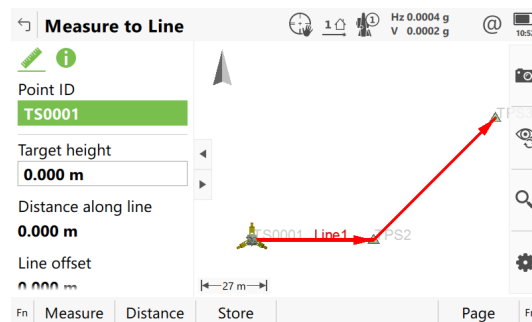
### Design point outside the range of the selected element:

When measuring outside of the defined lines, lines and arcs are extended in a straight projection tangent to the start/end of the line. For **Height: From line**, the start/end grade of the line is also extended. A warning appears when this is the case.

When working with segments, the same extension rules are applicable to the selected segment beyond its limits. For lines imported from a road alignment, heights are not extended outside the segment.

## Measure to Line, page

An additional page is available when a user-defined page is used.



| Key            | Description   |
|----------------|---|
| <b>Measure</b> | For GS:<br>To start measuring the point being staked. The key changes to <b>Stop</b> . The difference between the current position and the point being staked is still displayed. |
| <b>Measure</b> | For TS:<br>To measure a distance and store distance and angles.   |

| Key                                 | Description  |
|-------------------------------------|--|
| <b>Stop</b>                         | For GS:<br>To end measuring the point being staked. When <b>Automatically stop point measurement</b> is checked in <b>GS Quality Control, General</b> page recording of positions ends automatically as defined by the stop criteria. The key changes to <b>Store</b> .                                |
| <b>Store</b>                        | For GS:<br>To store the measured point. When <b>Automatically store point</b> is checked in <b>GS Quality Control, General</b> page, the measured point is stored automatically. The key changes to <b>Measure</b> .<br><br>For TS:<br>To store angles and distance. Distance must be measured before. |
| <b>Distance</b>                     | For TS:<br>To measure a distance.  |
| <b>Page</b>                         | To change to another page on this panel.   |
| <b>Fn Settings</b>                  | To configure the Measure to line/Stake to line app. Refer to <a href="#">44.3 Configuring Measure to line/Stake to line</a> .  |
| <b>Fn Connect and Fn Disconnect</b> | For GS:<br>To connect/disconnect from the reference data.  |
| <b>Fn Tools</b>                     | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

#### Description of fields

| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Point ID</b>            | Selectable list | The point ID of the point to be measured.   |
| <b>Antenna height</b>      | Editable field  | For GS:<br>The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style. |
| <b>Target height</b>       | Editable field  | For TS:<br>The last used target height is suggested. An individual target height can be typed in.   |
| <b>Chainage</b>            | Display only    | Chainage of the current position along the line. This value is the chainage of the start of the line plus <b>Distance along line</b> .  |
| <b>Distance along line</b> | Display only    | Horizontal distance from the start point to the reference point along the line.   |
| <b>Line offset</b>         | Display only    | Perpendicular offset from the line measured from the reference point to the measured point.   |
| <b>Height difference</b>   | Display only    | Difference between measured height and design height.   |

### Next step

**Page** changes to the user definable **i** page. Refer to [44.3 Configuring Measure to line/Stake to line](#) for information on all available items.

Displayed is in 3D viewer

- the horizontal distance or chainage along the line from the start point to the reference point.
- the perpendicular offset from the line measured from the reference point to the measured point.
- the cut/fill value.

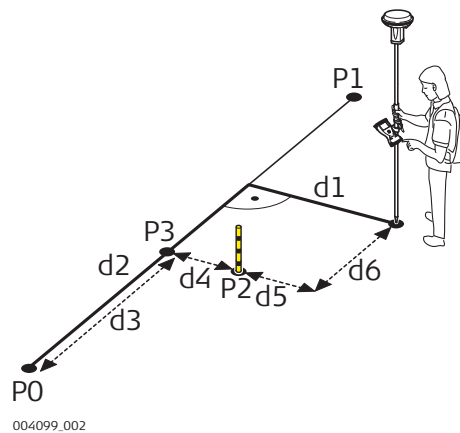
## 44.6

### Staking to a Line

#### Description

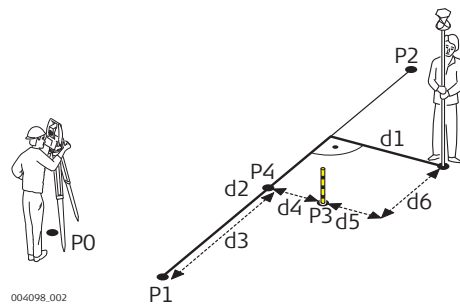
Allows for the position of a point to be defined relative to a line and then staked.

#### Stake to line - horizontal measurements



#### For GS:

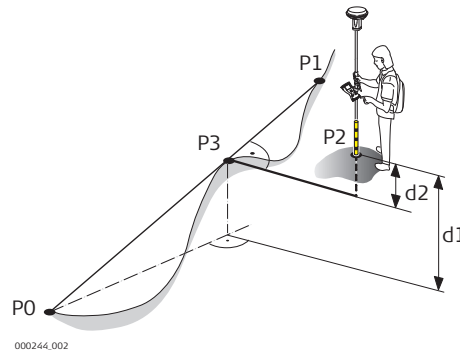
- P0 Start point
- P1 End point
- P2 Design point
- P3 Reference point
- d1 **Line offset**
- d2 **Distance along line**
- d3 **Defined line distance**
- d4 **Defined offset**
- d5 **Difference in offset**
- d6 **Difference in distance along line**



#### For TS:

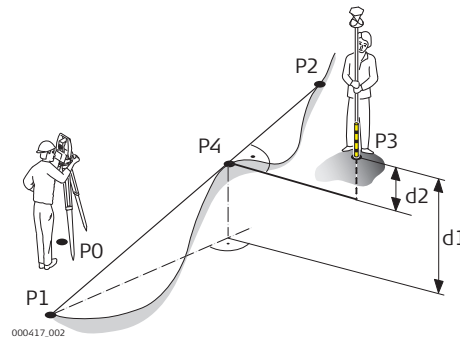
- P0 Instrument setup
- P1 Start point
- P2 End point
- P3 Design point
- P4 Reference point
- d1 **Line offset**
- d2 **Distance along line**
- d3 **Defined line distance**
- d4 **Defined offset**
- d5 **Difference in offset**
- d6 **Difference in distance along line**

## Stake to line - vertical measurements



### For GS:

- P0 Start point
- P1 End point
- P2 Design point
- P3 Reference point
- d1 **Height offset**, for **Height:Start point of line**
- d2 **Height offset**, for **Height:From line**



### For TS:

- P0 Instrument setup
- P1 Start point
- P2 End point
- P3 Design point
- P4 Reference point
- d1 **Height offset**, for **Height:Start point of line**
- d2 **Height offset**, for **Height:From line**

## Define Stake

This panel is for typing in the stakeout values for a point relative to the line. The fields available depend on the options chosen in the **Settings** panel.

Define Stake
Hz 0.0001 g  
V 0.0001 g

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| Line                              | Line_1049                           |
| Distance along line               | 0.000 m                             |
| Offset                            | 0.000 m                             |
| Height offset                     | 0.000 m                             |
| Use stake increments              | <input checked="" type="checkbox"/> |
| Increment                         | 10.000 m                            |
| Increment after storing           | No                                  |
| Use different increment on curves | <input type="checkbox"/>            |

Fn OK
Stake - Stake +
Fn

| Key                        | Description   |
|----------------------------|---|
| <b>OK</b>                  | To confirm the selections and to continue with the subsequent panel.  |
| <b>Stake -/Ch-</b>         | To decrease the distance along line/the chainage by <b>Increment</b> .  |
| <b>Stake +/Ch+</b>         | To increase the distance along line/the chainage by <b>Increment</b> .  |
| <b>Fn Settings</b>         | To configure the Measure to line/Stake to line app. Refer to <a href="#">44.3 Configuring Measure to line/Stake to line</a> . |
| <b>Fn Report</b>           | To view an alignment report. Refer to <a href="#">Save Line Report,Points page</a> .  |
| <b>Fn Start and Fn End</b> | To change between the start point and the end point of the line.  |

## Description of fields

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Line</b>  | Display only   | The name of the selected line.  |
| <b>Start chainage</b>                                    | Display only   | The chainage of the start point of a line.  |
| <b>Chainage</b>  | Editable field | Chainage along the line. Define this value as chainage of the start of the line plus a distance along the line.   |
| <b>Distance along line</b>                               | Editable field | Horizontal distance from the start point along the line to the design point.  |
| <b>Offset</b>  | Editable field | The offset from the line to the design point  |
| <b>Height offset</b>                                     | Editable field | The height offset of the design point. <ul style="list-style-type: none"> <li>For <b>Height:Start point of line</b><br/>The height of the design point is calculated as the height of the start point plus <b>Height offset</b>.</li> <li>For <b>Height:From line</b><br/>The height of the design point is calculated as the height of the reference point plus <b>Height offset</b>.</li> </ul>               |
| <b>Design height</b>                                     | Editable field | <ul style="list-style-type: none"> <li>For <b>Height:User entered</b><br/>The height of the design point is entered manually.</li> </ul>  |
| <b>Use stake increments/<br/>Use chainage increments</b> | Check box      | Activates the use of stake/chainage increments.   |
| <b>Increment</b>   | Editable field | Available when <b>Use stake increments</b> is checked. Stake/chainage increment to be used.   |
| <b>Increment after storing</b>                           |                | Sets behaviour of the stake/chainage after a point is stored. <ul style="list-style-type: none"> <li><b>No</b><br/>Does not change the stake/chainage after a point is stored.</li> <li><b>Increase</b><br/>Proceeds to the next point up stake/chainage after each stored staked point.</li> <li><b>Decrease</b><br/>Proceeds to the next point down stake/chainage after each stored staked point.</li> </ul> |
| <b>Use different increment on curves</b>                 | Check box      | Option to use a different chainage increment along a curve.   |
| <b>Increment</b>   | Editable field | Available when <b>Use different increment on curves</b> is checked. Chainage increment to be used along the small radius curve.   |



| Field                                    | Option         | Description  |
|--|----------------|--|
| <b>Only for curves under a radius of</b> | Editable field | Available when <b>Use different increment on curves</b> is checked. Defines the threshold value of a small radius curve. For example, a curve with a radius smaller than this value, uses the chainage increment defined in the following field. |

### Next step

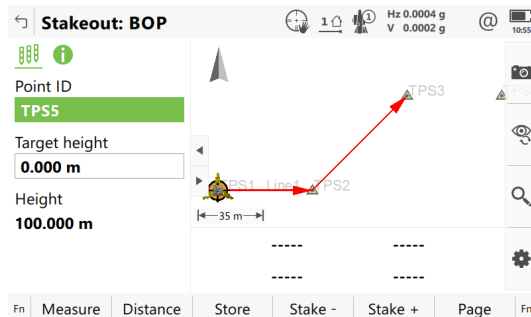
**OK** to accept changes and continue to **Stake Points**.

## Stake Points, page

Once in the **Stake Points** panels, the user is guided to reach design positions. The functionality of this panel is similar to the **Stake Points** panel. Differences between the two panels are outlined here. Refer to paragraph [54.4 Staking Out](#) for all other key and field explanations.

In the title bar is a description of where the stake point is on the alignment. This description can come from the position of the defined stake point along the line or a point of intersection. For points of interest, refer to [Points of interest](#).

The availability of the fields depends on the settings in **Settings, General** page.



| Key                | Description  |
|--------------------|--|
| <b>Stake -/Ch-</b> | To decrease the distance along line/the chainage by <b>Increment</b> . |
| <b>Stake +/Ch+</b> | To increase the distance along line/the chainage by <b>Increment</b> . |
| <b>Fn Tools</b>    | Refer to <a href="#">39 Apps - The Toolbox</a> .                       |

### Description of fields

| Field                | Option         | Description  |
|----------------------|----------------|--|
| <b>Point ID</b>      | Editable field | The point ID of the point to be staked.  |
| <b>Target height</b> | Editable field | For TS:<br>The last used target height as defined is suggested. An individual target height can be typed in. |

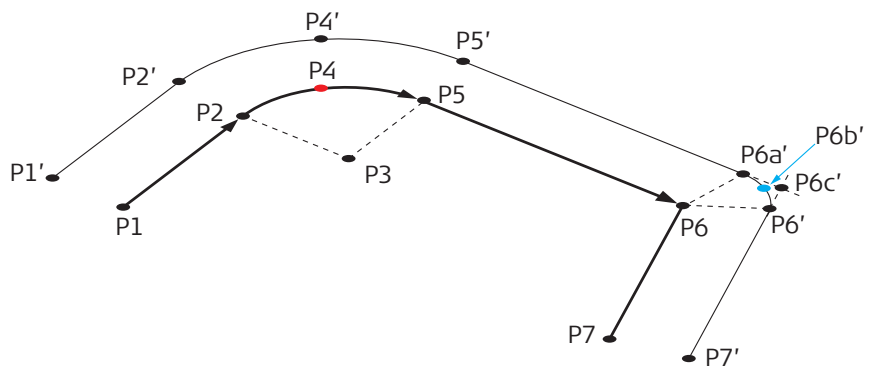
| Field                 | Option         | Description   |
|-----------------------|----------------|---|
| <b>Antenna height</b> | Editable field | For GS:<br>The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style. |
| <b>Chainage</b>       | Editable field | The current chainage to be staked.  |
| <b>Offset</b>         | Editable field | Current offset being staked.  |
| <b>Height</b>         | Display only   | Measured elevation. The orthometric height of the current position is displayed.  |
| <b>Height</b>         | Editable field | Design elevation. The orthometric height of the point to be staked is displayed.  |

### Next step

If configured, the **Results** panel is displayed.

### Points of interest

Points of interest are staked out if they appear within the defined **Ch-/Ch+ / Stake -/Stake +** range and if checked in **Settings, Design** page. Refer to [Settings, Design](#) page.



000262.002

On the original line:

On the offsetted line:

|    |   |      |  |
|----|---|------|--|
| P1 | BOP - Beginning of project                            | P1'  | Offset BOP - Beginning of project                            |
| P2 | PC - Beginning of curve                               | P2'  | Offset PC - Beginning of curve                               |
| P3 | RP - Radius point of the centre of the curve          | P4'  | Offset MCP - Mid point curve                                 |
| P4 | MCP - Mid point curve                                 | P6'  | AP-F - Offset angle point projected to the next segment      |
| P5 | PT - End of curve section - Start of straight segment | P5'  | Offset PT - End of curve section - Start of straight segment |
| P6 | AP - Angle point                                      | P6a' | AP-B - Offset angle point projected to the previous segment  |
| P7 | EOP - End of project                                  | P6b' | AVG - Offset in average direction                            |
|    |   | P6c' | BP - Offset bisected point                                   |
|    |   | P7'  | EOP - End of project   |

General terms:

- Curve - Along a curve section
- Extension - Along an extended part of the line
- Curve mid point - Mid curve point
- Straight - Along a straight section
- VPI - Vertical intersection point
- Offset PI avg - Offset intersection point average element

## Results, General page

If **View results after staking a point** is checked in **Settings, General** page, this panel opens automatically once a point is measured and stored.

**BOP, Straight** Hz 0.0001 g V 0.0001 g 1058

General Coords Code 3D viewer

|                 |         |
|-----------------|---------|
| Point ID        | TS0001  |
| Chainage        | 0.000 m |
| Offset          | 0.000 m |
| Design height   | 0.000 m |
| Measured height | 1.500 m |
| Cut             | 1.500 m |

Annotation 1 **STA0.00 L0.00 C1.50**

Store Edit Page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To return to the stake panel.  |
| <b>Edit</b> | To add a vertical offset to the design height and to display the new height. |
| <b>Page</b> | To change to another page on this panel.                                     |

### Description of fields

| Field           | Option         | Description                                |
|-----------------|----------------|--|
| <b>Point ID</b> | Editable field | The point ID of the point staked.          |
| <b>Chainage</b> | Display only   | The chainage measured at the stored point. |

| Field                  | Option         | Description   |
|------------------------|----------------|---|
| <b>Offset</b>          | Display only   | The offset from the alignment measured at the stored point.                             |
| <b>Design height</b>   | Display only   | The entered design elevation.   |
| <b>Measured height</b> | Display only   | The height measured at the stored point.  |
| <b>Cut/Fill</b>        | Display only   | The height difference between the <b>Design height</b> and the <b>Measured height</b> . |
| <b>Annotation 1</b>    | Display only   | Fixed value recorded for certain software packages.                                     |
| <b>Annotation 2</b>    | Editable field | Available for extra notes.  |

### Next step

**Page** changes to the **Coords** page. This page displays the design coordinates as well as the differences between design and measured coordinates.

**Page** changes to the **Code** where codes can be selected or typed in.

3D viewer provides an interactive display of the data.

## 44.7

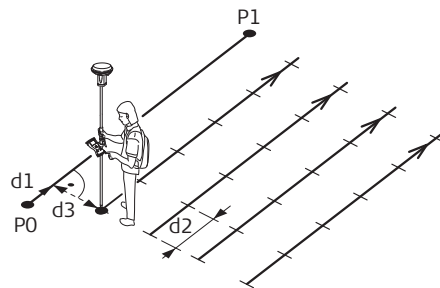
### Gridstaking to a Line

#### Description

A grid can be defined relative to a line and points staked out in that defined grid.

#### Stake grid from line

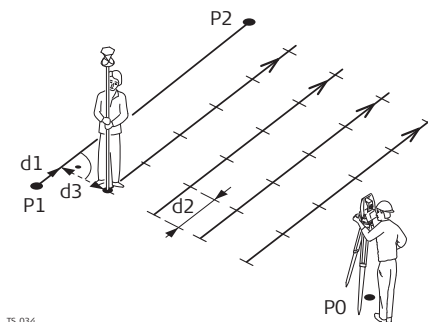
##### In same direction



GS\_026

#### For GS:

- P0 Start point
- P1 End point
- d1 **Distance along line to first grid point**
- d2 Grid spacing along line
- d3 Grid spacing across line

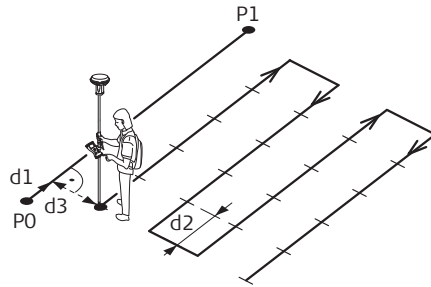


TS\_034

#### For TS:

- P0 Instrument setup
- P1 Start point
- P2 End point
- d1 **Distance along line to first grid point**
- d2 Grid spacing along line
- d3 Grid spacing across line

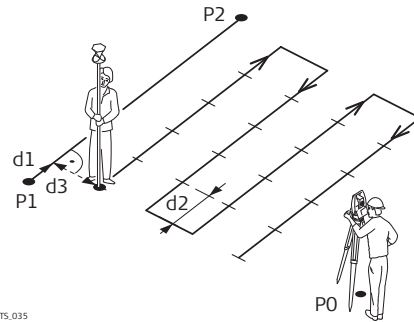
## In reverse direction



GS.027

### For GS:

- P0 Start point
- P1 End point
- d1 **Distance along line to first grid point**
- d2 Grid spacing along line
- d3 Grid spacing across line



TS.035

### For TS:

- P0 Instrument setup
- P1 Start point
- P2 End point
- d1 **Distance along line to first grid point**
- d2 Grid spacing along line
- d3 Grid spacing across line

## Define Grid

← Define Grid

Hz 0.0004 g  
V 0.0002 g

 10:59

Distance along line to first grid point 0.000 m

Grid spacing

Across line

Along line

Stake next grid line

Store point using

Fn
OK
Fn

| Key | Description  |
|-----|--|
| OK  | To confirm the selections and to continue with the subsequent panel. |

### Description of fields

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Distance along line to first grid point</b> | Editable field | Chainage of the first design point to be staked along the line. |
| <b>Across line</b>                             | Editable field | Spacing between grid lines.                                     |
| <b>Along line</b>                              | Editable field | Spacing between points on the grid line.                        |
| <b>Stake next grid line</b>                    |                | Method by which the grid is staked out.                         |

| Field                    | Option                      | Description  |
|--------------------------|-----------------------------|--|
|                          | <b>In same direction</b>    | Each new grid line is started at the same end as where the previous grid line started.   |
|                          | <b>In reverse direction</b> | Each new grid line is started at the same end as where the previous grid line finished.  |
| <b>Store point using</b> |                             | Determines the format of the point ID for grid points.   |
|                          | <b>Grid reference</b>       | Point ID is shown as the position of the grid being staked, where +yyy.yy is the chainage position along the grid line, and +xxx.xx is the grid line offset.       |
|                          | <b>Point ID template</b>    | The point ID template as defined in the active working style is used. The point ID template can be defined in <b>Leica Captivate - Home:SettingsID templates</b> . |

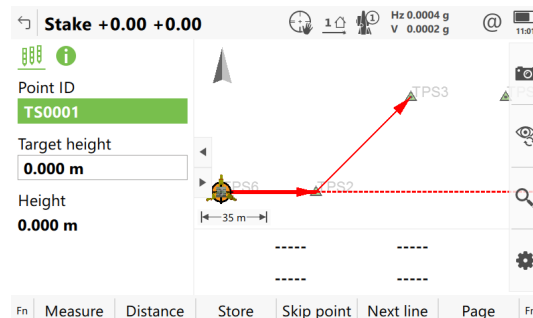
### Next step

**OK** to accept changes and continue to the Stakeout panel.

### Stake +yyy.yy +xxx.xx

The title of this panel indicates the position of the grid being staked, where +yyy.yy is the chainage position along the grid line, and +xxx.xx is the grid line offset.

The functionality of this panel is similar to the **Stake Points** panel. Differences between the two panels are outlined here. Refer to paragraph [54.4 Staking Out](#) for all other key and field explanations.



| Key                           | Description   |
|-------------------------------|---|
| <b>Flip view or Flip view</b> | To reverse the graphical display top to bottom. A reversed graphical display can be used when the point to be staked lies behind the current position.                        |
| <b>Skip point</b>             | To skip the currently displayed chainage and increment to the next chainage. Available when <b>Measure</b> is displayed.  |
| <b>Next line</b>              | To start staking the next grid line. Moves grid stake point to the next line (right) in the grid. There is no automatic <b>Next line</b> when the end of the line is reached. |

### Description of fields

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Point ID</b>       | Editable field | The point ID of the grid point to be staked. The point ID is based on the selection for <b>Store point using</b> in <b>Define Grid</b> . If a different point ID is typed in, the next point ID will still be shown as the next automatically computed point ID. |
| <b>Target height</b>  | Editable field | For TS:<br>The last used target height as defined is suggested. An individual target height can be typed in.   |
| <b>Antenna height</b> | Editable field | For GS:<br>The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style.  |
| <b>Height</b>         | Editable field | Design elevation. The orthometric height of the point to be staked is displayed.   |

### Next step

Displayed is in 3D viewer

- the horizontal distance from the current position to the point to be staked.
- the height difference from the height of the current position to the height of the point to be staked.

45.1

Overview

Description

The Reference Plane & Grid Scan app can be used to measure points relative to a reference plane.

For TS: Any surface can also be grid scanned. It is possible to measure either a regular grid on a predefined reference plane or any surface with an angle-based resolution.

Reference Plane & Grid Scan tasks

The Reference Plane & Grid Scan app can be used for the following tasks:

- Measuring points to calculate and store the perpendicular distance to the plane.
- Viewing and storing the instrument and/or local coordinates of the measured points.
- Viewing and storing the height difference from the measured points to the plane.
- For TS: Grid Scan a defined area on a predefined reference plane with a regular grid or on any surface with an angle-based resolution.



Planes can only be computed with grid coordinates.



For TS: Face scan is available for instruments with reflectorless EDM.

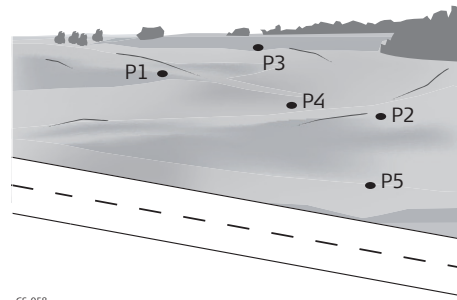
Activating the app

The Reference Plane & Grid Scan app must be activated using a licence key. Refer to [30.3 Entitlements & licences](#) for information on how to activate the app.

Defining a reference plane

Reference planes are created using a right-hand system. For two points defining a plane, a vertical plane is used. A reference plane is defined with the X axis and the Z axis of the plane. The Y axis of the plane defines the positive direction of the plane. A reference plane can be defined in the following ways:

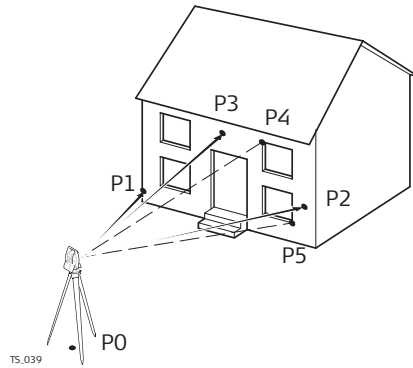
- vertical
- tilted
- horizontal



For GS:

- P1 Point defining reference plane
- P2 Point defining reference plane
- P3 Point defining reference plane
- P4 Point defining reference plane
- P5 Point defining reference plane





**For TS:**

- P0 Instrument setup
- P1 Point defining reference plane
- P2 Point defining reference plane
- P3 Point defining reference plane
- P4 Measured point
- P5 Measured point



- For GS: **Measure to plane** is applicable for tilted and horizontal plane definitions.
- For TS: **Measure to plane** and **Grid scan on plane** is applicable for tilted and horizontal plane definitions.

**Tilted plane**

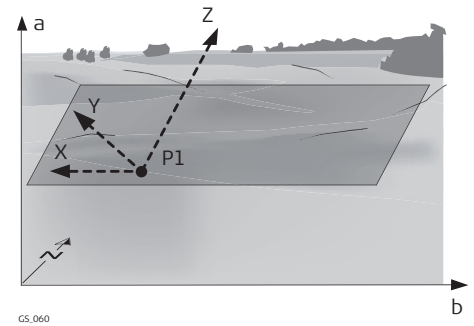
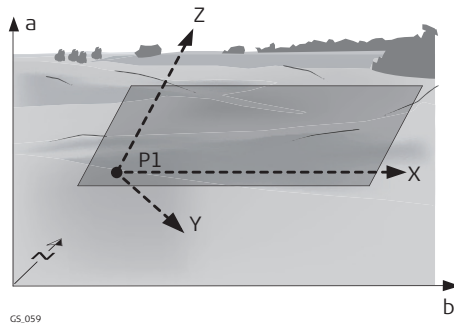
Any number of points define the plane. The axes of the tilted reference plane are:

| Axis | Description   |
|------|---|
| X    | Horizontal and parallel to the plane                              |
| Z    | Defined by steepest direction of the plane                        |
| Y    | Perpendicular to the plane; increases in the direction as defined |

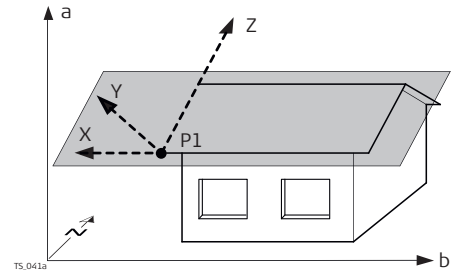
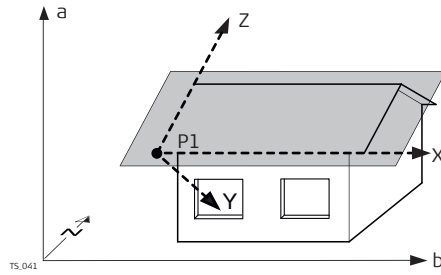


Offsets are applied in the direction of the Y axis.

For GS:




For TS:



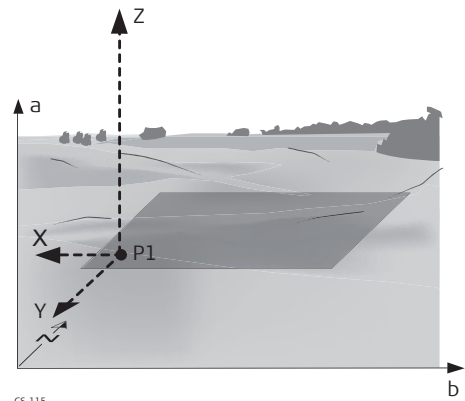
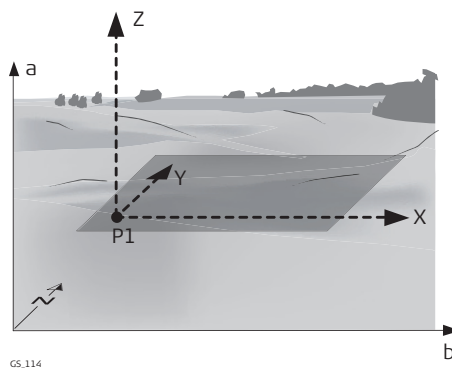
- a Height
- b Easting
- N Northing
- P1 Origin of plane
- X X axis of plane
- Y Y axis of plane
- Z Z axis of plane

## Horizontal plane

The axes of the horizontal reference plane are:

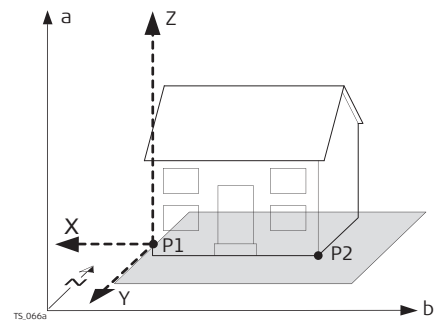
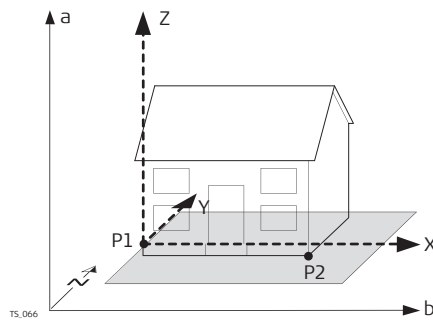
| Axis  | Description   |
|---|---|
| X   | Horizontal and parallel to the plane                              |
| Z   | Perpendicular to the plane; increases in the direction as defined |
| Y   | Parallel to the plane   |
|  | Offsets are applied in the direction of the Z axis.               |

For GS:



- a Height
- b Easting
- N Northing
- P1 Origin of plane
- X X axis of plane
- Y Y axis of plane
- Z Z axis of plane


For TS:

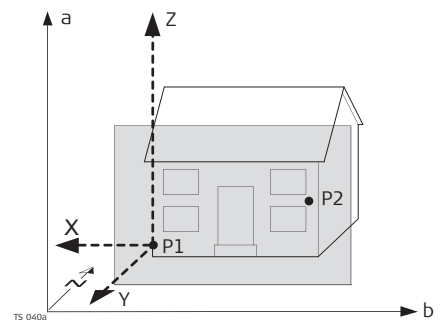
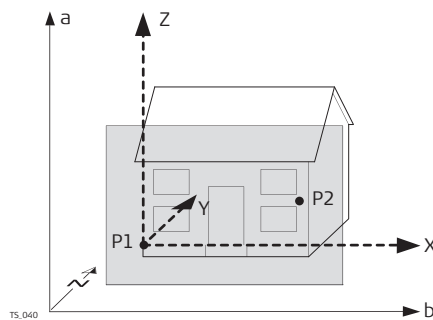


- a Height
- b Easting
- N Northing
- P1 Origin of plane
- P2 Point of plane
- X X axis of plane
- Y Y axis of plane
- Z Z axis of plane

### Vertical plane for TS

The axes of the vertical reference plane are:

| Axis  | Description  |
|---|--|
| X   | Horizontal and parallel to the plane; X axis starts in point defined as origin point |
| Z   | Parallel to the instrument zenith and parallel to the plane                          |
| Y   | Perpendicular to the plane; increases in the direction as defined                    |
|  | Offsets are applied in the direction of the Y axis.                                  |



- a Height
- b Easting
- N Northing
- P1 Origin of plane
- P2 Point of plane
- X X axis of plane
- Y Y axis of plane
- Z Z axis of plane



With four or more points, a least squares adjustment is calculated resulting in a best fit plane.

### Origin

The origin of the reference plane can be defined to be in the plane coordinates or in relation to the national coordinate system.

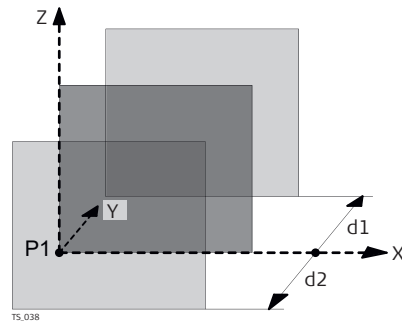
### Grid orientation

The orientation of the grid is part of a reference plane. The orientation is defined during the reference plane definition and can be changed when editing a reference plane.

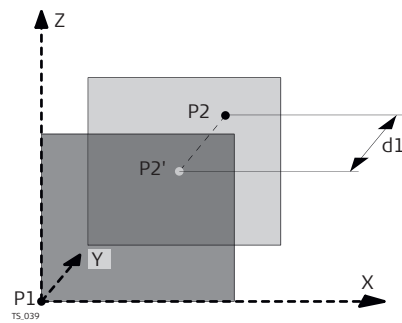
### Positive direction of plane

The positive direction of the plane is defined by the direction of the Y axis. The direction of the Y axis can be redefined by selecting a point on the desired side of the plane.

### Offset of the plane



- P1 Origin of plane
- X X axis of plane
- Y Y axis of plane
- Z Z axis of plane
- d1 Positive offset
- d2 Negative offset



- P1 Origin of plane
- P2 Point defining offset of plane
- P2' P2 projected on original plane
- d1 Offset defined by P2
- X X axis of plane
- Y Y axis of plane
- Z Z axis of plane

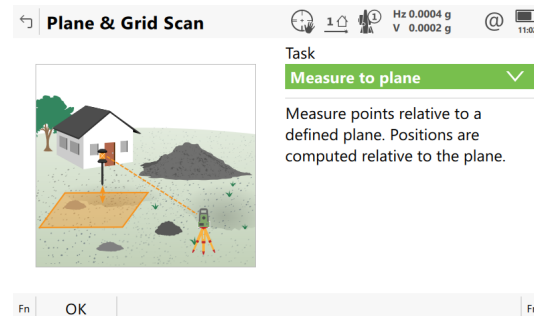
## 45.2

## Accessing Reference Plane & Grid Scan

### Access

Select **Leica Captivate - Home: Meas plane/grid.**

### Plane & Grid Scan



| Key         | Description   |
|-------------|---|
| OK          | To accept changes and to continue with the subsequent panel.  |
| Fn Settings | To configure the reference plane. Refer to <a href="#">45.5 Configuring Reference Plane &amp; Grid Scan</a> . |

### Description of the Reference Plane & Grid Scan tasks

| Task                 | Description  |
|----------------------|--|
| Measure to plane     | The coordinates of measured points are calculated relative to the reference plane.     |
| Grid scan on plane   | For TS:<br>Measures a regular grid on a defined reference plane within a defined area. |
| Grid scan on surface | For TS:<br>Measures any surface within a defined area.                                 |

### Next step

| IF   | THEN  |
|--|---|
| Task: Measure to plane or Grid scan on plane | <p><b>OK.</b></p> <ul style="list-style-type: none"> <li>To create a plane by measuring points, enter a name for the reference plane. New points can be measured by starting the Measure app.</li> <li>To create a plane from previously stored points, enter a name for the reference plane. Refer to <a href="#">45.3 Creating a Reference Plane From Previously Stored Points</a>.</li> <li>For selecting an existing reference plane from a job, refer to <a href="#">45.4 Selecting a Reference Plane from a Job</a>. Only available when a reference plane has already been stored in the current job.</li> </ul> |
| Task: Grid scan on surface                   | <b>OK</b> accesses <b>Define Grid Scan Area</b> . Refer to <a href="#">45.9 Grid Scan on Surface - TS</a> .   |

## 45.3

### Creating a Reference Plane From Previously Stored Points

#### Access step-by-step

- In **Plane & Grid Scan**, select **Create a new plane from previously stored points**.
- Press **OK**.
- In **New Plane**, type in the name of the reference plane.
- Press **OK**.

## New Plane, General page

**New Plane** Hz 0.0001 g V 0.0001 g 11:04

General Points 3D viewer

Plane name **333**

Number of points **0**

Standard deviation -----

Greatest distance of any point from plane -----

OK Page

| Key  | Description                              |
|------|--|
| OK   | To continue to the next panel.           |
| Page | To change to another page on this panel. |

### Description of fields

| Field  | Option       | Description  |
|--|--------------|--|
| <b>Plane name</b>                                | Display only | The name of the new reference plane.   |
| <b>Number of points</b>                          | Display only | Number of points used for plane definition.  |
| <b>Standard deviation</b>                        | Display only | Standard deviation of used points for plane definition. ----- is displayed unless more than four points are used to define the plane.    |
| <b>Greatest distance of any point from plane</b> | Display only | Maximum distance between measured point and defined plane. ----- is displayed unless more than four points are used to define the plane. |

### Next step

**Page** changes to the **Points** page.

## New Plane, Points page

- **Yes** is shown in the **Source point** metadata for a point which is used as origin of the plane.
- **!** is shown in the **Out of limit** metadata if the point is outside maximum distance between a point and the calculated plane as defined on the **General** page.
- $\Delta d$  is the perpendicular distance of the point from the definition of the plane.

**New Plane** Hz 0.0010 g V 0.0002 g 11:06

General **Points** 3D viewer

| Name        | Dist diff (m) | Out of limit | Source point     |
|-------------|---------------|--------------|------------------|
| <b>TPS3</b> | 0.000         | ---          | Use Yes          |
|             |               |              | Source point --- |
| <b>TPS2</b> | 0.000         | ---          | Use Yes          |
|             |               |              | Source point --- |
| <b>TPS1</b> | 0.000         | ---          | Use Yes          |
|             |               |              | Source point Yes |

Fn OK Add point Use Delete Page Fn

| Key       | Description  |
|-----------|--|
| OK        | To continue to the next panel.   |
| Add point | To add points from the job to define the reference plane. Available when creating a plane from previously stored points. |
| Use       | To change between <b>Yes</b> and <b>No</b> in the <b>Use</b> for the highlighted point.                                  |
| Delete    | To remove the highlighted point from the list.   |
| Meas app  | To measure a point to be used for the plane. Available when creating a plane by measuring new points.                    |
| Page      | To change to another page on this panel.   |

### Next step

Page changes to the **3D viewer** page.

## Plane Coordinate System

This panel is displayed if **Use local plane coordinate system** is checked in **Configuration, Parameters** page.

| Key      | Description   |
|----------|---|
| OK       | To compute and store the reference plane.   |
| Meas app | Available when <b>Point</b> is highlighted. To measure a point to define the plane direction. |

### Description of fields

| Field                | Option          | Description  |
|----------------------|-----------------|--|
| Current origin point | Display only    | Point which has been selected as origin point.   |
| X coordinate         | Editable field  | Enter local X coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane. |
| Z coordinate         | Editable field  | Enter local Z coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane. |
| Point                | Selectable list | Defines the direction of the Y axis.   |

## Plane Grid Orientation

Choose how you want to define the grid orientation on the reference plane.

| Key | Description                    |
|-----|--------------------------------|
| OK  | To continue to the next panel. |

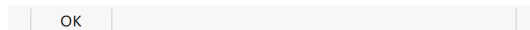
#### Description of fields

| Field   | Option          | Description   |
|---|-----------------|---|
| <b>Current origin point</b>                                 | Display only    | Point which has been selected as origin point.  |
| <b>Use the fall line of the plane</b>                       | Option button   | The fall line is the line of greatest slope. The fall line is a curve following the steepest slope. It is always orthogonal to the contour lines. The gradient of the height determines the fall line mathematically. |
| <b>Select a point of the plane besides the origin point</b> | Option button   | The origin point and another point on the reference plane define the orientation.   |
| <b>Orientation Point</b>                                    | Selectable list | Available when <b>Select a point of the plane besides the origin point</b> is selected. The point which defines the orientation together with the origin point.   |

#### Next step

OK changes to the **Offset of Plane**.

## Offset of Plane



| Key             | Description   |
|-----------------|---|
| OK              | To compute and store the reference plane.   |
| <b>Meas app</b> | Available when <b>Offset pt ID</b> is highlighted. To measure a point to define the offset point. |

#### Description of fields

| Field               | Option          | Description   |
|---------------------|-----------------|---|
| <b>Offset plane</b> | Selectable list | An offset is defined by a point or a distance. The defined plane is shifted along the Y axis by the offset. |
| <b>Offset pt ID</b> | Selectable list | Available for <b>Offset plane:Offset to a point</b> . Point ID of offset point.                             |



| Field         | Option                         | Description   |
|---------------|--------------------------------|---|
| <b>Offset</b> | Display only or editable field | Distance by which to offset the plane along the Y axis.<br>For <b>Offset plane:Offset by distance</b> , the distance can be entered.<br>For <b>Offset plane:Offset to a point</b> , the calculated distance to the adjusted plane is displayed. ----- if no values are available. |

## 45.4

### Selecting a Reference Plane from a Job

#### Access

In **Plane & Grid Scan**, select **Select an existing plane**. Press **OK**. Highlight **Plane name**. Press **ENTER**.

Available if a reference plane has already been stored in the current job.

#### Planes in Job



| Key           | Description                                |
|---------------|--|
| <b>OK</b>     | To select the highlighted reference plane. |
| <b>Delete</b> | To delete the highlighted reference plane. |

#### Description of metadata

Information about date and time of when the reference plane was created and the number of points defining the plane.

## 45.5

### Configuring Reference Plane & Grid Scan

#### Description

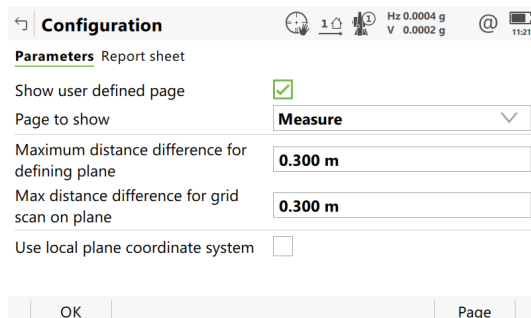
Allows options to be set which are used within the app. These settings are stored within the working style.

#### Access

Select **Leica Captivate - Home: Meas plane/grid**.

Press **Fn Settings**.

#### Configuration, Parameters page



| Key  | Description  |
|------|--|
| OK   | To accept changes and return to the panel from where this panel was accessed.  |
| Edit | To edit the page currently being displayed. Available when a list item in <b>Page to show</b> is highlighted. Refer to <a href="#">27.2 User defined pages</a> . |
| Page | To change to another page on this panel.   |

#### Description of fields

| Field  | Option          | Description  |
|--|-----------------|--|
| Show user defined page                         | Check box       | When this box is checked, pages can be selected.   |
| Page to show                                   | Selectable list | The names of the available pages.  |
| Maximum distance difference for defining plane | Editable field  | The maximum perpendicular deviation of a point from the calculated plane.  |
| Max distance difference for grid scan on plane | Editable field  | For TS:<br>The maximum perpendicular deviation of a measured point in grid scan on plane from defined plane. Measured points outside the defined limit are not stored.   |
| Use local plane coordinate system              | Check box       | When this box is checked, then point results are additionally stored with X, Y, Z coordinates based on the local plane coordinate system. The panel <b>Plane Coordinate System</b> is displayed in the reference plane definition workflow. Local coordinates and the positive direction of the reference plane can be defined.<br>When this box is not checked, then points on the plane are transformed into the global coordinate system. |

#### Next step

Page changes to the **Report sheet** page. Refer to [38 Apps - General](#).

## 45.6

### Editing a Reference Plane

#### Access

After creating or selecting a reference plane, select **Edit plane currently being used** in **Measure to Plane** or **Grid Scan on Plane**.

#### Edit Plane, General page

| Key  | Description                               |
|------|---|
| OK   | To compute and store the reference plane. |
| Page | To change to another page on this panel.  |

### Description of fields

| Field                                     | Option         | Description  |
|---|----------------|--|
| Plane name                                | Editable field | The name of the reference plane.   |
| Number of points                          | Display only   | Number of points used for plane definition.  |
| Standard deviation                        | Display only   | Standard deviation of used points for plane definition. ----- is displayed unless more than four points are used to define the plane.    |
| Greatest distance of any point from plane | Display only   | Maximum distance between measured point and defined plane. ----- is displayed unless more than four points are used to define the plane. |

### Next step

Page changes to the **Points** page.

### Edit Plane, Points page

- ✓ is shown in the **Source point** metadata for a point which is used as origin of the plane.
- ! is shown in the **Out of limit** metadata if the point is outside maximum distance between a point and the calculated plane as defined on the **General** page.
- $\Delta d$  is the perpendicular distance of the point from the definition of the plane.

| Key       | Description   |
|-----------|---|
| OK        | To compute and store the reference plane.                             |
| Add point | To add points from the job to define the reference plane.             |
| Use       | To change between <b>Yes</b> and <b>No</b> for the highlighted point. |
| Delete    | To remove the highlighted point from the list.                        |
| Meas app  | To measure a point to be used for the plane.                          |
| Page      | To change to another page on this panel.                              |

### Next step

Page changes to the **Origin** page.

### Edit Plane, Origin page

| Key      | Description   |
|----------|---|
| OK       | To compute and store the reference plane.   |
| Meas app | Available when <b>Point</b> is highlighted. To measure a point to define the plane direction. |
| Page     | To change to another page on this panel.  |

### Description of fields

| Field                                    | Option          | Description  |
|--|-----------------|--|
| <b>Use local plane coordinate system</b> | Check box       | When this box is checked, then point results are additionally stored with X, Y, Z coordinates based on the local plane coordinate system.<br>When this box is not checked, then points on the plane are transformed into the global coordinate system. |
| <b>Current origin point</b>              | Display only    | The point which has been selected as origin point.   |
| <b>X coordinate</b>                      | Editable field  | Enter local X coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane.   |
| <b>Z coordinate</b>                      | Editable field  | Enter local Z coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane.   |
| <b>Point</b>                             | Selectable list | Defines the direction of the Y axis.   |

### Next step

Page changes to the **Orientation** page.

### Edit Plane, Orientation page

Choose how you want to define the grid orientation on the reference plane.

| Key | Description                    |
|-----|--------------------------------|
| OK  | To continue to the next panel. |

### Description of fields

| Field   | Option          | Description   |
|---|-----------------|---|
| <b>Current origin point</b>                                 | Display only    | Point which has been selected as origin point.  |
| <b>Use the fall line of the plane</b>                       | Option button   | The fall line is the line of greatest slope. The fall line is a curve following the steepest slope. It is always orthogonal to the contour lines. The gradient of the height determines the fall line mathematically. |
| <b>Select a point of the plane besides the origin point</b> | Radio button    | The origin point and another point on the reference plane define the orientation.   |
| <b>Orientation Point</b>                                    | Selectable list | Available when <b>Select a point of the plane besides the origin point</b> is selected. The point which defines the orientation together with the origin point.   |

### Next step

Page changes to the **Offset** page.

### Edit Plane, Offset page

| Key             | Description   |
|-----------------|---|
| <b>OK</b>       | To compute and store the reference plane.   |
| <b>Meas app</b> | Available when <b>Offset pt ID</b> is highlighted. To measure a point to define the offset point. |
| <b>Page</b>     | To change to another page on this panel.  |

### Description of fields

| Field                       | Option                         | Description   |
|-----------------------------|--------------------------------|---|
| <b>Use offset for plane</b> | Check box                      | When this box is checked, an offset can be defined for the reference plane.   |
| <b>Offset plane</b>         | Selectable list                | An offset is defined by a point or a distance. The defined plane is shifted along the Y axis by the offset.   |
| <b>Offset pt ID</b>         | Selectable list                | Available for <b>Offset plane:Offset to a point</b> . Point ID of offset point.   |
| <b>Offset</b>               | Display only or editable field | Distance by which to offset the plane along the Y axis.<br>For <b>Offset plane:Offset by distance</b> , the distance can be entered.<br>For <b>Offset plane:Offset to a point</b> , the calculated distance to the adjusted plane is displayed. ----- if no values are available. |

### Next step

The **3D viewer** page shows a graphical view of the reference plane.

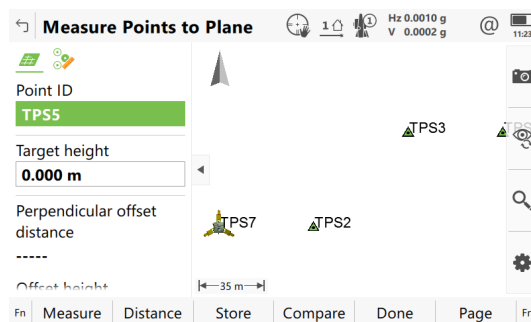
## 45.7

## Measuring Points to a Reference Plane

### Access

After creating or selecting a reference plane, select **Measure to plane** in **Measure to Plane**.

### Measure Points to Plane, page



| Key            | Description  |
|----------------|--|
| <b>Measure</b> | For GS:<br>To start measuring the point. The key changes to <b>Stop</b> . The difference between the current position and the adjusted plane is displayed. |

| Key             | Description  |
|-----------------|--|
| <b>Stop</b>     | For GS:<br>To end measuring the point. The key changes to <b>Store</b> .<br>After ending the measurement, the differences between the measured point and the adjusted plane are displayed. |
| <b>Measure</b>  | For TS:<br>To measure a distance and store distance and angles.  |
| <b>Distance</b> | For TS:<br>To measure a distance.  |
| <b>Store</b>    | To store the point information.  |
| <b>Compare</b>  | To calculate offsets to previously measured points.  |
| <b>Done</b>     | To finish measuring points.  |
| <b>Fn Tools</b> | Refer to <a href="#">39 Apps - The Toolbox</a> .   |

#### Description of fields

| Field   | Option         | Description   |
|---|----------------|---|
| <b>Point ID</b>                                 | Editable field | The number of the measured point.   |
| <b>Target height</b>                            | Editable field | For TS:<br>The target height.   |
| <b>Antenna height</b>                           | Editable field | For GS:<br>The height of the antenna.   |
| <b>Perpendicular offset distance</b>            | Display only   | The perpendicular distance between the measured point and the adjusted plane.                         |
| <b>Offset height</b>                            | Display only   | The vertical distance between the measured point and the adjusted plane.                              |
| <b>X coordinate, Y coordinate, Z coordinate</b> | Display only   | Available when <b>Use local plane coordinate system</b> is checked in <b>Edit Plane, Origin</b> .     |
| <b>Easting, Northing, Height</b>                | Display only   | Available when <b>Use local plane coordinate system</b> is not checked in <b>Edit Plane, Origin</b> . |

## 45.8

### Grid Scan on Plane - TS

#### Description

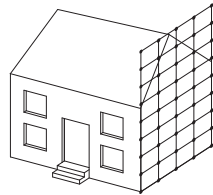
Grid scan on plane automates the process of measuring a sequence of points along the defined vertical, tilted or horizontal reference plane. The window of interest can be either rectangular or polygonal. The boundaries of the window of interest and the increment values can be defined. Grid scan on plane can be run on instruments with the option "reflectorless EDM" only.

#### Access step-by-step

1. After creating or selecting a reference plane, select **Grid scan plane** in **Grid Scan on Plane**.
2. Press **OK**.

3. Choose between:
    - **Rectangular area:** Two opposite corner points define the rectangular grid scan area. The area must be defined from the first to the second point. Grid scan areas bigger than 180° are not allowed.
    - **Polygonal area:** Three or more clockwise measured points define the polygonal grid scan area. The polygonal grid scan area is calculated based on the sequence of the points. Grid scan areas bigger than 180° are not allowed.
- 
4. Press **OK**.

## Diagram



TS.120



### Known

P0 Setup

### Unknown

Grid point coordinates

## Measure corner


For a rectangular grid scan area, measure two points at opposite corners.  
 For a polygonal grid scan area, measure all corner points in consecutive order.

| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To either measure another corner point of the grid scan area or to start grid scanning the area.                            |
| <b>Done</b> | For polygonal areas, this key appears for the first time after the third measured point.                                    |
| <b>Page</b> | To change to another page on this panel.  |
| <b>ESC</b>  | To delete the last measured point of the rectangular or polygonal grid scan area. If necessary, remeasure scan area points. |

## Grid Scan Settings, Define grid spacing on the plane.

### Description of fields

| Field                 | Option         | Description   |
|-----------------------|----------------|---|
| <b>Left / right</b>   | Editable field | For tilted and vertical planes. Horizontal grid distance. |
| <b>Up / down</b>      | Editable field | Up slope grid distance.                                   |
| <b>Grid scan area</b> | Display only   | Size of the grid scan area.                               |

| Field   | Option       | Description  |
|---|--------------|--|
| <b>Estimated points</b>                                   | Display only | Estimated number of points to be grid scanned.<br>>20'000 is shown for all resolution bigger than 20'000 points.<br> It is not checked if all points from the scan resolution fall within the defined grid scan area. For more than 20'000 points, grid scanning the defined grid scan area with the selected resolution may take long. |
| <b>Also measure the boundary of the defined scan area</b> | Check box    | When this box is checked, the boundary of the grid scan area is also measured.   |

Grid Scan Settings, Define start point ID & increment.

#### Description of fields

| Field              | Option         | Description   |
|--------------------|----------------|---|
| <b>Start point</b> | Editable field | The point ID to start with.   |
| <b>Increment</b>   | Editable field | The incrementation used for <b>Start point</b> . No point ID template used <ul style="list-style-type: none"> <li>For <b>Start point: RMS</b> and <b>Increment: 10</b> the points are RMS, RMS10, RMS20, ..., RMS100, ...</li> <li>For <b>Start point: 100</b> and <b>Increment: 10</b> the points are 100, 110, ..., 200, 210, ...</li> <li>For <b>Start point: abcdefghijklmn89</b> and <b>Increment: 10</b> the points are abcdefghijklmn99, point ID incrementing fails.</li> </ul> |

Grid Scan Settings, Choose the grid scan mode to be used.

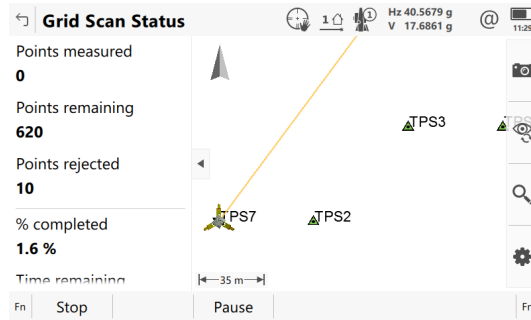
This panel is only displayed for motorised instruments. For all other instrument types, the standard measurement mode is set.

#### Description of fields

| Field  | Option    | Description  |
|--|-----------|--|
| <b>Standard - accuracy &amp; range optimised</b> | Check box | This measurement mode is accuracy and range optimised. It uses single distance measurements to any surface.        |
| <b>Fast - speed &amp; performance optimised</b>  | Check box | This measurement mode is speed and performance optimised. It uses continuous distance measurements to any surface. |



## Grid Scan Status



| Key          | Description                           |
|--------------|---------------------------------------|
| <b>Stop</b>  | To stop the grid scanning of points.  |
| <b>Pause</b> | To pause the grid scanning of points. |
| <b>Scan</b>  | To continue grid scanning.            |

### Description of fields

| Field                   | Option       | Description   |
|-------------------------|--------------|---|
| <b>Points measured</b>  | Display only | Number of points being measured.                      |
| <b>Points remaining</b> | Display only | Number of points remaining to be grid scanned.        |
| <b>Points rejected</b>  | Display only | Number of skipped points.                             |
| <b>% completed</b>      | Display only | Percentage of points measured.                        |
| <b>Time remaining</b>   | Display only | Estimated time remaining until grid scan is finished. |
| <b>Point ID</b>         | Display only | Point ID of last stored point.                        |

### Next step

In 3D viewer, points currently scanned are displayed in black, previously measured points and lines are displayed in grey.

## 45.9

### Grid Scan on Surface - TS

#### Description

Grid Scan on Surface allows the measurement of a grid on any surface based on an angular resolution (constant delta horizontal and delta vertical values). No reference plane is required. The grid scan area can be either rectangular or polygonal. Optionally, the boundary of the grid scan area can be measured. Grid Scan on Surface can be run on instruments with the option "reflectorless EDM" only.

## Diagram



TS.121



### Known

PO Setup

### Unknown

Grid point coordinates

## Access step-by-step

1. In **Plane & Grid Scan**, select **Grid scan on surface**.
2. Press **OK**.
3. Choose between:
  - **Rectangular area:** Two opposite corner points define the grid scan area. The area must be defined by pointing the instrument to opposite corners of the area. Grid scan areas bigger than 180° are allowed.
  - **Polygonal area:** Three or more clockwise measured points define the grid scan area. The polygonal grid scan area is calculated based on the sequence of the points. Grid scan areas bigger than 180° are allowed.
4. Press **OK**.



Most steps are identical with the steps for **Grid scan on plane**. Refer to [45.8 Grid Scan on Plane - TS](#) for a description of the panels.

## Surface Scan Settings, Define grid scan spacing.

**Surface Scan Settings** Hz 233.3335 g V 22.2223 g 12:11

**Settings** Camera

Define grid scan spacing.

Define spacing by **Angles**

Hz

V

Estimated points **23**

Also measure the boundary of the defined scan area


| Key | Description |
|-----|-------------|
|-----|-------------|

**OK** To continue with the next panel.

**Distance** Available when **Define spacing by: Distances** is selected. To take a distance measurement to any surface. The measured value is displayed in the **Horizontal distance** field.

### Description of fields

| Field                    | Option           | Description   |
|--------------------------|------------------|---|
| <b>Define spacing by</b> | <b>Angles</b>    | Horizontal and vertical angle values define the scan resolution.                |
|                          | <b>Distances</b> | Horizontal and vertical spacings at a certain range define the scan resolution. |

| Field   | Option         | Description   |
|---|----------------|---|
| <b>Hz and V</b>   | Editable field | Available for <b>Define spacing by: Angles</b> . The horizontal and vertical angle values defining the scan resolution.   |
| <b>Horizontal distance</b>                                | Editable field | Available for <b>Define spacing by: Distances</b> . The range for which the horizontal and vertical spacings are valid.   |
| <b>Horizontal spacing and Vertical spacing</b>            | Editable field | Available for <b>Define spacing by: Distances</b> . The horizontal and vertical spacing defining the scan resolution at the defined range.  |
| <b>Estimated points</b>                                   | Display only   | <p>The number of points to be scanned according to the defined scan resolution. <b>&gt;20'000</b> is displayed for all scan resolution exceeding 20'000 points.</p> <p> It is not checked if all points from the scan resolution fall within the defined grid scan area. For more than 20'000 points, grid scanning the defined grid scan area with the selected resolution may take long.</p> |
| <b>Also measure the boundary of the defined scan area</b> | Check box      | When this box is checked, then the boundary of the grid scan area is also measured.   |



Please be aware that the terminology or workflow used on different construction sites can vary from the one used in this manual. However, basic principles remain the same.

## Description

| Name                    | Description  |
|-------------------------|--|
| <b>Alignment editor</b> | <ul style="list-style-type: none"> <li>Alignment Editor is an "add-on" component. It is only intended for quick and easy modification of existing alignments, or creation of new ones. Alignment editor is not an onboard road planning and design app.</li> <li>This app supports the following alignment types: <ul style="list-style-type: none"> <li>Horizontal alignments</li> <li>Vertical alignments</li> <li>Cross section templates</li> <li>Cross section assignments</li> <li>Chainage equations</li> </ul> </li> <li>This app is a free app provided by Leica Geosystems AG. If the app does not appear on your menu or you are otherwise unable to access it, contact your Leica Geosystems AG representative.</li> </ul>   |
| <b>Roads</b>            | <ul style="list-style-type: none"> <li>This subapp allows the measuring and staking of roads and other alignments.</li> <li>It can be used with GS and with TS.</li> <li>It consists of two main functions: <ul style="list-style-type: none"> <li><b>Check road</b> for checking or measuring existing lines, surface grade, slopes or surfaces and comparing the measurements against design data.</li> <li><b>Stake road</b> for setting or staking out and adjusting road elements during construction using design data.</li> </ul> </li> <li>The data can be typed in manually by using the Alignment editor app or data created in a design package can be converted. The <b>Import data</b> functionality in the job menu and the Design to Field component of Infinity offer converters from several road design and CAD packages.</li> </ul> |
| <b>Rail</b>             | <ul style="list-style-type: none"> <li>This subapp allows the measuring and staking of railways and other alignments.</li> <li>It can be used with GS and with TS.</li> <li>It consists of two main functions: <ul style="list-style-type: none"> <li><b>Check rail</b> for checking or measuring an existing track and comparing the measurements against design data.</li> <li><b>Stake rail</b> for setting or staking out and adjusting track features during construction using design data.</li> </ul> </li> </ul>   |

| Name          | Description  |
|---------------|--|
|               | <ul style="list-style-type: none"> <li>• Single track or multiple track designs can be imported for use with this app. <ul style="list-style-type: none"> <li>• For horizontal and vertical alignments, the data can be typed in manually by using the Alignment editor app. Data created in a design package can be converted.</li> <li>• For multiple track designs, it is possible to define one centreline which is common to all tracks.</li> </ul> </li> <li>• A superelevation table can be created for each track using the Rail Editor computer app. This app is part of the Design to Field component in Infinity.</li> </ul>  |
| <b>Tunnel</b> | <ul style="list-style-type: none"> <li>• For TS.</li> <li>• This subapp allows the measuring and staking of tunnels.</li> <li>• It consists of two main functions: <ul style="list-style-type: none"> <li>• <b>Check tunnel</b> for checking a built or excavated tunnel with a tunnel design.</li> <li>• <b>Stake tunnel</b> for staking out tunnel features during construction.</li> </ul> </li> <li>• The centreline of the tunnel can be imported for use onboard the instrument using the industry standard LandXML data format. Alternatively the centreline can be imported in formats exported from many other tunnel design packages using the Design to Field component of the Infinity.</li> <li>• Tunnel design profiles can be created using the Tunnel Profile Editor computer app. This app is integrated into the Design to Field component in Infinity.</li> </ul> |



Roads, Rail and Tunnel subapps are licence protected. They can be activated through a licence key which is specific to the instrument. Refer to [30.3 Entitlements & licences](#).

## 46.2

### Jobs & Design Data

#### 46.2.1

#### Accessing Roads Apps

##### Access

Select one of the Road apps from the **Leica Captivate - Home** menu:

- **Stake road**
- **Check road**
- **Stake rail**
- **Check rail**
- **Stake tunnel**
- **Check tunnel**

#### 46.2.2

#### Working with a DTM Job

##### Access

In the job selection panel check **Use a DTM**.

Open the selectable list for **DTM**.

Design data for Road

2D and 3D lines

Depending on the method to be used, the design in all road jobs must consist of either 2D or 3D lines.

2D lines are required at least when working with lines, local lines, manual slope, local manual slope or layer. If the design consists of 2D lines, heights can be considered manually.

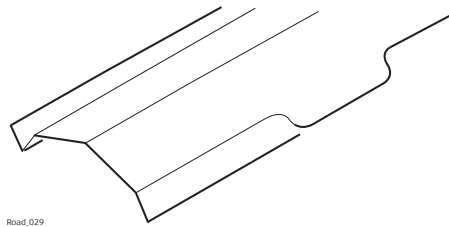
3D lines are required when working with slope, surface grade or crown. 3D lines can also be used when working with lines, local lines, manual slope, local manual slope or layer.

Description

Depending on the complexity of the road job, the design data can vary from a single horizontal alignment to a design containing profiles with dozens of defined vertices. Design elements can be grouped logically for faster access.

Lines

When manually typing in a road job, alignments and cross sections are used. Alignments are defined by geometric elements, for example straights and arcs, and the cross sections by vertices. Furthermore, at which chainage a certain cross section is used is also defined. By defining these elements the vertices are connected to create a series of lines representing the three-dimensional design of the road.

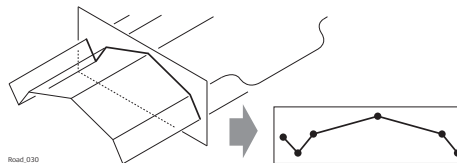


Line representation of a road design.

Such lines defining the design are called lines. Lines are the base elements used for stakeout and check activities. Lines have a project unique name by which they are identified and selected. Whenever a new road design is typed in or imported from a design package these lines are generated automatically in the background.



A cross section can be derived from the line model by slicing the group of lines with a vertical plane orthogonal to the centreline.



Vertical cut of a line group defines a cross section.



Lines are referenced by layers and can be used in more than one layer.



Every layer is relative to a centreline. This centreline does not have to be a part of the layer. In the previous example, layer one - general fill - uses the centreline for calculation even though the centreline is not part of the layer surface. Whereas the centreline is part of layer three - final surface.

---

## Design data for Rail

### Horizontal and vertical alignments

All rail jobs must consist of at least one horizontal alignment. Each horizontal alignment can either be typed in manually using the **Alignment editor** app, or converted from a rail design package using **Import data** from the job menu or the Design To Field component within the Infinity.

Horizontal alignments can consist of straights, circular curves, clothoids, parabolic curves and blossom curves.

Vertical alignments can consist of straights, circular curves and parabolic curves.

If a design comprises multiple tracks, one horizontal alignment can be defined as the chainage centreline. From the chainage centreline, all chainages are calculated and horizontal and vertical alignments can be used to define each track.

### Rail definition

Define rails by:

- Entering the design data manually in the field
- Using the **Alignment editor** to define the centreline only
- Using **Import data** from the job
- Converting data from a rail design package using the Design To Field component and if necessary the Rail Editor (for defining the superelevation) component within the Infinity program

Rails are stored as continuous 2D or 3D lines within the rail job.

### Tracks

Tracks are used to group related centreline and rails together.

For single tracks, the track centreline and the two rails are grouped in one track.

For multiple tracks where one chainage centreline is used for all tracks, each track consists of four lines: the track centreline, the chainage centreline and the left and right rails.

For multiple tracks where chainage is calculated relative to the track centreline, each track is stored as a single track as described previously.

---

## Design data for Tunnel

### Horizontal and vertical alignments

All tunnel jobs must consist of at least a horizontal and a vertical alignment. These data can be converted from a road design package using the Design To Field component within Infinity.

### Profiles

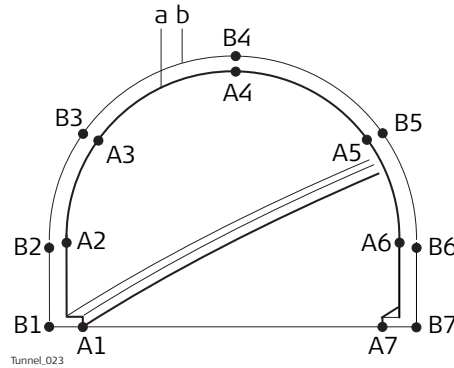
Depending on the complexity of the tunnel job, the design data can vary from a single horizontal and vertical alignment to a design containing many different design profiles with dozens of defined vertices.

Design profiles can be defined and edited using the Design To Field component within the Infinity.

### Layers

Tunnels generally consist of layers made of different materials, for example a shotcrete surface or a lining. At different times throughout a project, it may be required to work with different layers of the tunnel.

The Tunnel Profile Editor allows the possibility of creating such layers by grouping design profiles that are used at the same chainage.



- a The vertices **A1-A7** could be grouped in a layer (**a**) and represent the final lining of the tunnel.
- b The vertices **B1-B7** could be grouped in a layer (**b**) and represent the inner shotcrete layer of the tunnel.

Design Profile Layers can be assigned to chainages along the centreline using the Tunnel Profile Editor within the Design To Field component.

The layer of the tunnel to stake out or check can be defined when creating a task.

## 46.2.4

### Viewing and Editing the Design Data

#### Access

In the **Design Data** panel, check **Use a road design**, **Use a rail design** or **Use a tunnel design**.

Open the selectable list for the job.

In **Road Design/Rail Design/Tunnel Design**, highlight a job and press **Data**.

#### View & Edit Data

The design data stored within the road/rail/tunnel job contains all information about the road/rail/tunnel design. This information includes the lines and layers, for example, the geometry of the centreline or the layers of the different materials/surfaces which form the road/tunnel. The design data can be viewed and partially edited on this panel.

View & Edit Data
Hz 233.3335 g  
V 22.2223 g

|                 |                    |
|-----------------|--------------------|
| Job name        | Soccer_3D+2D_lines |
| Layer           | Test Strings       |
| Number of lines | 9                  |
| Centreline      | Centreline         |
| Chainage        | 100.000 m          |
| Ch increment    | 10.000 m           |


Fn OK
Edit
View
Fn

| Key | Description                     |
|-----|---------------------------------|
| OK  | To return to the job selection. |



| Key                | Description  |
|--------------------|--|
| <b>Edit</b>        | To edit the general job details and the start chainage of the centreline of the selected layer.<br>For Road additionally to select another centreline and include/exclude lines from the selected layer. |
| <b>View</b>        | To view geometry details of the lines and to view cross section plots.<br>For Road and Rail additionally to view the list of all lines in the layer.   |
| <b>Fn Settings</b> | To access the settings. Refer to <a href="#">46.3 Configuring Roads Apps.</a>  |

### Description of fields

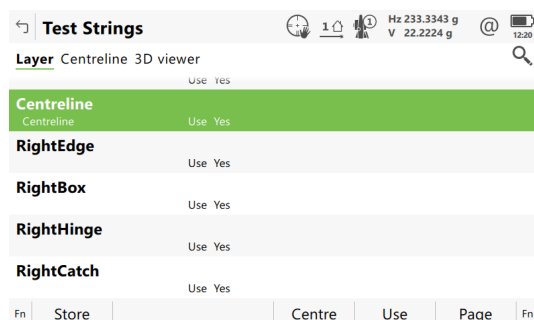
| Field                     | Option         | Description  |
|---------------------------|----------------|--|
| <b>Job name</b>           | Display only   | The name of the active road/rail/tunnel job, as selected in the job selection panel.   |
| <b>Layer</b>              | Display only   | To select a layer from the active road/rail/tunnel job. All layers within the active road/rail/tunnel job can be selected.                                   |
| <b>Number of lines</b>    | Display only   | Available for Road and Rail. The number of lines from the selected layer.  |
| <b>Number of profiles</b> | Display only   | Available for Tunnel. The number of profiles from the selected layer.  |
| <b>Centreline</b>         | Display only   | The name of the layer centreline.<br> Every layer must have a centreline. |
| <b>Chainage</b>           | Editable field | To enter chainage to use when viewing the data. The default value is the start chainage of the layer centreline.   |
| <b>Ch increment</b>       | Editable field | To enter a chainage increment to use when stepping through the data.   |


### Next step

| IF you want to | THEN press  |
|----------------|---|
| edit data      | <b>Edit.</b> Refer to <a href="#">Edit design data,Layer page.</a>            |
| view data      | <b>View.</b> Refer to <a href="#">View design data,Line information page.</a> |

### Edit design data, Layer page

Only available for Road.



| Key                             | Description  |
|---------------------------------|--|
| <b>Store</b>                    | To store data and return to the previous panel.  |
| <b>Centre</b>                   | To set the highlighted line as centreline.   |
| <b>Use</b>                      | To set <b>Yes</b> or <b>No</b> in the metadata for excluding/including the highlighted line of selected layer.   |
| <b>Page</b>                     | To change to the next page.  |
| <b>Fn All</b> or <b>Fn None</b> | To change the setting for the <b>Use</b> metadata for all lines at once.<br> Deactivates also the centreline. |

### Description of metadata

| Metadata          | Description   |
|-------------------|---|
| -                 | The name of all the lines in the layer.   |
| <b>Centreline</b> | Shown for the line selected as centreline.  |
| <b>Use</b>        | For <b>Yes</b> :<br>The selected line is used for stake/check.<br><br>For <b>No</b> :<br>The selected line is not used for stake/check.<br>Stringlines with this status are drawn in 3D viewer, but they are not included in the profile. |



0014334\_001

- a Lines with status **No** excluded from profile
- b Lines with status **Yes** excluded from profile

### Next step

**Page** changes to the **Centreline** page.

## Edit design data, Centreline page

Test Strings

Layer **Centreline** 3D viewer

Centreline **Centreline**

Set start chainage **100.000 m**

End chainage **285.746 m**

Store Reset Page

| Key          | Description  |
|--------------|--|
| <b>Store</b> | To store changes and return to the previous panel.   |
| <b>Reset</b> | To clear all changes made and to reset to the original start chainage. The original start chainage is always remembered. |
| <b>Page</b>  | To change to the next page.  |

### Description of fields

| Field                     | Option         | Description   |
|---------------------------|----------------|---|
| <b>Centreline</b>         | Display only   | The name of the centreline.   |
| <b>Set start chainage</b> | Editable field | To enter a start chainage for the layer centreline.   |
| <b>End chainage</b>       | Display only   | The end chainage of the layer centreline. The end chainage is automatically calculated using the centreline length. |

### Next step

**Store** to store the changes.

**View** to the design data.

## View design data, Line information page

If a value is unavailable in the design data, the field is shown as -----.

100.000

Line information Lines 3D viewer

Line name **Centreline**

Chainage **100.000 m**

Easting **-19846.790 m**

Northing **5301045.974 m**

Height -----

Hz tangent **374.7362 g**

Hz radius -----

OK Ch - Ch + Segment Vt Page Fn

| Key            | Description  |
|----------------|--|
| <b>OK</b>      | To return to the previous panel.   |
| <b>Ch -</b>    | To decrease the chainage by the chainage increment, as defined in the <b>View &amp; Edit Data</b> panel. |
| <b>Ch +</b>    | To increase the chainage by the chainage increment, as defined in the <b>View &amp; Edit Data</b> panel. |
| <b>Segment</b> | To access <b>Segment Info - Start Point</b> .  |

| Key             | Description  |
|-----------------|--|
| <b>Hz or Vt</b> | To change between the vertical alignment data and the horizontal alignment data. |
| <b>Page</b>     | To change to another page on this panel.   |

### Description of fields

| Field                               | Option          | Description  |
|-------------------------------------|-----------------|--|
| <b>Line name</b>                    | Selectable list | All lines available at the defined chainage are displayed and can be selected.                                   |
| <b>Chainage</b>                     | Editable field  | To enter chainage to use when viewing the data. The default value is the start chainage of the layer centreline. |
| <b>Easting, Northing and Height</b> | Display only    | The East/North coordinate and height of the line at defined chainage.  |
| <b>Hz tangent</b>                   | Display only    | The tangent direction of the line at defined chainage.   |
| <b>Grade</b>                        | Display only    | The grade of the line at defined chainage.   |
| <b>Hz radius</b>                    | Display only    | The horizontal radius of the line segment at defined chainage.   |
| <b>Vertical radius</b>              | Display only    | The vertical radius of the line segment at defined chainage.   |
| <b>Hz type</b>                      | Display only    | The horizontal segment type at defined chainage.   |
| <b>Vertical type</b>                | Display only    | The vertical segment type at defined chainage.   |
| <b>Hz offset</b>                    | Display only    | The horizontal offset to the layer centreline at defined chainage.   |
| <b>Vertical offset</b>              | Display only    | The vertical offset to the layer centreline at defined chainage.   |

### Next step

**Page** to change to the **Lines** page.

### View design data, Lines page

Unavailable for Tunnel.

Line information **Lines** 3D viewer

| Centreline                              |
|---|
| CL offset: 0.000      Height diff: ---- |

Fn   OK   Ch -   Ch +   Segment   More   Page   Fn

| Key            | Description  |
|----------------|--|
| <b>OK</b>      | To return to the previous panel.   |
| <b>Ch -</b>    | To decrease the chainage by the chainage increment, as defined in the <b>View &amp; Edit Data</b> panel. |
| <b>Ch +</b>    | To increase the chainage by the chainage increment, as defined in the <b>View &amp; Edit Data</b> panel. |
| <b>Segment</b> | To access <b>Segment Info - Start Point</b> .  |
| <b>More</b>    | To change between the height differences or absolute heights at the selected chainage.                   |
| <b>Page</b>    | To change to another page on this panel.   |

#### Description of metadata

| Metadata           | Description  |
|--------------------|--|
| -                  | The name of the lines available at defined chainage in the selected layer. |
| <b>CL offset</b>   | The horizontal offset of the line from the layer centreline.               |
| <b>Height diff</b> | The height difference of the line to the layer centreline.                 |
| <b>Height</b>      | The absolute height of the line.   |

#### Next step

**Page** to change to the **3D viewer** page.

The **3D viewer** page shows a 2D, 3D, cross section and long section view of the design data at the selected chainage.

**Segment** to access **Segment Info - Start Point/Segment Info - End Point**.

#### Segment Info - Start Point/ Segment Info - End Point, Hz alignment page

If a value is unavailable in the design data, the field is shown as -----.

**Segment Info - Start Point**

Hz alignment Vertical alignment

|            |               |
|------------|---------------|
| Line name  | Centreline    |
| Chainage   | 100.000 m     |
| Easting    | -19846.790 m  |
| Northing   | 5301045.974 m |
| Height     | -----         |
| Hz tangent | 374.7362 g    |
| Hz radius  | -----         |

OK Segment - Segment + End point Page

| Key  | Description   |
|--|---|
| <b>OK</b>                                    | To return to the previous panel.                                    |
| <b>Segment -</b>                             | To move to the previous segment.                                    |
| <b>Segment +</b>                             | To move to the next segment.  |
| <b>End point</b><br>or<br><b>Start point</b> | To change between the start point and the end point of the segment. |
| <b>Page</b>                                  | To change to another page on this panel.                            |

### Description of fields

| Field                        | Option       | Description   |
|------------------------------|--------------|---|
| Line name                    | Display only | The name of the selected line.  |
| Chainage                     | Display only | The chainage of start/end point of the segment.                             |
| Easting, Northing and Height | Display only | The East/North coordinate and height of the start/end point of the segment. |
| H <sub>z</sub> tangent       | Display only | The tangent direction at the start/end point of the segment.                |
| H <sub>z</sub> radius        | Display only | The radius at the start/end point of the segment.                           |
| H <sub>z</sub> type          | Display only | The current segment type.   |

### Next step

Page to change to the **Vertical alignment** page.

Segment Info - Start Point/  
Segment Info - End Point,  
Vertical alignment page

Refer to [Segment Info - Start Point/Segment Info - End Point,H<sub>z</sub> alignment page](#) for a description of keys.

If a value has not been defined, the field is shown as -----.

### Description of fields

| Field                        | Option       | Description   |
|------------------------------|--------------|---|
| Line name                    | Display only | The name of the selected line.  |
| Chainage                     | Display only | The chainage of start/end point of the segment.                             |
| Easting, Northing and Height | Display only | The East/North coordinate and height of the start/end point of the segment. |
| Grade                        | Display only | The grade at the start/end point of the segment.                            |
| Vertical radius              | Display only | The radius at the start/end point of the segment.                           |
| Vertical type                | Display only | The current segment type.   |

### Next step

OK returns to the previous panel.

## 46.3

## Configuring Roads Apps

### 46.3.1

### Configuration Settings

#### Access

Select one of the Road apps from the **Leica Captivate - Home** menu.

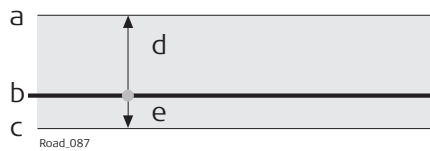
In the **Task** press **Fn Settings**.

**Road Settings,  
Quality control page**

**Description**

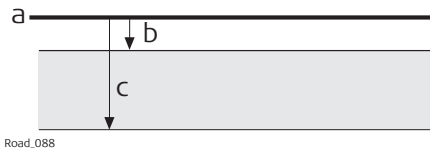
Especially when checking points in an as-built control or when staking out it is useful to enable the **Quality control** criteria available. For every point stored, the chosen parameters are checked and if the check limits are exceeded a warning is shown. This function guarantees a higher productivity as it is no longer necessary to check the values for every shot taken. Checking layers of a road, a layer that is too thick results in higher costs as more material is used. Alternatively, a too thin layer can lead to problems and could cause serious damage. Therefore different check limits for above and below the design can be defined.

**Graphic**




- a Layer is too thick
- b Design surface
- c Layer is too thin
- d **Upper height limit**
- e **Lower height limit**

Height limits below the design surface are entered as negative values. For example, the **Lower height limit** with -10 mm in the previous diagram. Using the signs of the height limits, it is also possible to cover situations like the one shown in the following diagram, with a valid range between -10 to -50 mm below the design surface.



- a Design surface
- b **Upper height limit**
- c **Lower height limit**

**Description of fields**

| Field                                   | Option   | Description   |
|---|--|---|
| <b>Check differences before storing</b> | Check box  | When this box is checked, a position check is done when storing a staked or checked point. When the defined tolerance is exceeded, the stake out/check can be repeated, skipped or stored. When this box is not checked, no quality check is done during stake out/check of points. |
| <b>Differences to check</b>             | <input type="checkbox"/><br><br><input type="checkbox"/> <b>Chainage, offset &amp; height</b><br><br><input type="checkbox"/> <b>Chainage &amp; offset</b> | <p> Depending on this selection the following lines are enabled/disabled.</p> <p>Check for chainage, horizontal offset and height.</p> <p>Check for chainage and horizontal offset.</p>          |

| Field                          | Option                          | Description   |
|--------------------------------|---------------------------------|---|
|                                | <b>Position &amp; height</b>    | Check for 2D position and height.   |
|                                | <b>Position</b>                 | Check for 2D position.  |
|                                | <b>Height</b>                   | Check for height.   |
|                                | <b>Profile</b>                  | Available for Tunnel. Check for distance from design profile.   |
| <b>Chainage limit</b>          | From <b>0.001</b> to <b>100</b> | Maximum difference in chainage.   |
| <b>Offset limit</b>            | From <b>0.001</b> to <b>100</b> | Maximum horizontal offset from defined position.  |
| <b>Position limit</b>          | From <b>0.001</b> to <b>100</b> | Maximum radial horizontal distance.   |
| <b>Upper height limit</b>      | From <b>-100</b> to <b>+100</b> | Minimum height difference.  |
| <b>Lower height limit</b>      | From <b>-100</b> to <b>+100</b> | Maximum height difference.  |
| <b>Upper profile tolerance</b> | From <b>-100</b> to <b>+100</b> | Available for Tunnel. Permitted maximum distance from the measured point to the design profile, when the point is measured above the profile. |
| <b>Lower profile tolerance</b> | From <b>-100</b> to <b>+100</b> | Available for Tunnel. Permitted maximum distance from the measured point to the design profile, when the point is measured below the profil.  |

### Next step

Page changes to the **Graphics** page.

## Road Settings, Graphics page

**Road Settings** Hz 233.3335 g V 22.2223 g 12:27

**Graphics** Quality control Heights Design Info TS specific Report sheet

Help me navigate **Using alignment** ▾

Navigational arrow types **In/out, left/right** ▾

Switch to bulls-eye when 0.5m (1.5ft) from point


Beep faster when getting close to point

OK Page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To confirm the changes and move to the previous panel. |
| <b>Page</b> | To change to another page on this panel.               |



## Description of fields

| Field   | Option                            | Description  |
|---|-----------------------------------|--|
| <b>Help me navigate</b>                                 |                                   | The reference direction used to stakeout points. The stakeout elements and the graphics displayed are based on this selection. Applies to the Stake view (  ).                                    |
|   | <b>Using alignment</b>            | The direction of the orientation is relative to the alignment.   |
|   | <b>From behind instrument</b>     | Available for TS.<br>The direction of the orientation is from the instrument to the point to be staked.  |
|   | <b>Facing instrument</b>          | Available for TS.<br>The direction of the orientation is from the current position relative to the instrument.   |
|   | <b>Facing point (design data)</b> | The direction of the orientation is from the current position relative to a point from the design job.   |
|   | <b>Facing point</b>               | The direction of the orientation is from the current position relative to the last recorded point. If no points are yet staked, <b>Help me navigate: Facing north</b> is used for the first point to be staked.  |
|   | <b>Facing north</b>               | The direction of the orientation is from the current position relative to North.   |
|   | <b>Following arrow</b>            | The direction of the orientation is from the current moving direction to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked. The current position must have moved at least 0.5 m for the orientation to be calculated. |
|   | <b>Facing sun</b>                 | For GS:<br>The position of the sun calculated from the current position, the time and the date.  |
| <b>Point ID</b>   | Selectable list                   | Available for <b>Help me navigate: Facing point (design data)</b> . To select the point or line to be used for orientation.  |
| <b>Navigational arrow types</b>                         |                                   | The method of staking out.   |
|   | <b>Direction &amp; distance</b>   | The direction from the orientation reference, the horizontal distance and the cut/fill are displayed.  |
|   | <b>In/out, left/right</b>         | The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed.   |
| <b>Switch to bulls-eye when 0.5m (1.5ft) from point</b> | Check box                         | When this box is checked, a bulls eye bubble is shown in the stakeout graphic when less than half a metre from the point being staked.   |

| Field  | Option  | Description  |
|--|---|--|
| <b>Beep faster when getting close to point</b> | Check box   | The instrument beeps when the distance from the current position to the point to be staked is equal to or less than defined in <b>Start within</b> .<br>The closer the instrument is to the point to be staked the faster the beeps are. |
| <b>Distance to use</b>                         | <b>Height, Horizontal distance or Position &amp; height</b> | Available when <b>Beep faster when getting close to point</b> is checked. The type of distance to use for the stake beep.  |
| <b>Start within</b>                            | Editable field  | Available when <b>Beep faster when getting close to point</b> is checked. The horizontal radial distance, from the current position to the point to be staked, when a beep is to be heard.   |

#### Next step

Page changes to the **Heights** page.

#### Road Settings, Heights page



The following field is shown in the Stake and Check methods except for **Slope** and **Manual slope**.

#### Description of fields

| Field  | Option    | Description  |
|--|-----------|--|
| <b>Allow editing the height of the location being staked</b> | Check box | When this box is checked, a height value typed in manually is used instead of design height or DTM height. When this box is not checked, the height from design is used. |

#### Next step

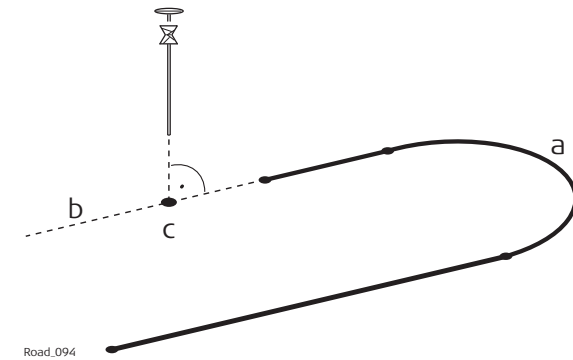
Page changes to the **Design** page.


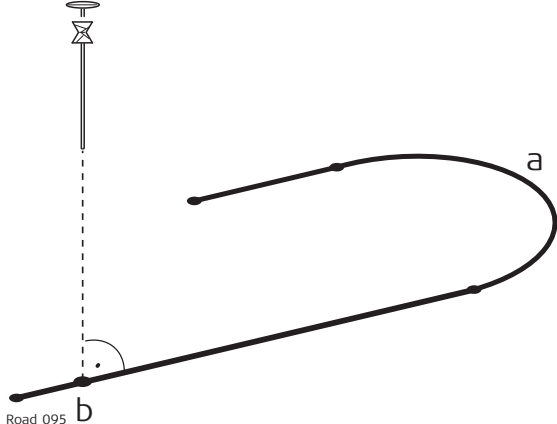


#### Road Settings, Design page

#### Description of fields

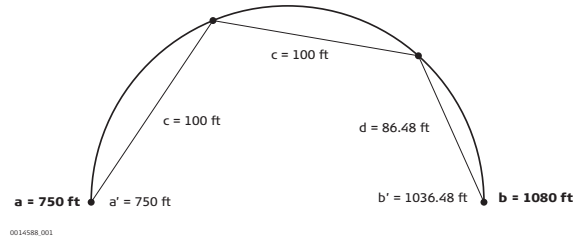
| Field                   | Option         | Description  |
|-------------------------|----------------|--|
| <b>Working corridor</b> | Editable field | Valid offset range defined by the working corridor left and right of the centreline. If a measured point is further away from the working corridor distance, an error message is displayed.<br>Refer to <a href="#">46.6 Understanding Terms and Expressions</a> for more information on the working corridor. |

| Field                      | Option                           | Description   |
|----------------------------|----------------------------------|---|
| <b>Show tangent points</b> | Check box                        | When this box is checked, a message box is shown when a tangent point (PI or PVI) has been detected within the chainage increment range. This tangent point can be selected for stakeout.<br>When this box is not checked, no tangent points are indicated. |
| <b>Type</b>                |                                  | Available when <b>Show tangent points</b> is checked.   |
|                            | <b>Horizontal</b>                | Indicates tangent points of the horizontal alignment only.  |
|                            | <b>Vertical</b>                  | Indicates tangent points of the vertical alignment only.  |
|                            | <b>Horizontal &amp; vertical</b> | Indicates all tangent points.   |
| <b>Slope signs</b>         |                                  | Available for Road only. Selects sign definition method for slopes and surface grades.  |
|                            | <b>Mathematical</b>              | All slope signs defined from left to right, independent of whether left or right of the centreline.   |
|                            |                                  | <p>Road_054c</p>  |
|                            | <b>Relative to centreline</b>    | Slope signs defined relative to the centreline.   |
|                            |                                  | <p>Road_054a</p>  |
|                            | <b>Relative from centreline</b>  | Slope signs defined relative from the centreline.   |
|                            |                                  | <p>Road_054b</p>  |

| Field                                | Option                    | Description   |
|--------------------------------------|---------------------------|---|
| <b>Extend slopes</b>                 |                           | When using slopes generated by a design package, the quality of the change from cut to fill or where slopes start and end, depends on the terrain model used for the project. Occasionally, one of the lines defining the slope ends before intersecting with the natural surface. A message appears asking to extend the slope, as soon as a measurement is taken outside of the defined design slope. |
|                                      | <b>Yes (show message)</b> | The slope is expanded beyond and above or below the hinge point. A warning is shown as soon as leaving the defined slope.   |
|                                      | <b>Yes</b>                | The slope is expanded beyond and above or below the hinge point. No warning is when leaving the defined slope.  |
|                                      | <b>No</b>                 | The slope is not expanded beyond and above or below the hinge point.  |
| <b>Allow measuring beyond design</b> | Check box                 | Extend each line or curve at its beginning and end with a tangent. The extension is used for projecting a point to the line and for intersecting the line.  |
|                                      | Checked                   | <p>Intersection points on extended lines/curves are not shown in cross sections and cannot be staked out.</p>  <p>Road_094</p> <ul style="list-style-type: none"> <li>a Any type of line or curve</li> <li>b Extended line</li> <li>c Projected point on extended line</li> </ul>                                   |

| Field                                   | Option         | Description   |
|---|----------------|---|
|   | Not checked    | <p>This option is recommended when working with closed alignments, for example roundabout, slip road, motorway exit.</p> <p></p>  <p>a Any type of line or curve<br/>b Projected point on line</p>   |
| <b>Apply scale to horizontal design</b> | Check box      | <p>When this box is not checked, no scale factor is applied to length values. Length values are displayed in the grid format.</p> <p>When this box is checked, a defined scale factor is applied to length values. All distance values (chainages, chainage increments, offsets, <math>\Delta</math> chainage, <math>\Delta</math> offset, <math>\Delta</math> height, ...) are displayed in ground using the <b>Scale factor</b>.</p> <p> The Road job data is still in grid format.</p> <p> All data is saved to the DBX in ground format. Only ground data is written to the report sheet.</p> |
| <b>Scale factor</b>                     | Editable field | To apply an appropriate geodetic map projection to scale over the ground. The scale factor is only applied to Road, not to Rail or Tunnel.  |
| <b>Calculate chainage along chord</b>   | Check box      | <p>When this box is not checked, the chainage refers to the centreline of the alignment. The app calculates the points to be staked out from that chainage.</p> <p>When this box is checked, the chainage is calculated along chords defined for the arc. The setting is applied to the entire alignment. To stake arcs along the centreline, the check box must be unchecked.</p>  |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



- a Start chainage on centreline
- a' Start chainage on chord
- b End chainage on centreline
- b' End chainage on chord
- c **Chord length**
- d Last chord at the end of an arc. May be shorter than the defined chord length.

At the end of a first arc when starting a straight, the chainage is calculated again along the centreline until the next arc starts. At the end of the straight when starting the second arc, a new chord of the defined length is started to be used as chainage reference. At the end of an arc or for a short arc, the chord may be shorter than the defined chord length.

|                     |                |   |
|---------------------|----------------|---|
| <b>Chord length</b> | Editable field | Available when <b>Calculate chainage along chord</b> is checked.<br>The defined chord length. |
|---------------------|----------------|---|

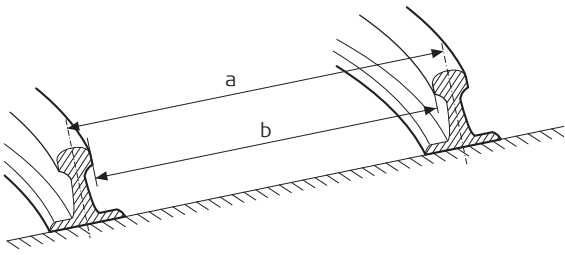
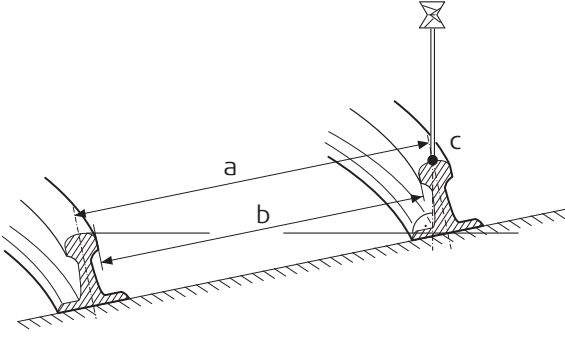
#### Next step

| IF you work with | THEN Page changes to the   |
|------------------|----------------------------|
| Road             | <b>Info</b> page.          |
| Rail             | <b>Rail design</b> page.   |
| Tunnel           | <b>Tunnel design</b> page. |

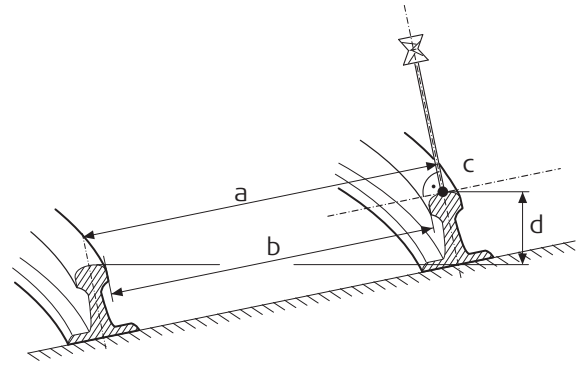
Road Settings,  
Rail design page

Available for Rail only.

## Description of fields

| Field                       | Option                | Description  |
|-----------------------------|-----------------------|--|
| <b>Nominal gauge</b>        | Editable field        | Nominal distance between the active (internal) faces of the left and right rails.<br><br> <p>Rail.014</p> <p>a Superelevation base<br/>b Nominal gauge</p>                                       |
| <b>Super-elevation base</b> | Editable field        | Distance over which the superelevation is to be applied. This distance normally corresponds to the distance between the rail axes.   |
| <b>Use super-elevation</b>  | <b>From design</b>    | To use the superelevation values from the design. If these values don't exist in the design, then all superelevation values are ignored.   |
|                             | <b>Enter manually</b> | To ignore all superelevation values from the design and to enter them manually.  |
|                             | <b>Show message</b>   | All superelevation values are ignored.   |
| <b>Apply target height</b>  | <b>Plumbline</b>      | The target height is applied in plumbline to the measured position.<br><br> <p>Rail12.17</p> <p>a Superelevation base<br/>b Nominal gauge<br/>c Measured point (Easting, Northing, Height)</p> |
|                             | <b>Perpendicular</b>  | Use this setting when working with a rail bar (solar gauge) with a fix mounted prism. Easting, Northing and Elevation of the measured point is calculated using the design cant or, if enabled, the manually defined cant.   |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

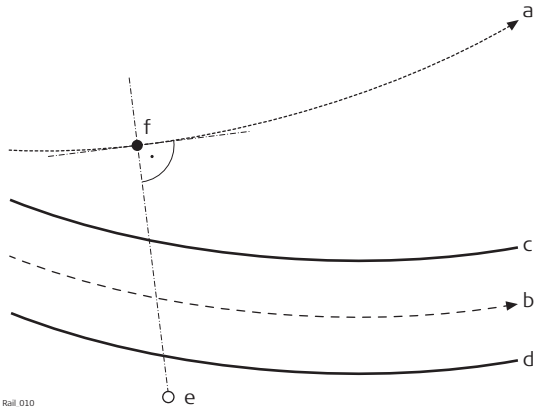
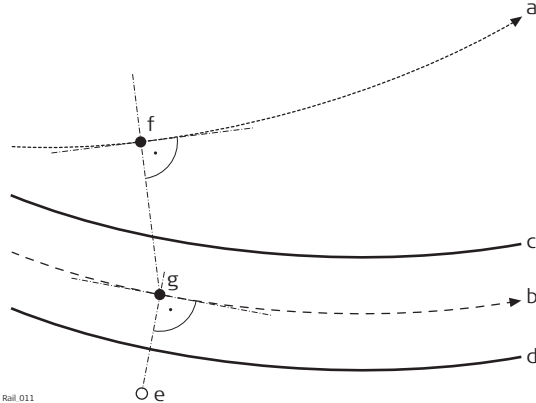


Rail12\_18

- a Superelevation base
- b Nominal gauge
- c Measured point (Easting, Northing, Height)
- d Superelevation

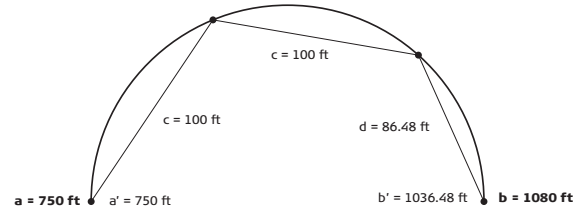
|   |                               |  |
|---|-------------------------------|--|
| <b>Centreline height reference</b>                                    | <b>Design</b>                 | The centreline height is taken from the alignment centreline.  |
|   | <b>Interpolate from rails</b> | The centreline height is interpolated between the left rail height and right rail height.  |
|   | <b>Lower rail</b>             | The height of the lower rail is used as centreline height.   |
| <b>Always calculate chainage perpendicular to chainage centreline</b> | Check box                     | Chainage calculation method when checking points of multiple tracks with respect to a chainage centreline.<br>The direct measurement method is when the chainage is calculated by projecting the measured point directly onto the chainage centreline. |
|   |                               | The indirect measurement method is when the chainage is calculated by first projecting the measured point onto the track centreline, and then projecting the point onto the chainage centreline.   |



| Field                              | Option      | Description   |
|------------------------------------|-------------|---|
|                                    | Checked     | Project measured point directly onto the chainage centreline.   |
|                                    |             |  <p>Rail 010</p> <ul style="list-style-type: none"> <li>a Chainage centreline</li> <li>b Track centreline</li> <li>c Left rail</li> <li>d Right rail</li> <li>e Measured point</li> <li>f Direct chainage</li> </ul>  |
|                                    | Not checked | Project measured point onto track centreline and then make a second projection onto the chainage centreline.  |
|                                    |             |  <p>Rail 011</p> <ul style="list-style-type: none"> <li>a Chainage centreline</li> <li>b Track centreline</li> <li>c Left rail</li> <li>d Right rail</li> <li>e Measured point</li> <li>f Indirect chainage</li> <li>g Measured point projected onto track centreline</li> </ul> |
| <b>Disable chainage centreline</b> | Check box   | Only affecting multiple track designs. The defined chainage centreline is disabled and the track centreline is used for chainage calculations.  |

| Field                                 | Option    | Description  |
|---------------------------------------|-----------|--|
| <b>Calculate chainage along chord</b> | Check box | When this box is not checked, the chainage refers to the centreline of the alignment. The app calculates the points to be staked out from that chainage. |

When this box is checked, the chainage is calculated along chords defined for the arc. The setting is applied to the entire alignment. To stake arcs along the centreline, the check box must be unchecked.



- a Start chainage on centreline
- a' Start chainage on chord
- b End chainage on centreline
- b' End chainage on chord
- c **Chord length**
- d Last chord at the end of an arc. May be shorter than the defined chord length.

At the end of a first arc when starting a straight, the chainage is calculated again along the centreline until the next arc starts. At the end of the straight when starting the second arc, a new chord of the defined length is started to be used as chainage reference.

At the end of an arc or for a short arc, the chord may be shorter than the defined chord length.

### Next step

Page changes to the **Info** page.

## Rail Settings, Gauge device page

Available for Rail only.

A gauge device is used to measure the track geometry or the relative positions of the rails.

### Requirements to connect to a gauge device

Configure an interface connection to be used with a device called **GAUGE DEVICE**. Create the device **GAUGE DEVICE** manually with the standard communication parameters for RS232. For example, configure a **GeoCOM** connection using **TS Bluetooth 1** with the device **GAUGE DEVICE**.

| Key           | Description   |
|---------------|---|
| <b>Adjust</b> | Available for certain gauge devices. To adjust the gauge device from within the software. |

| Key     | Description   |
|---------|---|
| <Gauge> | Available for <b>Gauge device: Carttop RLM PLUS</b> .<br>To change the nominal gauge used by the gauge device.<br>Changes between the different nominal gauges available in the device. |

#### Description of fields

| Field                      | Option          | Description   |
|----------------------------|-----------------|---|
| <b>Gauge device</b>        | <b>None</b>     | No gauge device is used.  |
|                            | Selectable list | Select a gauge device. The internal offsets are applied.  |
| <b>Device sensor mode</b>  | <b>Ruler</b>    | Device without wheels.  |
|                            | <b>Trolley</b>  | Device with wheels.<br>For <b>Stake: Track &amp; gauge device</b> and <b>Check: Track &amp; gauge device</b> : The measured gauge and the calculated coordinates for the rails are corrected according to the current radius for the curve. |
| <b>Gauge target offset</b> | Editable field  | Horizontal offset of the prism from the fix side of the gauge device.   |
| <b>Gauge target height</b> | Editable field  | Height of the prism on the gauge device.  |
| <b>Nominal gauge</b>       | Display only    | Available for some gauge devices.<br>The nominal gauge received from the gauge device.  |

#### Next step

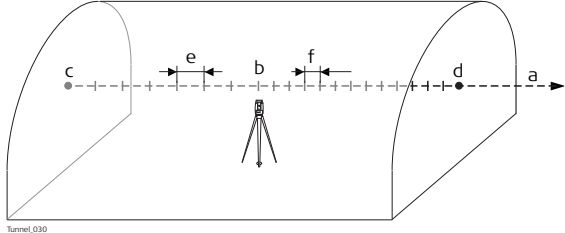
Page changes to the **Info** page.

#### Road Settings, Tunnel design page

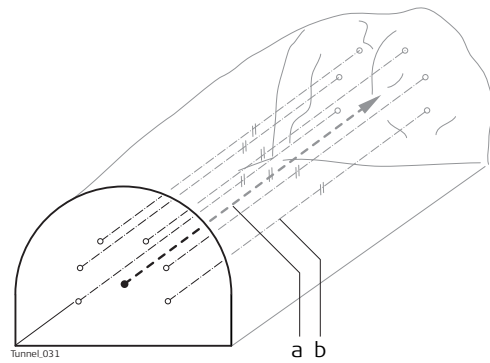
Available for Tunnel on TS only.

#### Description of fields

| Field                       | Option          | Description   |
|-----------------------------|-----------------|---|
| <b>Profile definition</b>   | <b>Vertical</b> | Profiles are always defined as vertical.  |
|                             | <b>Tilted</b>   | Profiles are always defined perpendicular to the vertical alignment of the tunnel axis.   |
| <b>Scan area defined by</b> |                 | Available for <b>Stake: Scan profile</b> .<br>When measuring tunnel profiles, it is possible to scan various profiles from one instrument position. |
|                             | <b>Chainage</b> | Allows a scan area to be defined by entering a back and forward chainage.   |

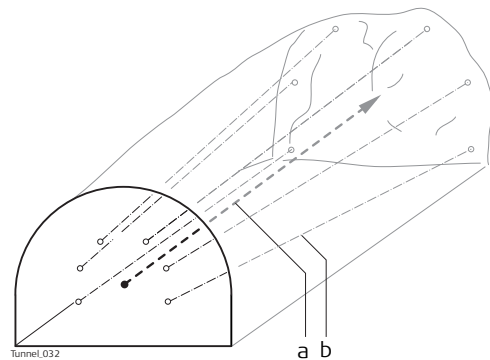
| Field | Option          | Description  |
|-------|-----------------|--|
|       | <b>Distance</b> | <p>Allow a scan area to be defined by measuring/entering a back distance and forward distance from the setup chainage.</p> <p><b>Plan view</b></p>  <p>a Alignment<br/> b <b>Instrument chainage</b><br/> c <b>Start chainage</b> or <b>Start distance</b><br/> d <b>End chainage</b> or <b>End distance</b><br/> e <b>Profiles interval</b><br/> f <b>Profiles interval</b></p> |

|                                 |                              |   |
|---------------------------------|------------------------------|---|
| <b>Drilling rig orientation</b> | <b>Parallel to alignment</b> | Guides a jumbo to drill in the direction parallel to the alignment. |
|---------------------------------|------------------------------|---|



- a Alignment
- b Drill direction

|                      |   |
|----------------------|---|
| <b>Drill Pattern</b> | Guides a jumbo to drill in the user-defined direction. The direction must not be parallel to the alignment. |
|----------------------|---|



- a Alignment
- b Drill direction

## Next step

Page changes to the **Info** page.

## Road Settings, Info page

Two things can be configured on this page:

1. The required information for each stakeout and check method to be displayed on the **i** page. Depending on the working method used on the construction site, different information is written on the stakes. The information to be written on the stake is displayed on the **i** page.
2. If and which user-defined page is displayed.

| Key               | Description                             |
|-------------------|---|
| <b>OK</b>         | To confirm the changes and continue.    |
| <b>Clear</b>      | To clear all parameters from all lines. |
| <b>Fn Default</b> | To set the default value for all lines. |

### Description of fields

| Field                         | Option          | Description  |
|-------------------------------|-----------------|--|
| <b>Show user defined page</b> | Check box       | The user-defined page to be shown in the stake or check panel.   |
| <b>Page to show</b>           | Selectable list | The names of the available pages.  |
| <b>Method</b>                 | Display only    | The method is based on the selected subapp and, if available, the setting for <b>Stake</b> . The settings in the following lines can only be changed for the current method. The method defines the parameters available to view on the <b>i</b> page of the app. Different combinations of the parameters to view can be stored                           |
| <b>1st line to 16th line</b>  | Selectable list | To modify the selection on any particular line, place the cursor on the line to modify using the arrow keys and press the <b>ENTER</b> key. Use the arrow keys to select the required parameter and press the <b>ENTER</b> key to confirm the choice.<br><br>Define which parameters are viewed on each line. Up to 16 lines of parameters can be defined. |

| Field | Option | Description   |
|-------|--------|---|
|       |        | <p>The available parameters depending on the <b>Method</b> selected are explained separately:</p> <ul style="list-style-type: none"> <li>• For Road Line, refer to <a href="#">46.3.2 Road Line - Info Page</a>.</li> <li>• For Road Local line, refer to <a href="#">46.3.3 Road Local Line - Info Page</a>.</li> <li>• For Road Surface grade, refer to <a href="#">46.3.4 Road Surface Grade - Info Page</a>.</li> <li>• For Road Manual slope, Local manual slope and Slope, refer to <a href="#">46.3.5 Road Manual Slope, Local Manual Slope and Slope - Info Page</a>.</li> <li>• For Road Crown, refer to <a href="#">46.3.6 Road Crown - Info Page</a>.</li> <li>• For Road Layer, refer to <a href="#">46.3.7 Road Layer - Info Page</a>.</li> <li>• For Road DTM, refer to <a href="#">46.3.8 Road DTM - Info Page</a>.</li> <li>• For Rail refer to <a href="#">46.3.9 Rail - Info Page</a>.</li> <li>• For Tunnel refer to <a href="#">46.3.10 Tunnel - Info Page - TS</a>.</li> </ul> |

#### Next step

For TS: **Page** changes to the **TS specific** page.

For GS: **Page** changes to the **Report sheet** page.

#### Road Settings, TS specific page

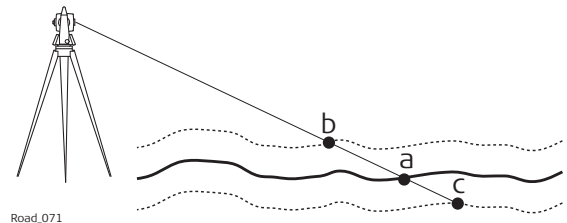
#### Description of fields

| Field  | Option               | Description   |
|--|----------------------|---|
| <b>Do not update stakeout values between distance measurements</b> | Check box            | When this box is checked, angles and stakeout values are updated after a distance measurement. All values are then frozen until the next distance is taken. When <b>Aim at target: With lock</b> is selected and the instrument is locked onto a target the angular values do not change. |
|  |                      | When this box is not checked, angles are updated with telescope movement after a distance was measured.   |
| <b>Automatic behaviour when aiming to point being staked</b>       |                      | Available for Road and Rail.<br>To make stake out of points even more efficient, a motorised instrument offers you the possibility to aim automatically at the stakeout position.   |
|  | <b>Position only</b> | The instrument positions horizontally in the direction of the point to stake out.   |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

**Position & height**

The instrument positions horizontally and vertically to the point to stake out. The instrument only points to the correct position on the ground if the point to stake out has the same height as the natural surface. If the natural surface is higher than the point to stake out, the measured point would be closer than the stakeout point. If the natural surface is lower than the point, the measured point would be further away. With **Position & measure**, the possibility of iterative positioning using the auto position, this problem can be avoided.



Road\_071

- a Point to stake out, defined with 3D coordinates
- b Position if natural surface is higher than point to stake out
- c Position if natural surface is lower than point to stake out

**Position & measure**

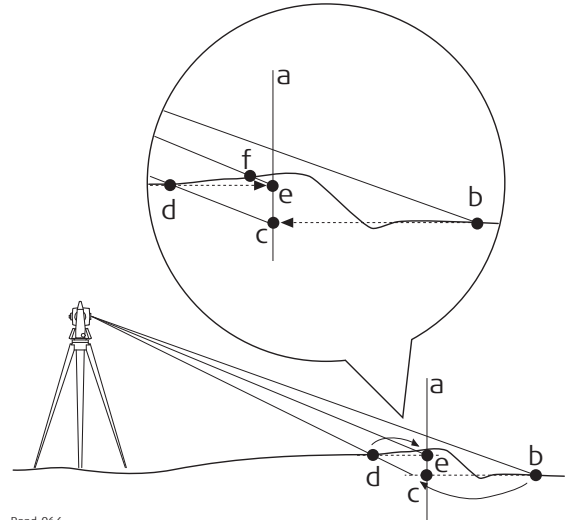
Allows the instrument to aim at a 2D position. As the natural surface height is unknown the correct position is calculated via iterations.



Depending on the settings chosen for **Red laser pointer** the instrument will turn on the red laser as soon as the position is found.

The first position (b) the instrument points to is defined by the 2D coordinates (a) of the point to stake out (= horizontal direction) and the current vertical angle. Therefore, aim the instrument at the approximate position of the point to stake out. The measured 2D position is compared with the stakeout position to determine a new position (c) to aim at. As no information about the natural surface is available, a point at the same height as the measured position is calculated. The new position (d) is measured and compared again with the point to stake out (a). This iteration process runs until the tolerances defined for the stakeout are reached.

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

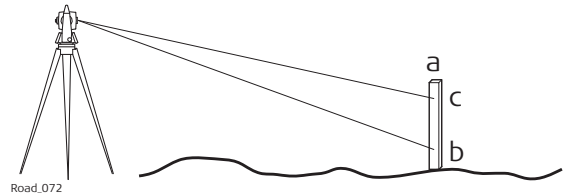


Road\_064

- a 2D position to stake out
- b First position measured defined by 2D coordinates and current vertical angle
- c New position calculated based on height of b
- d Second position measured
- e New position calculated based on height of d. The measured position for this point is within the defined tolerance, the correct position is found.

**Prompt before turn**

The method how the instrument turns is not fixed but is selected when pressing **Position**. Additionally to the three methods listed above, an option allowing the instrument to find the height on the peg is available:




Road\_072

- a Peg placed at the correct position
- b First height, manually chosen direction
- c Required height on the peg

For more information refer to [46.3.11 Workflow for Height \(aim to stake ht\) - for TS](#).

|                       |                                |   |
|-----------------------|--------------------------------|---|
| <b>Position limit</b> | From <b>0.001</b> to <b>10</b> | Maximum permitted radial horizontal distance.<br>Available for Tunnel and for Road/Rail with <b>Automatic behaviour when aiming to point being staked: Position &amp; measure</b> or <b>Automatic behaviour when aiming to point being staked: Prompt before turn</b> . |
|-----------------------|--------------------------------|---|



| Field                     | Option  | Description  |
|---------------------------|---|--|
| <b>Height limit</b>       | From <b>0.001</b> to <b>10</b>  | Maximum height difference. Available for Road and Rail.  |
| <b>Chainage limit</b>     | From <b>0.001</b> to <b>10</b>  | Chainage tolerance of the position to stake out.<br>Available for Tunnel and for Road/Rail with <b>Automatic behaviour when aiming to point being staked: Position &amp; measure</b> or <b>Automatic behaviour when aiming to point being staked: Prompt before turn.</b>  |
| <b>Offset limit</b>       | From <b>0.001</b> to <b>10</b>  | Maximum horizontal offset from defined position. Available for Road and Rail.  |
| <b>Red laser pointer</b>  | <p><b>Always off</b></p> <p><b>Turn on when aimed at pt</b></p> <p><b>Always on</b></p> | <p>Defines when the visible red laser beam is turned on during the automatic search of the position.<br/>Available for Tunnel and for Road/Rail with <b>Automatic behaviour when aiming to point being staked: Position &amp; measure</b> or <b>Automatic behaviour when aiming to point being staked: Prompt before turn.</b></p> <p>Visible red laser is turned off.</p> <p>Visible red laser is turned on as soon as the point is found.</p> <p>Visible red laser is turned on during the whole search.</p> <p> The laser can also be permanently turned on by using the instrument settings. Refer to <a href="#">23.5 Lights &amp; accessories</a> for more information.</p> |
| <b>Maximum iterations</b> | From <b>2</b> to <b>10</b>  | Maximum number of iterations for the distance measurement before stopping.<br>Available for Tunnel and for Road/Rail with <b>Automatic behaviour when aiming to point being staked: Position &amp; measure</b> or <b>Automatic behaviour when aiming to point being staked: Prompt before turn.</b>  |

#### Next step

Page changes to the **Report sheet** page. Refer to [38 Apps - General](#).

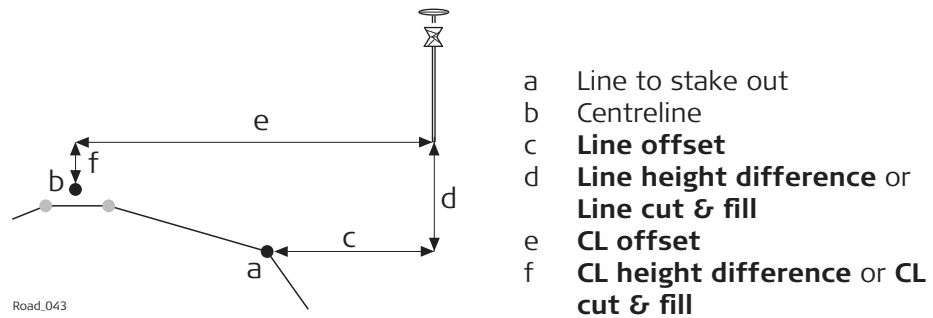
## 46.3.2

### Road Line - Info Page




#### Description

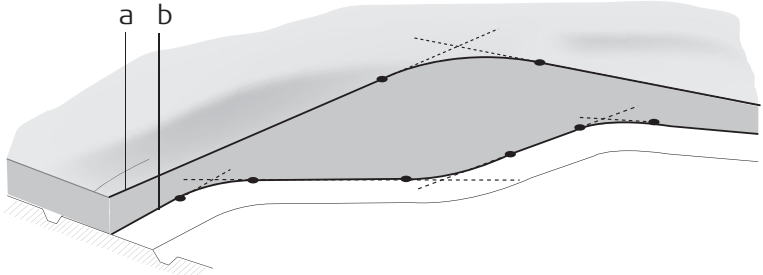
This  page is used for staking and checking Road lines.

## Available fields







The following parameters are available. All fields are display only.

| Field   | Description   |
|---|---|
| <b>Line task</b>  | Name defined for the line task.   |
| <b>Difference in offset</b>                                 | Horizontal offset between the defined position and the current position.  |
| <b>Difference in height</b>                                 | Vertical offset between the defined position and the current position.  |
| <b>Difference in chainage</b>                               | Difference between the defined chainage and the current chainage.   |
|   |  If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |
| <b>Chainage</b>   | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |
| <b>Stake chainage</b>                                       | Chainage to stake out.  |
| <b>Line offset</b>  | Horizontal offset from the line.  |
| <b>Line height difference</b> or <b>Line cut &amp; fill</b> | Height difference from the defined line.<br>C = cut, F = fill   |
| <b>Line name</b>  | Name of the line to stake out or the stakeout is relative to.   |
| <b>Additional line</b>                                      | The name of an extra line.  |
| <b>Additional line chainage</b>                             | Current local chainage of extra line.   |
| <b>Additional line offset</b>                               | Current perpendicular offset to the additional line including the defined stake/check offset of extra line of the  page.                     |
| <b>Additional line ht diff</b>                              | Current height difference to the additional line including the defined stake/check height difference of the additional line of  page.        |
| <b>CL height difference</b> or <b>CL cut &amp; fill</b>     | Height difference from the centreline.<br>C = cut, F = fill   |

| Field   | Description   |
|---|---|
| <b>CL height</b>  | Height of the centreline at the current chainage.   |
| <b>CL radius</b>  | Radius of the centreline at the current chainage.   |
| <b>CL type</b>  | Element type of the centreline.   |
| <b>CL offset</b>  | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page. |
| <b>CL tangent</b>   | Tangent direction of the centreline at the current chainage.  |
| <b>Offset angle</b>   | The current angle to selected line.   |
| <b>Nearest hz tangent point</b>   | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.                              |
|  <p style="text-align: center; font-size: small;">Road_099</p> <p style="text-align: center;"> a Vertical alignment<br/> b Horizontal alignment </p> <p>Only tangent points are detected. A tangent point is the start/end point of a road segment.</p> |   |
| <b>Nearest vertical tangent point</b>   | Distance to the nearest vertical tangent point of the design.   |
| <b>Height difference at 3D chainage</b>   | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment.   |
| <b>3D chainage</b>  | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.   |

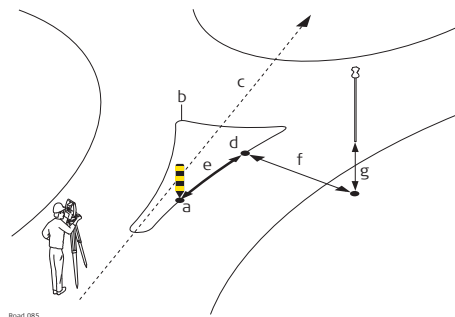
| Field                        | Description   |
|------------------------------|---|
|                              | <p>Road_089</p> <ul style="list-style-type: none"> <li>a <b>3D chainage</b></li> <li>b Chainage</li> <li>c Centreline</li> <li>d Centreline height difference</li> <li>e <b>Height difference at 3D chainage</b></li> </ul> |
| <b>Centreline grade</b>      | Grade of the centreline at the current position.  |
| <b>Direction to point</b>    | Direction from the current position to the point to stake out.  |
| <b>Distance to point</b>     | Distance from the current position to the point to stake out.   |
| <b>Defined easting</b>       | Easting of the point to stake out.  |
| <b>Defined northing</b>      | Northing of the point to stake out.   |
| <b>Defined height</b>        | Height of the point to stake out.   |
| <b>Current design east</b>   | Easting of the design for the current position. A relevant point at the selected line.  |
| <b>Current design north</b>  | Northing of the design for the current position. A relevant point at the selected line.   |
| <b>Current design height</b> | Height of the design for the current position. A relevant point at the selected line.   |
| <b>Actual easting</b>        | Easting of the current position.  |
| <b>Actual northing</b>       | Northing of the current position.   |
| <b>Actual height</b>         | Height of the current position.   |
| <b>3D quality</b>            | Standard deviation of the point measurement.  |

| Field                                    | Description   |
|--|---|
| <b>Go forward/<br/>backward</b>          | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:        |
|  |    |
| <b>Go left/right</b>                     | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:        |
|  |    |
| <b>Go</b>                                | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:  |
|  |    |
| <b>Turn left/<br/>right</b>              | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to: |
|  |    |
| <b>Separator<br/>and<br/>Unused line</b> | Empty line.   |

### 46.3.3

### Road Local Line - Info Page

#### Available fields






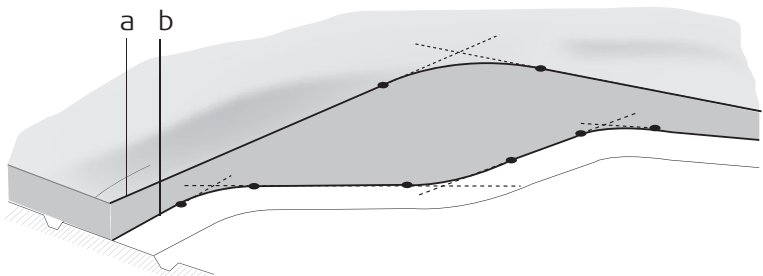
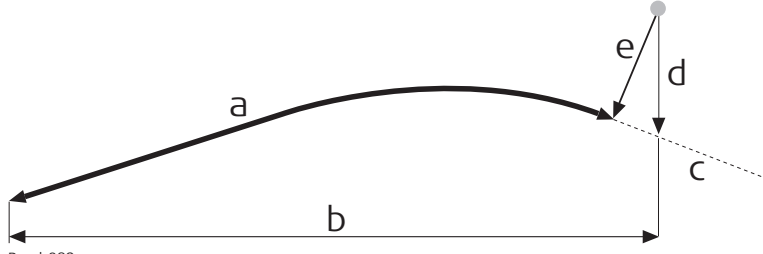
#### Stakeout of roundabout



- a Position to stake out
- b Line to stake out
- c Centreline
- d **Chainage**
- e **Difference in chainage**
- f **Difference in offset**
- g **Difference in height**

The following parameters are available. All fields are display only.



| Field            | Description                           |
|------------------|---------------------------------------|
| <b>Line task</b> | Name defined for the local line task. |

| Field  | Description  |
|--|--|
| <b>Additional line</b>   | The name of an extra line.   |
| <b>Additional line chainage</b>                                | Current local chainage of extra line.  |
| <b>Additional line offset</b>                                  | Current perpendicular offset to the additional line including the defined stake/check offset of extra line of the  page.  |
| <b>Additional line ht diff</b>                                 | Current height difference to the additional line including the defined stake/check height difference of the additional line of  page.   |
| <b>Difference in offset</b>                                    | Horizontal offset between the defined position and the current position.   |
| <b>Difference in height</b>                                    | Vertical offset between the defined position and the current position.   |
| <b>Difference in chainage</b>                                  | Difference between the defined chainage and the current chainage.<br><br> If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |
| <b>Chainage</b>  | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.   |
| <b>Stake chainage</b>  | Chainage to stake out.   |
| <b>Line offset</b>   | Horizontal offset from the line.   |
| <b>Line height difference</b><br>or <b>Line cut &amp; fill</b> | Height difference from the defined line.<br>C = cut, F = fill  |
| <b>Line name</b>   | Name of the line to stake out or the stakeout is relative to.  |
| <b>CL height difference</b><br>or <b>CL cut &amp; fill</b>     | Height difference from the centreline.<br>C = cut, F = fill  |
| <b>CL height</b>   | Height of the centreline at the current chainage.  |
| <b>CL radius</b>   | Radius of the centreline at the current chainage.  |
| <b>CL type</b>   | Element type of the centreline.  |
| <b>CL offset</b>   | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |
| <b>CL tangent</b>  | Tangent direction of the centreline at the current chainage.   |
| <b>Offset angle</b>  | The current angle to selected line.  |

| Field  | Description  |
|--|--|
| <b>Nearest hz tangent point</b>  | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment. |
|  <p>Road_099</p> <p>a Vertical alignment<br/>b Horizontal alignment</p> <p>Only tangent points are detected. A tangent point is the start/end point of a road segment.</p> |  |
| <b>Nearest vertical tangent point</b>  | Distance to the nearest vertical tangent point of the design.  |
| <b>Height difference at 3D chainage</b>  | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment.            |
| <b>3D chainage</b>   | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.  |
|  <p>Road_089</p> <p>a <b>3D chainage</b><br/>b Chainage<br/>c Centreline<br/>d Centreline height difference<br/>e <b>Height difference at 3D chainage</b></p>            |  |
| <b>Centreline grade</b>  | Grade of the centreline at the current position.   |
| <b>Direction to point</b>  | Direction from the current position to the point to stake out.   |
| <b>Distance to point</b>   | Distance from the current position to the point to stake out.  |
| <b>Defined easting</b>   | Easting of the point to stake out.   |


| Field  | Description  |
|--|--|
| <b>Defined northing</b>                                  | Northing of the point to stake out.  |
| <b>Defined height</b>                                    | Height of the point to stake out.  |
| <b>Actual easting</b>                                    | Easting of the current position.   |
| <b>Actual northing</b>                                   | Northing of the current position.  |
| <b>Actual height</b>                                     | Height of the current position.  |
| <b>Current design east</b>                               | Easting of the design for the current position. Relevant point at the line.  |
| <b>Current design north</b>                              | Northing of the design for the current position. Relevant point at the line.   |
| <b>Current design height</b>                             | Height of the design for the current position. Relevant point at the line.   |
| <b>Height at end of vertical alignment</b>               | Height at the endpoint of the vertical alignment of the line.  |
| <b>Difference in height at end of vertical alignment</b> | Height difference to the endpoint of the vertical alignment of the line.   |
| <b>3D quality</b>  | Standard deviation of the point measurement.   |
| <b>Go forward/backward</b>                               | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to: |
|  |   |
| <b>Go left/right</b>                                     | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to: |
|  |   |



| Field                            | Description   |
|----------------------------------|---|
| <b>Go</b>                        | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:  |
|                                  |    |
| <b>Turn left/right</b>           | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to: |
|                                  |    |
| <b>Separator and Unused line</b> | Empty line.   |

### Working with pipelines

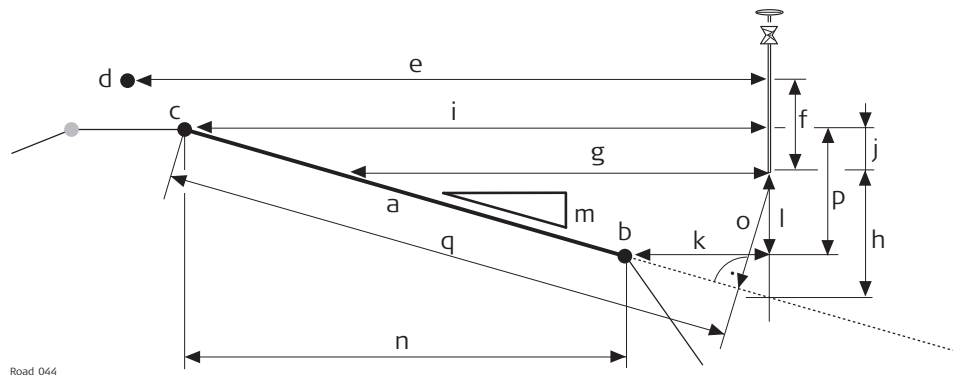
#### Description

When staking/checking pipes, a common task is to use height differences at the start/end of the pipe. The two  page items for local lines enable the height difference to be added to the end of the vertical alignments **Difference in height at end of vertical alignment** and **Height at end of vertical alignment**.

### 46.3.4




#### Road Surface Grade - Info Page

#### Available fields



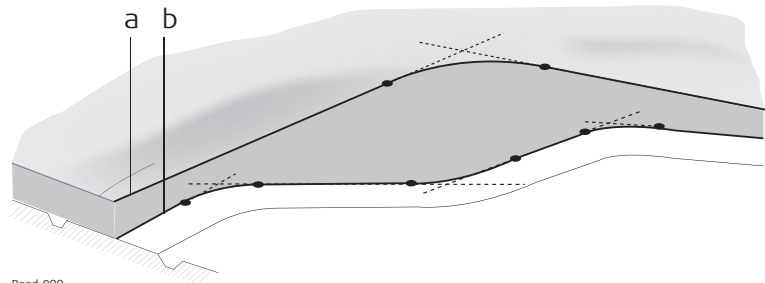
- a Surface grade to stake out
- b Right line of the surface grade **Right name**
- c Left line of the surface grade **Left name**
- d Centreline
- e **CL offset**
- f **CL height difference** or **CL cut & fill**
- g **Surface grade offset**
- h **Surface grade ht diff**
- i **Left offset**
- j **Left height diff**
- k **Right offset**
- l **Right height diff**
- m **Surface grade ratio**
- n **Width**
- o **Square offset**
- p **Camber** (in this case negative)
- q **Square slope dist**

The following parameters are available. All fields are display only.

| Field                           | Description   |
|---------------------------------|---|
| <b>Surface grade task</b>       | Name defined for the surface grade task.  |
| <b>Additional line</b>          | The name of an extra line.  |
| <b>Additional line chainage</b> | Current local chainage of extra line.   |
| <b>Additional line offset</b>   | Current perpendicular offset to the additional line including the defined stake/check offset of extra line of the  page.                       |
| <b>Additional line ht diff</b>  | Current height difference to the additional line including the defined stake/check height difference of the additional line of  page.            |
| <b>Difference in offset</b>     | Horizontal offset between the defined position and the current position.  |
| <b>Difference in height</b>     | Vertical offset between the defined position and the current position.  |
| <b>Difference in chainage</b>   | Difference between the defined chainage and the current chainage.   |
|                                 |  If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |
| <b>Chainage</b>                 | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |
| <b>Stake chainage</b>           | Chainage to stake out.  |
| <b>Surface grade offset</b>     | Horizontal offset from the surface grade.   |

| Field  | Description  |
|--|--|
| <b>Surface grade ht diff</b>                     | Height difference to the surface grade. If no stake height difference is used <b>Surface grade ht diff = Difference in height.</b>   |
| <b>Camber</b>                                    | The superelevation of the active surface grade.<br>The calculation is always in relation to the defined reference line of the surface grade:<br>Camber = line – reference line   |
| <b>Left name</b>                                 | Name of the left line defining the surface grade.  |
| <b>Left offset</b>                               | Horizontal offset from the left point of the surface grade.  |
| <b>Left height diff</b>                          | Height difference from the left point of the surface grade.  |
| <b>Right name</b>                                | Name of the right line defining the surface grade.   |
| <b>Right offset</b>                              | Horizontal offset from the right point of the surface grade.   |
| <b>Right height diff</b>                         | Height difference from the right point of the surface grade.   |
| <b>Ref line</b>                                  | Indicates which side of the surface grade the stakeout is relative to.   |
| <b>Ref offset</b>                                | Horizontal offset from the line of the surface grade used as reference. Depends on <b>Ref line</b> and is identical to <b>Right offset</b> or <b>Left offset</b> .   |
| <b>Ref height diff</b>                           | Height difference from the line of the surface grade used as reference. Depends on <b>Ref line</b> and is identical to <b>Right height diff</b> or <b>Left height diff</b> .   |
| <b>Surface grade ratio</b>                       | Slope ratio of the surface grade.  |
| <b>Square offset</b>                             | Offset from the surface grade, perpendicular to the surface grade.   |
| <b>Square slope dist</b>                         | Slope distance from the slope reference line to the current position perpendicular to the slope. The slope distance is always at the same grade as the defined or current slope. If the current position is above or below the slope, the slope distance is projected square to the slope. The slope distance is calculated to the defined reference point.<br><br>The <b>Square slope dist</b> is measured from the current position to the reference line. |
| <b>CL height difference or CL cut &amp; fill</b> | Height difference from the centreline.<br>C = cut, F = fill  |
| <b>CL height</b>                                 | Height of the centreline at the current chainage.  |
| <b>CL radius</b>                                 | Radius of the centreline at the current chainage.  |
| <b>CL type</b>                                   | Element type of the centreline.  |
| <b>CL offset</b>                                 | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |

| Field                           | Description  |
|---------------------------------|--|
| <b>CL tangent</b>               | Tangent direction of the centreline at the current chainage.   |
| <b>Width</b>                    | Horizontal width of the surface grade.   |
| <b>Nearest hz tangent point</b> | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment. |

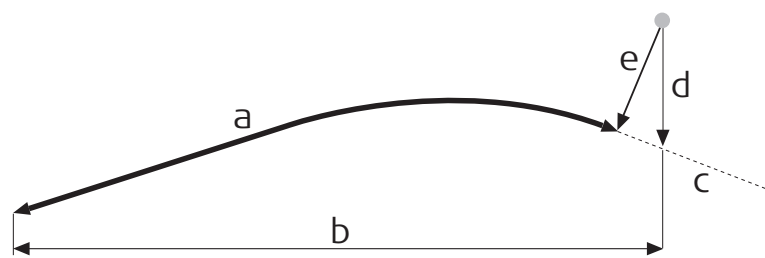


Road\_099

- a Vertical alignment
- b Horizontal alignment

Only tangent points are detected. A tangent point is the start/end point of a road segment.




|   |   |
|---|---|
| <b>Nearest vertical tangent point</b>   | Distance to the nearest vertical tangent point of the design.   |
| <b>Centreline grade</b>                 | Grade of the centreline at the current position.  |
| <b>Height difference at 3D chainage</b> | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
| <b>3D chainage</b>                      | Chainage of the measured point is projected perpendicular to the vertical component of the selected line.   |




Road\_089

- a **3D chainage**
- b Chainage
- c Centreline
- d Centreline height difference
- e **Height difference at 3D chainage**

|                           |  |
|---------------------------|--|
| <b>Direction to point</b> | Direction from the current position to the point to stake out. |
| <b>Distance to point</b>  | Distance from the current position to the point to stake out.  |

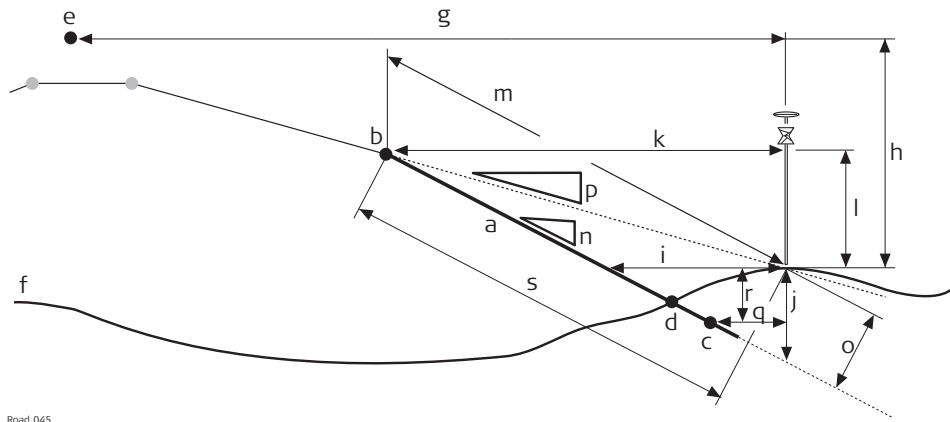
| Field                        | Description   |
|------------------------------|---|
| <b>Defined easting</b>       | Easting of the point to stake out.  |
| <b>Defined northing</b>      | Northing of the point to stake out.   |
| <b>Defined height</b>        | Height of the point to stake out.   |
| <b>Actual easting</b>        | Easting of the current position.  |
| <b>Actual northing</b>       | Northing of the current position.   |
| <b>Actual height</b>         | Height of the current position.   |
| <b>Current design east</b>   | Easting of the design for the current position. Relevant point on the surface grade = <b>Actual easting</b> .   |
| <b>Current design north</b>  | Northing of the design for the current position. Relevant point on the surface grade = <b>Actual northing</b> .   |
| <b>Current design height</b> | Height of the design for the current position. Relevant point on the surface grade.   |
| <b>3D quality</b>            | Standard deviation of the point measurement.  |
| <b>Go forward/backward</b>   | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
| <b>Go left/right</b>         | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
| <b>Go</b>                    | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |

| Field   | Description   |
|---|---|
| <b>Turn left/<br/>right</b>   | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to: |
|  |   |
| <b>Separator<br/>and<br/>Unused line</b>  | Empty line.   |

### 46.3.5

### Road Manual Slope, Local Manual Slope and Slope - Info Page

#### Available fields







Road\_045

- a Slope to stake out/check
- b Hinge point **Hinge name**, reference line
- c Second line of slope **Additional line name**
- d Real catch point
- e Centreline
- f Natural surface
- g **CL offset**
- h **CL height difference** or **CL cut & fill**
- i **Slope offset**
- j **Slope height diff**
- k **Hinge offset**
- l **Hinge ht diff**
- m **Slope distance hinge**
- n **Slope design ratio**
- o **Square offset**
- p **Current slope ratio**
- q **Additional line offset**
- r **Additional line ht diff**
- s **Square slope dist**

The following parameters are available. All fields are display only.

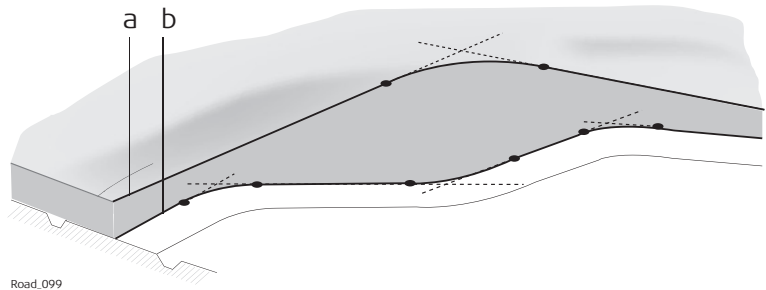
| Field             | Description                      |
|-------------------|----------------------------------|
| <b>Slope task</b> | Name defined for the slope task. |

| Field                           | Description  |
|---------------------------------|--|
| <b>Difference in offset</b>     | Horizontal offset between the defined position and the current position.   |
| <b>Difference in height</b>     | Vertical offset between the defined position and the current position.   |
| <b>Difference in chainage</b>   | Difference between the defined chainage and the current chainage.<br> If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |
| <b>Chainage</b>                 | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.   |
| <b>Stake chainage</b>           | Chainage to stake out.   |
| <b>Slope offset</b>             | Horizontal offset from the slope.  |
| <b>Slope height diff</b>        | Height difference from the slope. If no stake height difference is used <b>Slope height diff = Difference in height</b> .  |
| <b>Height difference rail</b>   | Height difference from the batter rail to mark the slope (for <b>Type: Batter rail vertical</b> in <b>Slope Stakeout Settings</b> ).   |
| <b>Hinge name</b>               | Name of the line defining the hinge of the slope.  |
| <b>Hinge offset</b>             | Horizontal offset from the hinge point of the slope.   |
| <b>Hinge ht diff</b>            | Height difference from the hinge point of the slope.   |
| <b>Additional line name</b>     | Name of the second line defining the slope.  |
| <b>Additional line offset</b>   | Horizontal offset from the second line of the slope.   |
| <b>Additional line ht diff</b>  | Height difference from the second line of the slope.   |
| <b>Slope design ratio</b>       | Ratio of the slope.<br> The display format is defined as system setting in <b>Regional, Slope</b> page.   |
| <b>Slope distance hinge</b>     | Slope distance to the hinge point.<br> All defined settings for a batter rail or reference point are already taken into account. This value is the information to write on the stake.                               |
| <b>Slope design ratio (gon)</b> | Slope ratio in gon.  |
| <b>Slope design ratio (deg)</b> | Slope ratio in decimal degrees.  |

| Field  | Description   |
|--|---|
| <b>Slope design ratio (%)</b>                    | Slope ratio in percent.   |
| <b>Current slope ratio</b>                       | Ratio of the slope from the current position to the hinge.<br><br> For the catch point, the <b>Current slope ratio</b> is identical to the <b>Slope design ratio</b> .   |
| <b>Square offset</b>                             | Offset from the slope, perpendicular to the slope.  |
| <b>Square slope dist</b>                         | Slope distance from the slope reference line to the current position perpendicular to the slope. The slope distance is always at the same grade as the defined or current slope. If the current position is above or below the slope, the slope distance is projected square to the slope. The slope distance is calculated to the defined reference point.<br><br>For slope, the <b>Square slope dist</b> is measured from the current position to the reference line.<br><br>For manual slope and local manual slope, <b>Square slope dist</b> is measured from the current position to the hinge line. |
| <b>CL height difference or CL cut &amp; fill</b> | Height difference from the centreline.<br>C = cut, F = fill   |
| <b>CL height</b>                                 | Height of the centreline at the current chainage.   |
| <b>CL radius</b>                                 | Radius of the centreline at the current chainage.   |
| <b>CL type</b>                                   | Element type of the centreline.   |
| <b>CL offset</b>                                 | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.   |
| <b>CL tangent</b>                                | Tangent direction of the centreline at the current chainage.  |
| <b>Offset angle</b>                              | Available for manual slope. The defined value for the angle to alignment.   |
| <b>Traveller height</b>                          | Height of the traveller in use.<br>Refer to <a href="#">48.2.3 Advanced Slope Settings</a> for information on the different methods of slope staking.   |
| <b>Nearest hz tangent point</b>                  | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.  |



| Field | Description |
|-------|-------------|
|-------|-------------|



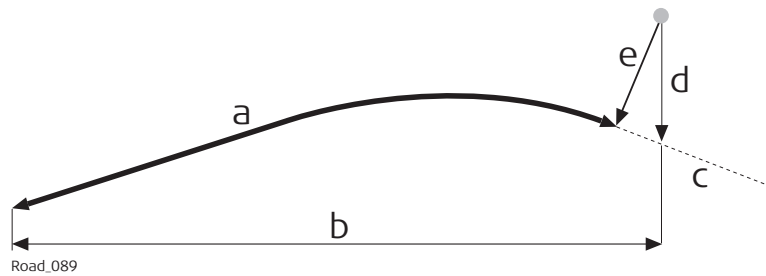
- a Vertical alignment
- b Horizontal alignment

Only tangent points are detected. A tangent point is the start/end point of a road segment.

|                                       |   |
|---------------------------------------|---|
| <b>Nearest vertical tangent point</b> | Distance to the nearest vertical tangent point of the design. |
|---------------------------------------|---|

|   |   |
|---|---|
| <b>Height difference at 3D chainage</b> | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
|---|---|

|                    |   |
|--------------------|---|
| <b>3D chainage</b> | Chainage of the measured point is projected perpendicular to the vertical component of the selected line. |
|--------------------|---|



- a **3D chainage**
- b Chainage
- c Centreline
- d Centreline height difference
- e **Height difference at 3D chainage**

|                         |  |
|-------------------------|--|
| <b>Centreline grade</b> | Grade of the centreline at the current position. |
|-------------------------|--|





|                           |  |
|---------------------------|--|
| <b>Direction to point</b> | Direction from the current position to the point to stake out. |
|---------------------------|--|

|                          |   |
|--------------------------|---|
| <b>Distance to point</b> | Distance from the current position to the point to stake out. |
|--------------------------|---|

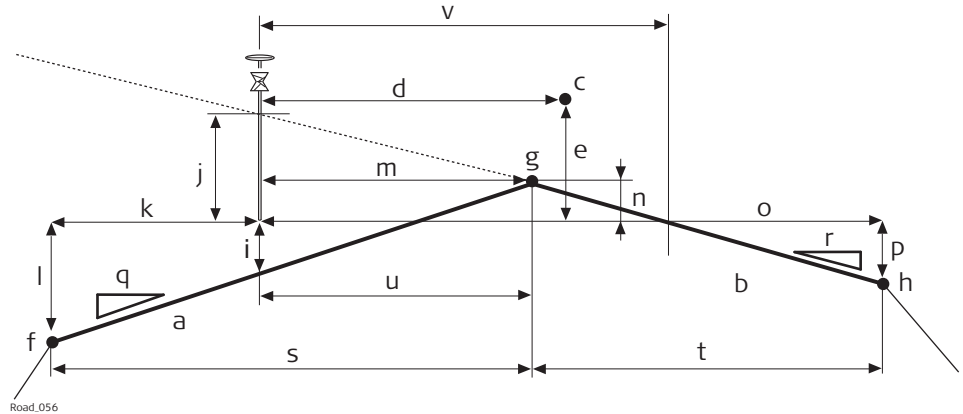
|                        |                                    |
|------------------------|------------------------------------|
| <b>Defined easting</b> | Easting of the point to stake out. |
|------------------------|------------------------------------|

|                         |                                     |
|-------------------------|-------------------------------------|
| <b>Defined northing</b> | Northing of the point to stake out. |
|-------------------------|-------------------------------------|

|                       |                                   |
|-----------------------|-----------------------------------|
| <b>Defined height</b> | Height of the point to stake out. |
|-----------------------|-----------------------------------|



| Field                            | Description  |
|----------------------------------|--|
| <b>Actual easting</b>            | Easting of the current position.   |
| <b>Actual northing</b>           | Northing of the current position.  |
| <b>Actual height</b>             | Height of the current position.  |
| <b>Current design east</b>       | Easting of the design for the current position. Relevant point on the slope = <b>Actual easting</b> .  |
| <b>Current design north</b>      | Northing of the design for the current position relevant point on the slope = <b>Actual northing</b> .   |
| <b>Current design height</b>     | Height of the design for the current position. Relevant point on the slope.  |
| <b>3D quality</b>                | Standard deviation of the point measurement.   |
| <b>Go forward/backward</b>       | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>          |
| <b>Go left/right</b>             | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>        |
| <b>Go</b>                        | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br>  |
| <b>Turn left/right</b>           | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |
| <b>Separator and Unused line</b> | Empty line.  |


Available fields

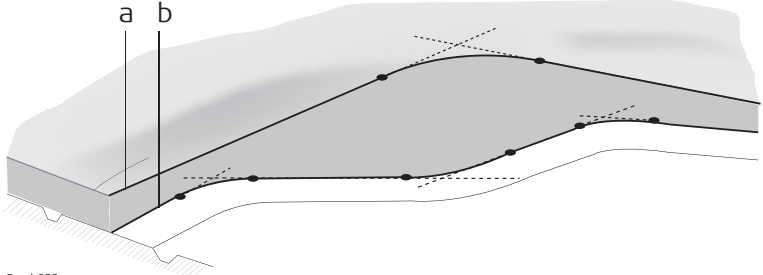





- a Left surface grade of road crown
- b Right surface grade of road crown
- c Centreline
- d **CL offset**
- e **CL height difference** or **CL cut & fill**
- f Left most line of the crown **Left name**
- g Middle line of the crown **Mid name**
- h Right most line of the crown **Right name**
- i **Left surface grade ht diff**
- j **Right surface grade ht diff**
- k **Left offset**
- l **Left height diff**
- m **Mid offset**
- n **Mid height diff**
- o **Right offset**
- p **Right height diff**
- q **Left surface grade ratio**
- r **Right surface grade ratio**
- s **Left width**
- t **Right width**


The following parameters are available. All fields are display only.

| Field                            | Description  |
|----------------------------------|--|
| <b>Crown task</b>                | Name defined for the road crown task.  |
| <b>Additional line</b>           | The name of an extra line.   |
| <b>Additional line chain-age</b> | Current local chainage of extra line.  |
| <b>Additional line offset</b>    | Current perpendicular offset to the additional line including the defined stake/check offset of extra line of the  page.            |
| <b>Additional line ht diff</b>   | Current height difference to the additional line including the defined stake/check height difference of the additional line of  page. |

| Field                              | Description   |
|------------------------------------|---|
| <b>Difference in offset</b>        | Horizontal offset to the line of the crown defined as the reference line.<br>If working in the toggle offset left/right mode, the correct line is automatically selected as the reference. The measured point can be to the left or right of the middle line.<br>Refer to <a href="#">48.3.9 Measuring Road Crowns</a> for more information on the toggle offset left/right mode. |
| <b>Diff in ht to left surface</b>  | Vertical offset to the left/right surface grade defining the road crown.  |
| <b>Diff in ht to right surface</b> | Vertical offset to the left/right surface grade defining the road crown.  |
| <b>Difference in chainage</b>      | Difference between the defined chainage and the current chainage.<br> If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> .  |
| <b>Chainage</b>                    | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |
| <b>Stake chainage</b>              | Chainage to stake out.  |
| <b>Left surface grade ht diff</b>  | Height difference from the road crowns left surface grade.  |
| <b>Right surface grade ht diff</b> | Height difference from the road crowns right surface grade.   |
| <b>Height difference crown</b>     | Height difference from <b>Active surface grade</b> of the crown.  |
| <b>Active surface grade</b>        | Indicates if you are on the left or right surface grade of the road crown.  |
| <b>Active surface grade ratio</b>  | Slope ratio of <b>Active surface grade</b> . This value is equal to <b>Left surface grade ratio</b> or <b>Right surface grade ratio</b> depending on the value of <b>Active surface grade</b> .   |
| <b>Left name</b>                   | Name of the left-most line defining the road crown.   |
| <b>Left offset</b>                 | Horizontal offset from the left line of the road crown.   |
| <b>Left height diff</b>            | Height difference from the left line of the road crown.   |
| <b>Right name</b>                  | Name of the right-most line defining the road crown.  |
| <b>Right offset</b>                | Horizontal offset from the right line of the road crown.  |
| <b>Right height diff</b>           | Height difference from the right line of the road crown.  |
| <b>Mid name</b>                    | Name of the mid line defining the road crown.   |
| <b>Mid offset</b>                  | Horizontal offset from the mid line of the road crown.  |

| Field  | Description   |
|--|---|
| <b>Mid height diff</b>   | Height difference from the mid line of the road crown.  |
| <b>Left surface grade ratio</b>  | Slope ratio of the road crowns left surface grade.  |
| <b>Right surface grade ratio</b>   | Slope ratio of the road crowns right surface grade.   |
| <b>Left width</b>  | Horizontal width of the road crowns left surface grade.   |
| <b>Right width</b>   | Horizontal width of the road crowns right surface grade.  |
| <b>CL height difference</b><br>or <b>CL cut &amp; fill</b>   | Height difference from the centreline.<br>C = cut, F = fill   |
| <b>CL height</b>   | Height of the centreline at the current chainage.   |
| <b>CL radius</b>   | Radius of the centreline at the current chainage.   |
| <b>CL type</b>   | Curve type of the centreline.   |
| <b>CL offset</b>   | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page. |
| <b>CL tangent</b>  | Tangent direction of the centreline at the current chainage.  |
| <b>Nearest hz tangent point</b>  | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.                              |
|  <p style="text-align: center;">Road_099</p> <p style="text-align: center;">a Vertical alignment<br/>b Horizontal alignment</p> <p>Only tangent points are detected. The tangent point is the start/end point of a road segment.</p> |   |
| <b>Nearest vertical tangent point</b>  | Distance to the nearest vertical tangent point of the design.   |
| <b>Centreline grade</b>  | Grade of the centreline at the current position.  |
| <b>Direction to point</b>  | Direction from the current position to the point to stake out.  |
| <b>Distance to point</b>   | Distance from the current position to the point to stake out.   |

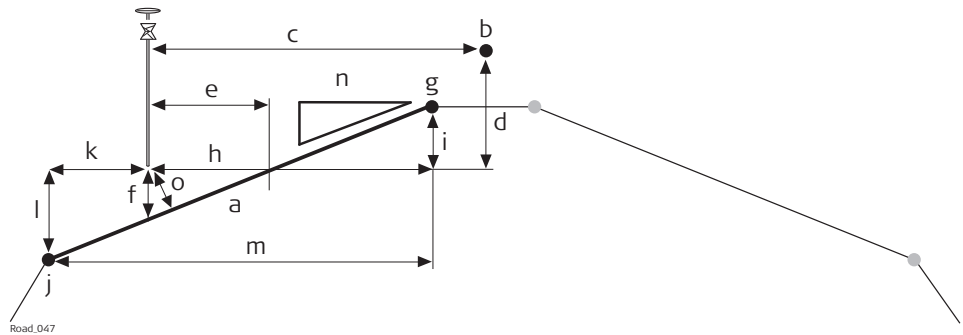
| Field                        | Description   |
|------------------------------|---|
| <b>Defined easting</b>       | Easting of the point to stake out.  |
| <b>Defined northing</b>      | Northing of the point to stake out.   |
| <b>Defined height</b>        | Height of the point to stake out.   |
| <b>Actual easting</b>        | Easting of the current position.  |
| <b>Actual northing</b>       | Northing of the current position.   |
| <b>Actual height</b>         | Height of the current position.   |
| <b>Current design east</b>   | Easting of the design for the current position (relevant point on the crown = <b>Actual easting</b> ).  |
| <b>Current design north</b>  | Northing of the design for the current position relevant point on the crown = <b>Actual northing</b> ).   |
| <b>Current design height</b> | Height of the design for the current position. Relevant point on the crown.   |
| <b>3D quality</b>            | Standard deviation of the point measurement.  |
| <b>Go forward/backward</b>   | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
| <b>Go left/right</b>         | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
| <b>Go</b>                    | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |

| Field   | Description   |
|---|---|
| <b>Turn left/right</b>  | Direction to point. Available for staking.<br>For <b>Navigational arrow types</b> : <b>Direction &amp; distance</b> in 3D viewer equivalent to: |
|  |   |
| <b>Separator and Unused line</b>  | Empty line.   |

### 46.3.7


### Road Layer - Info Page



#### Available fields



- a Relevant part of the layer
- b Centreline
- c **CL offset**
- d **CL height difference** or **CL cut & fill**
- e Slope offset
- f **Layer ht diff**
- g **Right name**
- h **Right offset**
- i **Right height diff**
- j **Left name**
- k **Left offset**
- l **Left height diff**
- m **Width**
- n **Slope design ratio** or **Surface grade ratio**
- o **Square offset**

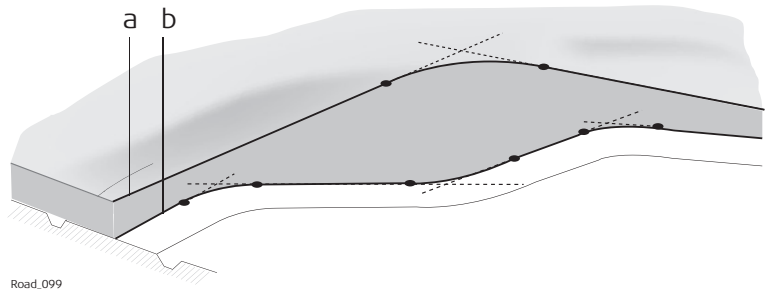
The following parameters are available. All fields are display only.

| Field                         | Description   |
|-------------------------------|---|
| <b>Layer task</b>             | Name defined for the layer task.  |
| <b>Layer name</b>             | Name of the layer to check.   |
| <b>Chainage</b>               | Chainage of the current measured position.  |
| <b>Difference in chainage</b> | Difference between the defined chainage and the current chainage.   |
|                               |  If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |

| Field  | Description  |
|--|--|
| <b>Stake chainage</b>                                      | Chainage to stake out.   |
| <b>Layer offset</b>  | Horizontal offset from the layer. Surface between <b>Left line</b> and <b>Right line</b> .   |
| <b>Layer ht diff</b>                                       | Height difference of the measured position to the layer  |
| <b>Difference in height</b>                                | Height difference to the layer, including the stake or check height difference.  |
| <b>Left name</b>   | Name of the line next to the current position on the left side.  |
| <b>Left offset</b>   | Horizontal offset from the left line <b>Left name</b> .  |
| <b>Layer ht diff</b>                                       | Height difference to the left line <b>Left name</b> .  |
| <b>Right name</b>  | Name of the line next to the current position on the right side.   |
| <b>Right offset</b>  | Horizontal offset from the right line <b>Right name</b> .  |
| <b>Right height diff</b>                                   | Height difference to the right line <b>Right name</b> .  |
| <b>Slope design ratio</b>                                  | Ratio of the slope between the left line <b>Left name</b> and the right line <b>Right name</b> .<br> The display format is defined as system setting in <b>Regional, Slope</b> page.  |
| <b>Surface grade ratio</b>                                 | Ratio of the surface grade between the left line <b>Left name</b> and the right line <b>Right name</b> .<br> The display format of the <b>Surface grade ratio</b> depends on the type chosen for <b>Surface grade</b> on <b>Regional, Slope</b> page. |
| <b>Square offset</b>                                       | Offset from the slope, perpendicular to the slope.   |
| <b>CL height difference</b><br>or <b>CL cut &amp; fill</b> | Height difference from the centreline.<br>C = cut, F = fill  |
| <b>CL height</b>   | Height of the centreline at the current chainage.  |
| <b>CL radius</b>   | Radius of the centreline at the current chainage.  |
| <b>CL type</b>   | Curve type of the centreline.  |
| <b>CL offset</b>   | Horizontal offset from the centreline at the current chainage.   |
| <b>CL tangent</b>  | Tangent direction of the centreline at the current chainage.   |
| <b>Traveller height</b>                                    | The height of the traveller.   |
| <b>Nearest hz tangent point</b>                            | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.   |



| Field | Description |
|-------|-------------|
|-------|-------------|



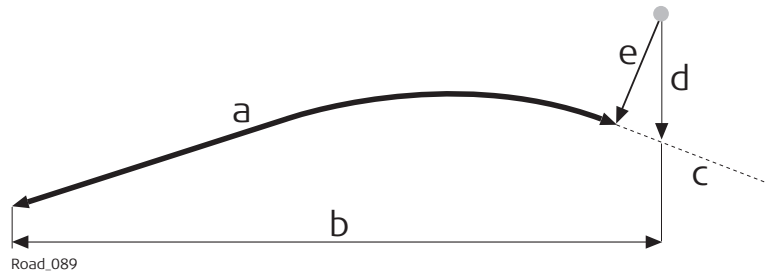
- a Vertical alignment
- b Horizontal alignment

Only tangent points are detected. The tangent point is the start/end point of a road segment.

|                                       |   |
|---------------------------------------|---|
| <b>Nearest vertical tangent point</b> | Distance to the nearest vertical tangent point of the design. |
|---------------------------------------|---|

|   |   |
|---|---|
| <b>Height difference at 3D chainage</b> | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment. |
|---|---|

|                    |   |
|--------------------|---|
| <b>3D chainage</b> | Chainage of the measured point is projected perpendicular to the vertical component of the selected line. |
|--------------------|---|



- a **3D chainage**
- b Chainage
- c Centreline
- d Centreline height difference
- e **Height difference at 3D chainage**

|                         |  |
|-------------------------|--|
| <b>Centreline grade</b> | Grade of the centreline at the current position. |
|-------------------------|--|





|                           |  |
|---------------------------|--|
| <b>Direction to point</b> | Direction from the current position to the point to stake out. |
|---------------------------|--|

|                          |   |
|--------------------------|---|
| <b>Distance to point</b> | Distance from the current position to the point to stake out. |
|--------------------------|---|

|                        |                                    |
|------------------------|------------------------------------|
| <b>Defined easting</b> | Easting of the point to stake out. |
|------------------------|------------------------------------|

|                         |                                     |
|-------------------------|-------------------------------------|
| <b>Defined northing</b> | Northing of the point to stake out. |
|-------------------------|-------------------------------------|

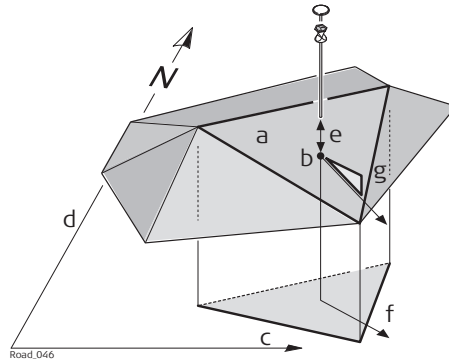
|                       |                                   |
|-----------------------|-----------------------------------|
| <b>Defined height</b> | Height of the point to stake out. |
|-----------------------|-----------------------------------|

| Field                            | Description  |
|----------------------------------|--|
| <b>Actual easting</b>            | Easting of the current position.   |
| <b>Actual northing</b>           | Northing of the current position.  |
| <b>Actual height</b>             | Height of the current position.  |
| <b>Current design east</b>       | Easting of the design for the current position (relevant point on the crown = <b>Actual easting</b> ).   |
| <b>Current design north</b>      | Northing of the design for the current position relevant point on the crown = <b>Actual northing</b> ).  |
| <b>Current design height</b>     | Height of the design for the current position. Relevant point on the crown.  |
| <b>3D quality</b>                | Standard deviation of the point measurement.   |
| <b>Go forward/backward</b>       | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>          |
| <b>Go left/right</b>             | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>        |
| <b>Go</b>                        | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br>  |
| <b>Turn left/right</b>           | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |
| <b>Separator and Unused line</b> | Empty line.  |



An **i** page is only available for **Check rail**.

### Available fields



- a Relevant triangle of the DTM
- b Projected point on DTM
- c Easting
- d Northing
- e **DTM height diff**
- f **Flow direction**
- g **Flow ratio**

The following parameters are available. All fields are display only.

| Field                        | Description   |
|------------------------------|---|
| <b>DTM task</b>              | Name defined for the DTM task.  |
| <b>DTM height diff</b>       | Vertical height difference to the DTM.  |
| <b>Difference in height</b>  | Height difference to the layer including the stake or check height difference.  |
| <b>DTM height</b>            | Height of the DTM at the current measured position.   |
| <b>Flow direction</b>        | Direction of maximum slope ratio on the current DTM triangle. This direction is the direction water would flow toward from the projected point. |
| <b>Flow ratio</b>            | Slope ratio of the DTM. This ratio is the maximum slope ratio of the triangle.  |
| <b>DTM name</b>              | Name of the DTM surface.  |
| <b>Actual easting</b>        | Easting of the current position.  |
| <b>Actual northing</b>       | Northing of the current position.   |
| <b>Actual height</b>         | Height of the current position.   |
| <b>Current design east</b>   | Easting of the DTM for the current position = <b>Actual easting</b> .   |
| <b>Current design north</b>  | Northing of the DTM for the current position = <b>Actual northing</b> .   |
| <b>Current design height</b> | Height of the DTM for the current position.   |
| <b>3D quality</b>            | Standard deviation of the point measurement.  |


| Field                            | Description |
|----------------------------------|-------------|
| <b>Separator and Unused line</b> | Empty line. |

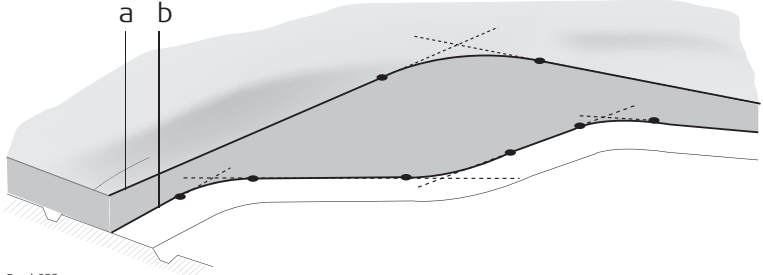
### 46.3.9




### Rail - Info Page





#### Available fields

The following parameters are available. All fields are display only.

| Field  | Description  |
|--|--|
| <b>Difference in offset</b>                      | Distance from the measured point to the point to stake out in a direction perpendicular to the horizontal alignment.   |
| <b>Difference in height</b>                      | Vertical offset between the defined position and the current position.   |
| <b>Difference in chainage</b>                    | Difference between the defined chainage and the current chainage.<br><br> If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |
| <b>Chainage</b>                                  | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.   |
| <b>CL height difference or CL cut &amp; fill</b> | Height difference from the centreline.<br>C = cut, F = fill  |
| <b>CL height</b>                                 | Height of the centreline at the current chainage.  |
| <b>CL radius</b>                                 | Radius of the horizontal alignment at the chainage of the measured point.  |
| <b>CL type</b>                                   | Element type of the centreline.  |
| <b>CL offset</b>                                 | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |
| <b>CL tangent</b>                                | Tangent direction of the centreline at the current chainage.   |
| <b>Nearest hz tangent point</b>                  | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.   |

| Field                                 | Description  |
|---------------------------------------|--|
|                                       |  <p>Road_099</p> <p>a Vertical alignment<br/>b Horizontal alignment</p> <p>Only tangent points are detected. The tangent point is the start/end point of a road segment.</p> |
| <b>Nearest vertical tangent point</b> | Distance to the nearest vertical tangent point of the design.  |
| <b>Centreline grade</b>               | Grade of the centreline at the current position.   |
| <b>Direction to point</b>             | Direction from the current position to the point to stake out.   |
| <b>Distance to point</b>              | Distance from the current position to the point to stake out.  |
| <b>Defined easting</b>                | Easting of the point to stake out.   |
| <b>Defined northing</b>               | Northing of the point to stake out.  |
| <b>Defined height</b>                 | Height of the point to stake out.  |
| <b>Actual easting</b>                 | Easting of the current position.   |
| <b>Actual northing</b>                | Northing of the current position.  |
| <b>Current design east</b>            | Easting of the design for the current position. Relevant point at the selected line.   |
| <b>Current design north</b>           | Northing of the design for the current position. Relevant point at the selected line.  |
| <b>Current design height</b>          | Height of the design for the current position. Relevant point at the selected line.  |
| <b>3D quality</b>                     | Standard deviation of the point measurement.   |
| <b>Height of lower rail</b>           | Height of the lower rail at current chainage.  |
| <b>Height difference lower rail</b>   | Height difference between the measured point and the lower rail.   |

| Field  | Description   |
|--|---|
| <b>Current design super-elevation</b>            | Design cant at the current position.  |
| <b>Ref offset</b>                                | Horizontal distance between the measured point and the rail or centreline being used as a reference.  |
| <b>Ref height diff</b>                           | Height difference between the measured point and the rail or centreline being used as a reference.  |
| <b>Offset (using super-elevation)</b>            | Offset calculated regarding the cant.   |
| <b>Height difference (using super-elevation)</b> | Height difference calculated regarding the cant.  |
| <b>Rail task</b>                                 | Name of the current task.   |
| <b>Rail name</b>                                 | Name of the centreline or rail being used as a reference.   |
| <b>Defined design cant</b>                       | Design cant at the defined chainage.  |
| <b>Pendular length</b>                           | The pendulum length as distance value: The difference in elevation of the pendulum centre on the original track and above the axis point.   |
| <b>Def pendulum displacement</b>                 | The defined horizontal displacement for the track.  |
| <b>Def pendulum angle</b>                        | The pendulum displacement and the superelevation (cant) define the pendulum angle.  |
| <b>Actual pendulum displacement</b>              | The current horizontal displacement for the track.  |
| <b>Separator and Unused line</b>                 | Empty line.   |
| <b>Current super-elevation</b>                   | Available for Check. Superelevation of the current position. This value is calculated by using the 'Second Point of Cant' option, which is located in the toolbox.  |
| <b>Measured super-elevation</b>                  | Displays the value entered on <b>Check Track</b> ,  page. The value is measured with a camber measurement instrument.  |
|  |  Using <b>Second Point</b> of the toolbox, <b>Measured super-elevation</b> on the  page is set to ----- and is not stored in the DBX. The current cant value of <b>Second Point</b> is used and not the manually entered measured cant value. |

| Field   | Description  |
|---|--|
| <b>Super-elevation difference</b>   | <p>The calculation depends on the setting for <b>Use super-elevation</b> in <b>Road Settings, Rail design</b> page:</p> <ul style="list-style-type: none"> <li>For <b>Use super-elevation: From design:</b><br/><b>Super-elevation difference</b> = Measured cant - Current design cant</li> <li>For <b>Use super-elevation: Enter manually:</b><br/><b>Super-elevation difference</b> = Measured cant - Manually defined cant of <b>Check Track</b>,  page</li> <li>For <b>Use super-elevation: Show message:</b><br/><b>Super-elevation difference</b> = -----</li> </ul> |
| Also available for <b>Stake: Track &amp; gauge device</b> or <b>Rails &amp; gauge device:</b> |  |
| <b>Director rail offset difference</b>  | Difference between the theoretical position of the rail director and the measured position.  |
| <b>Left rail height difference</b>  | Height difference between the theoretical left rail position and the measured position.  |
| <b>Right rail height diff</b>   | Height difference between the theoretical right rail position and the measured position.   |
| <b>Measured gauge</b>   | Gauge value measured by the gauge device.  |
| <b>Measured gauge</b>   | Cant value measured by the gauge device.   |
| <b>Difference in gauge</b>  | Difference between the nominal gauge and the gauge measured from the gauge device.   |
| <b>Go forward/backward</b>  | <p>Distance to point. Available for staking.<br/>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:</p> <p style="text-align: center;"></p>  |
| <b>Go left/right</b>  | <p>Distance to point. Available for staking.<br/>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:</p> <p style="text-align: center;"></p>  |
| <b>Go</b>   | <p>Distance to point. Available for staking.<br/>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:</p> <p style="text-align: center;"></p>  |

| Field                  | Description   |
|------------------------|---|
| <b>Turn left/right</b> | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to: |




### 46.3.10

### Tunnel - Info Page - TS

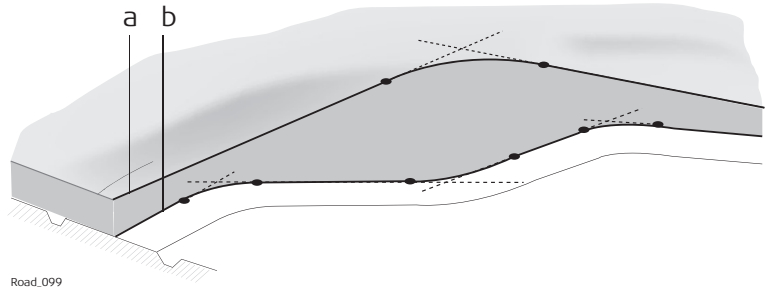
#### Available fields

The following parameters are available. All fields are display only.

| Field                                   | Description  |
|---|--|
| <b>Line task</b>                        | Name of the current task.  |
| <b>Difference in offset</b>             | Horizontal offset between the defined position and the current position.   |
| <b>Difference in height</b>             | Vertical offset between the defined position and the current position.   |
| <b>Difference in chainage</b>           | Difference between the defined chainage and the current chainage.<br><br> If no defined chainage exists, for example if staking out random chainages or checking, this field reads <b>Difference in chainage: -----</b> . |
| <b>Chainage</b>                         | The current chainage. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.   |
| <b>Line offset</b>                      | Horizontal offset from the line.   |
| <b>Line name</b>                        | Name of the line to stake out or the stakeout is relative to.  |
| <b>Line height difference</b>           | Height difference from the centreline.   |
| <b>Height difference at 3D chainage</b> | Offset perpendicular to the vertical component of the selected line.<br>This value can be useful when dealing with pipelines, cables and in the construction segment.  |
| <b>CL height</b>                        | Height of the centreline at the current chainage.  |
| <b>CL radius</b>                        | Radius of the centreline at the current chainage.  |
| <b>CL type</b>                          | Element type of the centreline.  |
| <b>CL offset</b>                        | Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for <b>Help me navigate</b> and <b>Navigational arrow types</b> in <b>Road Settings, Graphics</b> page.  |
| <b>CL tangent</b>                       | Tangent direction of the centreline at the current chainage.   |
| <b>Nearest hz tangent point</b>         | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.   |



| Field | Description |
|-------|-------------|
|-------|-------------|



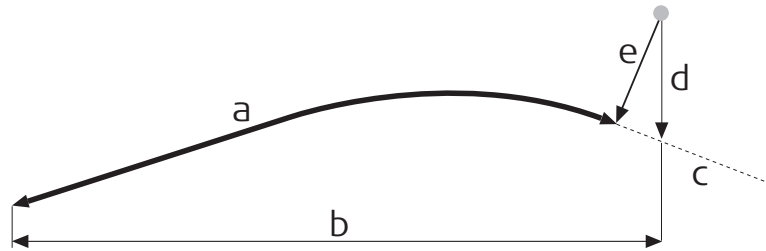
Road\_099

- a Vertical alignment
- b Horizontal alignment

Only tangent points are detected. The tangent point is the start/end point of a road segment.

|                                       |   |
|---------------------------------------|---|
| <b>Nearest vertical tangent point</b> | Distance to the nearest vertical tangent point of the design. |
|---------------------------------------|---|




|                    |   |
|--------------------|---|
| <b>3D chainage</b> | Chainage of the measured point is projected perpendicular to the vertical component of the selected line. |
|--------------------|---|



Road\_089

- a **3D chainage**
- b Chainage
- c Centreline
- d Centreline height difference
- e **Height difference at 3D chainage**

|                           |   |
|---------------------------|---|
| <b>Centreline grade</b>   | Grade of the centreline at the current position.                                      |
| <b>Direction to point</b> | Direction from the current position to the point to stake out.                        |
| <b>Distance to point</b>  | Distance from the current position to the point to stake out.                         |
| <b>Defined easting</b>    | Easting of the point to stake out.  |
| <b>Defined northing</b>   | Northing of the point to stake out.   |
| <b>Defined height</b>     | Height of the point to stake out.   |
| <b>Actual easting</b>     | Easting of the design for the current position. Relevant point at the selected line.  |
| <b>Actual northing</b>    | Northing of the design for the current position. Relevant point at the selected line. |

| Field                                 | Description   |
|---------------------------------------|---|
| <b>Actual height</b>                  | Height of the design for the current position. Relevant point at the selected line.   |
| <b>3D quality</b>                     | Standard deviation of the point measurement.  |
| <b>Separator and Unused line</b>      | Empty line.   |
| <b>Difference to profile</b>          | Distance from the design profile to the measured point.   |
| <b>Element number</b>                 | Element number of the closest design profile element to the measured point.   |
| <b>Element (%)</b>                    | Distance in percentage terms of the measured point along the design profile element.  |
| <b>Dist along profile</b>             | Distance of the measured point along the design profile starting at the origin of the profile.  |
| <b>Top distance</b>                   | Distance of the measured point along the design profile starting at the top of the profile.   |
| <b>CL offset rotated</b>              | Perpendicular horizontal offset from the current position to the centreline, along the X-axis of the rotated tunnel profile   |
| <b>Centreline height diff rotated</b> | Height difference from the current position to the centreline along the Y-axis of the rotated tunnel profile.   |
| <b>Go forward/backward</b>            | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
| <b>Go left/right</b>                  | Distance to point. Available for staking.<br>For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
| <b>Go</b>                             | Distance to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |

| Field                  | Description   |
|------------------------|---|
| <b>Turn left/right</b> | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to: |

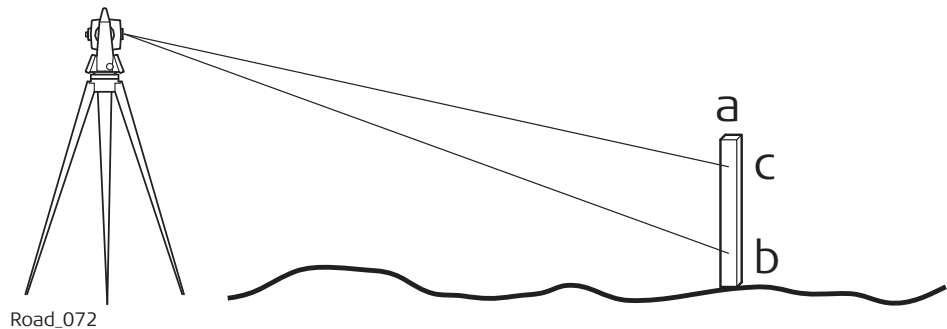


### 46.3.11

### Workflow for Height (aim to stake ht) - for TS

#### Step-by-step

In this example, the height of the surface grade is marked on a peg by using the auto position function.



- a Peg placed at the correct position
- b First height, manually chosen direction
- c Required height on the peg

1. In the **Road Settings, TS specific** page, select **Automatic behaviour when aiming to point being staked: Prompt before turn**.


 Make sure that the instrument uses the reflectorless EDM mode.

2. After staking out the peg at the correct position with **Prompt before turn**, aim the instrument at the peg.


3. Press **Fn Position** to open the **Settings** panel.

4. **Settings**  
Highlight **Height (aim to stake ht)**.

5. Press **OK**.

 The instrument searches for the point on the peg at the required height without changing the horizontal direction.

 As soon as the defined **Upper height limit/Lower height limit** from **Road Settings, Quality control** is reached, the instrument stops.

 Depending on the settings chosen, the instrument turns on the red laser to mark the height.

### 46.4

### Working with Shifts

#### Description

When working on site, often design data does not match the measured data. For example, an existing road surface that should intersect with the design surface may be 15 cm higher than the plans indicate. To guarantee a smooth

intersection, this difference has to be distributed over the remaining 100m of paving. To handle these situations, shifts can be added to the existing design data. A shift is applied when selecting the element to stake out/check.

Horizontal and vertical shifts can be applied to the selected element. By using these shifts the design can be lifted/lowered and moved horizontally.

A shift is always an overlay of the existing design and is stored with the task. For a horizontal alignment, the shift is applied perpendicular to the centreline. For the vertical part of the alignment, shifts are applied following the plumb line.



Shifts are applied temporarily to the design data. The original design data is not modified when a shift is applied.

## Access

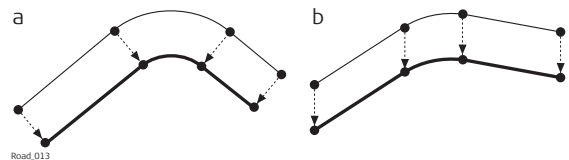
Press **Shifts** in the Define panel.

## Define Shifts, Horizontal shift/ Vertical shift/ Scale profile page

The parameters required for applying the shift are identical for all entities.

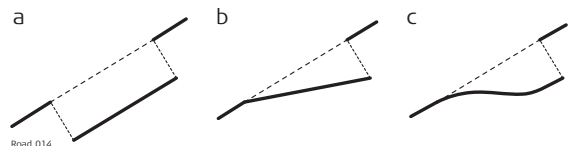
### Description of fields

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Apply horizontal shift/<br/>Apply vertical shift</b> | Check box | When this box is checked, shifts can be defined.<br>Horizontal shifts are always rectangular to the centreline of the element being worked with. Whereas vertical shifts are defined along the plumb line. |



- a Horizontal alignment with constant shift  
b Vertical alignment with constant shift

### Shift type

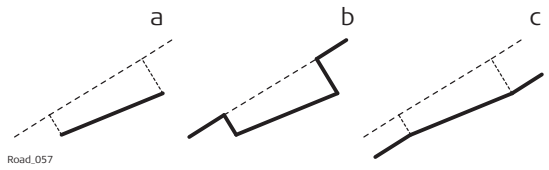


- a Constant shift  
b Linear shift  
c Parabolic shift and reverse curve

### Linear

The difference between the shift at the begin chainage and the shift defined at the end chainage is distributed in a linear fashion.

| Field                 | Option               | Description  |
|-----------------------|----------------------|--|
|                       | <b>Constant</b>      | A constant shift is applied from the begin chainage of the shift to the end chainage of the shift. The shift stays the same from its start chainage or station to the end chainage or station.   |
|                       | <b>Parabolic</b>     | Available for Road and Rail. The difference between the shift at the begin chainage and the shift defined at the end chainage is distributed using a cubic parabola. Parabolic shifts allow a smooth transition between the existing curve and the shifted part.   |
|                       | <b>Reverse curve</b> | Available for Road and Rail. Two arcs with the same radius are used to distribute the shift. As for parabolic shifts, reverse curves guarantee a smooth transition between the existing curve and the shifted part.  |
|                       |                      | <p>Road_077</p> <ul style="list-style-type: none"> <li>a Chainage</li> <li>b Shift</li> <li>c Start shift at chainage (e)</li> <li>d End shift at chainage (f)</li> <li>e Start chainage of the shift</li> <li>f End chainage of the shift</li> <li>g Radius of the two arcs used as transition curve</li> <li>h Random chainage between (e) and (f)</li> <li>i Shift applied at chainage (h)</li> </ul> |
| <b>Start chainage</b> | Editable field       | Chainage from which the shift is applied.  |
| <b>Start shift</b>    | Editable field       | Magnitude of the shift to apply at the begin chainage.   |
| <b>Shift value</b>    | Editable field       | Available for <b>Shift type: Constant</b> . The magnitude of shift.  |
| <b>End chainage</b>   | Editable field       | Chainage at which the shift ends.  |
| <b>End shift</b>      | Editable field       | Magnitude of the shift to apply at the end chainage.   |

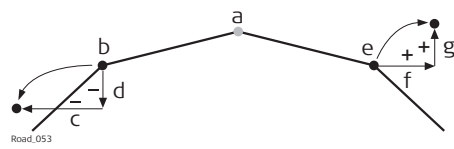
| Field                           | Option                              | Description   |
|---------------------------------|-------------------------------------|---|
| <b>Outside of entered shift</b> |                                     | Available for Road and Rail. Defines the object outside of the defined shift range.   |
|                                 |                                     |  <p>Road_057</p> <p>a <b>Show message</b><br/> b <b>Use alignment</b><br/> c <b>Continue with parallel shift</b></p>                  |
|                                 | <b>Show message</b>                 | The object only exists within the defined shift range.  |
|                                 | <b>Continue with parallel shift</b> | The begin shift and the end shift are continued parallel. The start shift is used from the start of the alignment until the start chainage. The end shift is used from the end chainage until the end of the alignment. |
|                                 | <b>Use alignment</b>                | Before/after the defined shift range, no shift is added. Outside of the defined shift area the original design is used. This option means a "step" appears at the start and/or end of the shifted area.                 |

**Plot with shifts**

In the 3D viewer, the design data is shown in its original position. The point to stake symbol is shown in its shifted position.

**Sign convention for shifts**

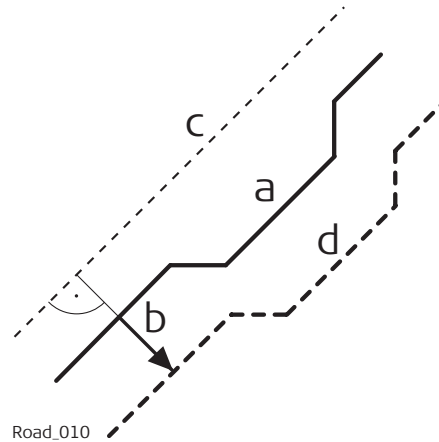
The sign convention for design shifts is identical to the convention used for stake offset and height difference.



- a Centreline
- b Line on left side
- c Negative horizontal shift
- d Negative vertical shift
- e Line on right side
- f Positive horizontal shift
- g Positive vertical shift



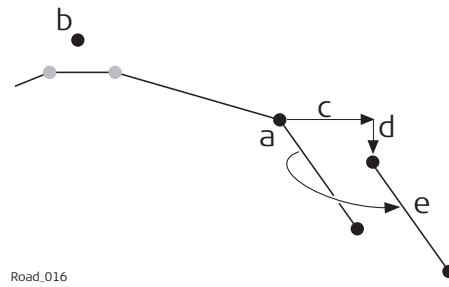
Horizontal stake offsets are always defined perpendicular to the centreline of the layer the line/s belongs to.



- a Line the horizontal shift is applied to
- b User defined horizontal shift for the line
- c Centreline
- d Shifted line

### Shifts for lines, slopes, layers and DTMs

The shifts applied to lines, slopes, road crowns layers and DTMs are identical with one exception: Given that DTMs are not defined relative to a centreline and hold no orientation information, no horizontal shift is possible for a DTM.

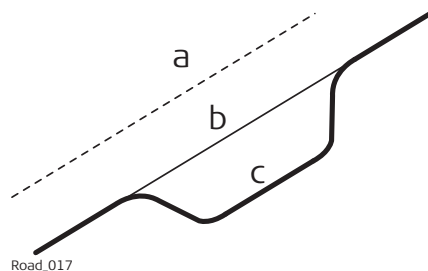


- a Slope to shift
- b Centreline
- c Value for horizontal shift
- d Value for vertical shift
- e Shifted slope

### Shift for surface grade and road crowns

#### Description

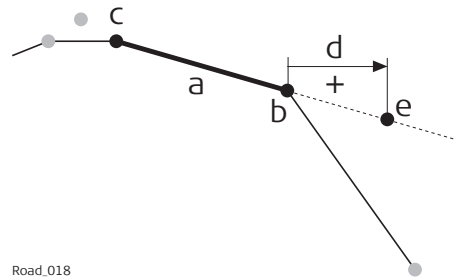
To allow widening and narrowing of surface grade and road crowns, only one of the two lines defining the surface grade or crown, is shifted when adding a horizontal shift. This behaviour is useful for small changes to the original design, for example to bus stops or emergency bays.



- a Centreline
- b Original line of the design
- c Line with horizontal parabolic shift

### Horizontal shift

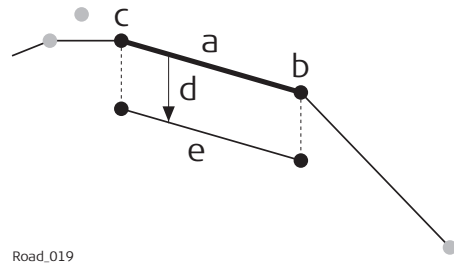
For surface grades and crowns, the horizontal shift is added to the line that is defined as the reference line. To maintain the original surface grade/crown ratio the line is shifted along the surface grade/crown.



- a Surface grade to shift
- b Reference line of the surface grade
- c Second line of the surface grade
- d Positive horizontal shift
- e Position of the shifted reference line

### Vertical shift

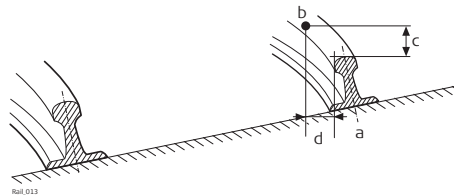
The vertical component of the shift for a surface grade or crown is applied to all lines.



- a Surface grade to shift
- b Right line of the surface grade
- c Left line of the surface grade
- d Negative vertical shift
- e Shifted surface grade

### Horizontal alignment with constant horizontal shift

Horizontal shifts are always perpendicular to the centreline.



#### Plan view

- a Reference line
- b Point to stake
- c Stake height difference
- d Stake offset

## 46.5

### Tasks

#### Description

When staking out or checking a road/rail/tunnel, often it is not possible to finish a particular task in one go. The element to be staked out or checked can be stored together with all defined settings as a work task.

Stored in a task are:

- Selected layer
- Working chainage
- Selected line(s) or element
- Shifts

Tasks are stored within the selected Road/Rail/Tunnel job. They can be created at any time when working in the field or during preparation in the office.

Deleting a task does not delete the referenced jobs.



Deleting a Road/Rail/Tunnel job deletes all referencing tasks.  
Tasks are method-specific.

## Creating a task

1. Start the Roads/Rail/Tunnel app.
2. Select a method, if necessary, and press **OK**.
3. In the Define panel press **Save task**.
4. Type in a name for the task and press **OK**.

## Load a Defined Task/ Load a Defined Rail Task/ Load Defined Tunnel Task

### Access

Press **Load** in the Define panel.



| Key                           | Description  |
|-------------------------------|--|
| <b>OK</b>                     | To select the highlighted task and continue.                                     |
| <b>Delete</b>                 | To delete the selected task.   |
| <b>More</b>                   | To display information about <b>Date, Time, Creator</b> and <b>Description</b> . |
| <b>Fn Name</b> or <b>Time</b> | To sort task list by name or time.   |

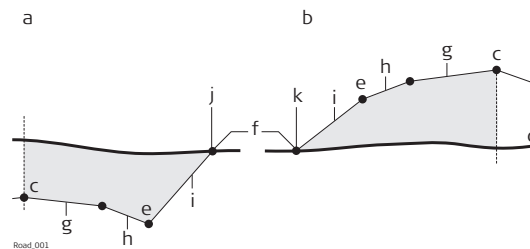
## 46.6

## Understanding Terms and Expressions

### 46.6.1

### Road - Basic Terms

#### Terms and expressions



- a Cut situation
- b Fill situation
- c Centreline
- d Natural surface
- e Hinge point
- f Catch point
- g Carriage way
- h Shoulder
- i Slope
- j Top
- k Toe

| Term / expression                         | Description   |
|---|---|
| <b>Carriage way</b>                       | The part of the road on which users drive once the road is finished.  |
| <b>Shoulder or Verge</b>                  | Often located next to the carriage way, usually with a slightly higher slope ratio than the carriage way.   |
| <b>Slope</b>                              | Located next to the verge and can be thought of as linking the road level with the natural surface. The ratio of the slope is greater than the ratio of the verge. A slope starts at the hinge point.   |
| <b>Natural surface or original ground</b> | The undisturbed surface before project construction.  |
| <b>Finished road level</b>                | Describes the final road surface.   |
| <b>Catch point or daylight point</b>      | Indicates the point of intersection between the slope and the natural surface. Both the hinge point and the catch point lie on the slope. For a cut slope, the catch point forms part of the top of a bank. For a fill slope, the catch point forms part of the bottom of a bank. |
| <b>Chainage or station</b>                | The cumulative distance along the centreline, frequently but not always starting at zero.   |

## 46.6.2

### Road - Horizontal and Vertical Geometry Elements

#### Horizontal alignment

The app supports the following elements in the horizontal component of alignments:

- Straights
- Arcs
- Clothoid, entry and exit as well as partial
- Cubic parabolas, entry and exit as well as partial
- Bloss curves, entry and exit as well as partial; only available for Rail
- Multipoints, all other elements than the previous types. Discrete points along the curve represent multipoints. For example, a line parallel to a clothoid.

#### Vertical alignment

The app supports the following elements in the vertical component of alignments:

- Straights
- Arcs
- Quadratic parabolas
- Asymmetric quadratic parabola
- Multipoints, all elements that cannot be described by one of the previous types are represented by discrete points along the curve.

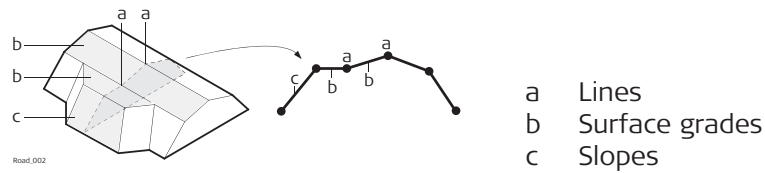
### 46.6.3

## Road - Basic Elements for Stake and Check Measurements

### Description

In general, there are four different basic stakeout and check elements:

- Surface grades, for example, the final carriage way
- Lines, for example, a centreline
- Slopes, for example, the end-slopes of a cross section
- Surfaces, for example, a DTM surface

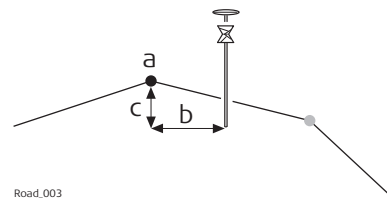


Every stakeout or check is based on one or more of these four base elements. For example, a road crown consists of two surface grades with one common line.

### Lines

The stake out of a line is used in different situations:

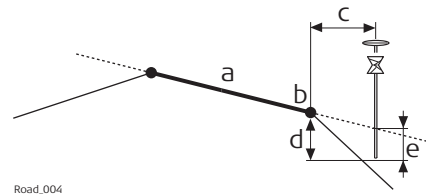
- Centre line of a road
- Edges of a road or any other change in slope
- Gutters
- Pipelines, cables and any other line-related design feature



- a Line to stake out or check, in this case the centreline
- b Line offset
- c Line height difference

### Surface grades

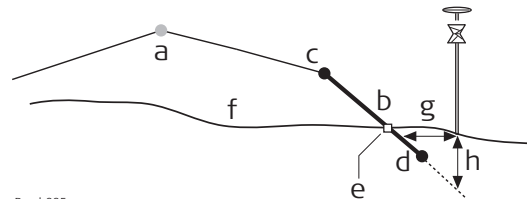
Surface grades are defined by two lines. The two lines define the right and left edge of the surface grade. One of the two lines is used as the reference line.



- a Surface grade to stake out or check
- b Reference line
- c Horizontal offset to reference line
- d Height difference to reference line
- e Height difference to expanded surface grade

## Slopes

Slopes, like surface grades, are defined by two lines. Different to surface grades, only one edge of the slope, the hinge point, is known. The second edge, catch point or daylight point, is defined by the intersection of the slope and the natural surface. As the natural surface is unknown this edge can only be staked out in the field. Finding and staking out the catch point is the most important task when working with slopes.



Road\_005

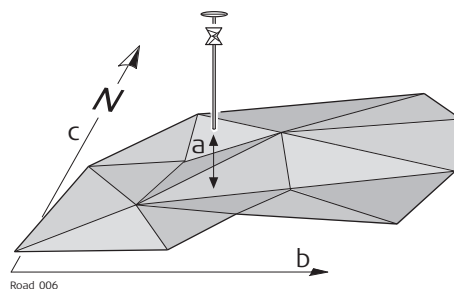
- a Centreline
- b Slope
- c Hinge Point
- d Second line defining the slope
- e Catch point
- f Natural surface
- g  $\Delta$  Offset from the slope
- h Height difference from the slope

## Surfaces

There are two types of surfaces supported that represent a three-dimensional design:

- DTM / TIN (**D**igital **T**errain **M**odel; **T**riangular **I**rrregular **N**etwork)
- Layer

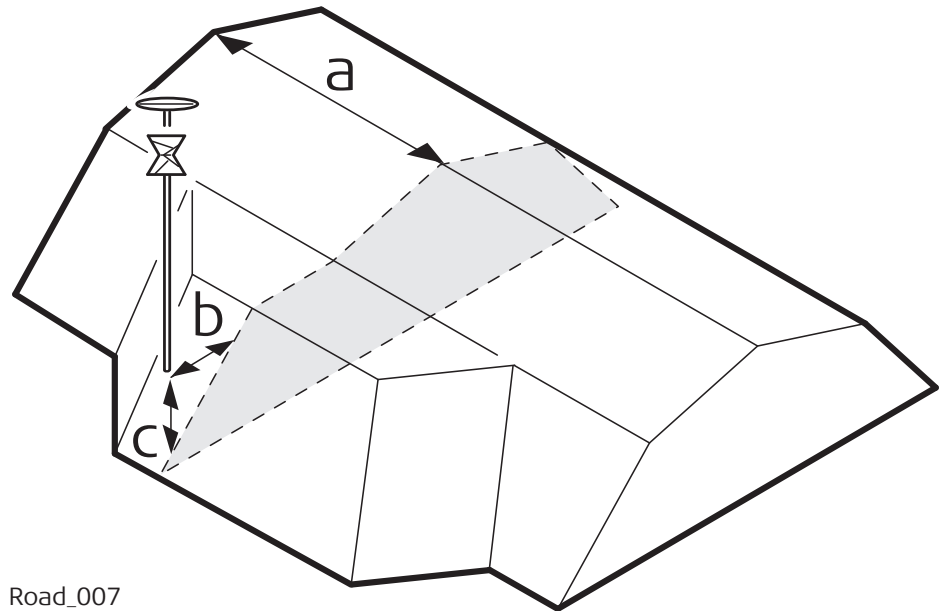
A DTM consists of several 3D triangles. DTMs do not include information relating the DTM to a centreline. Positions are defined by easting, northing and height values.



Road\_006

- a Height difference from the triangle of the DTM found in the same vertical line as the measured point
- b Easting of coordinate system
- c Northing of the coordinate system

A layer is a combination of lines that form a 3D surface relative to a centreline. Thus it is possible to define points by chainage or station, offset and height. Refer to [46.2.3 Design Data](#) for more information.



Road\_007

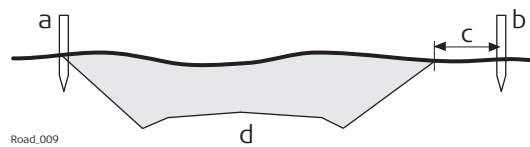
- a Chainage or station
- b Layer Offset
- c Layer height difference

#### 46.6.4

### Road - Stake Offset and Stake Height Difference

#### Description

When conducting a stake out, the aim is usually to mark the position of geometric elements defined by the design. For example, in the graphic below, the catch point of a slope. A point can be staked either directly or indirectly. For a directly staked point, the peg ends up at exactly the position of the point to be staked. Staking the same point indirectly, the peg will be placed with a certain offset to the point.



Road\_009

One reason to stake out a point indirectly is that the peg would not last long at the position of the actual point. In this example, the peg staked directly would be removed as soon as the excavation work starts.

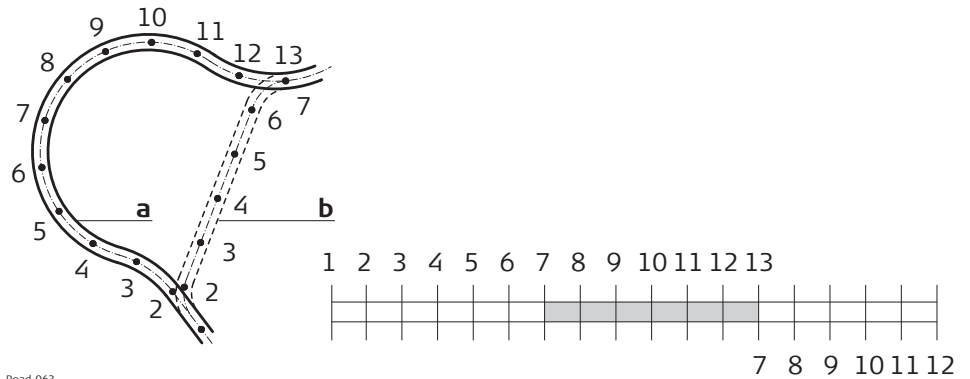


Horizontal stake offsets are, like shifts, defined perpendicular to the centreline of the layer the line(s) belongs to, if no offset angle has been defined. For surface grades and road crowns, the stake offset is applied following the same rules as stated for horizontal shifts. Refer to [46.4 Working with Shifts](#) for more information.



Gap chainage or station equation. Chainage or station back 10 = chainage or station ahead 15.

- a Old
- b New



Road\_063

Overlap chainage or station equation. Chainage or station back 13 = chainage or station ahead 7.

- a New
- b Old

## Multiple chainage or station

In the case of the overlap shown in the example, the chainages or stations between seven and thirteen appear twice. When a duplicate chainage or station is entered, a message asks which one is to be used.

### Example

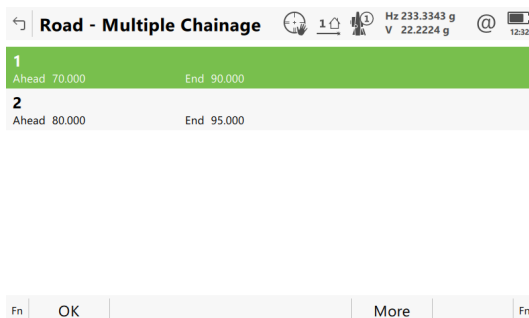
As more than one chainage or station equation is possible, a chainage or station can appear more than twice on a design. In this example, the chainages or stations 11 to 13 appear three times.



Road\_069

Overlap chainage or station equation. Chainage back 13 = chainage ahead 7 and chainage back 15 = chainage ahead 11.

Example: Chainage or station 12 is entered in **Road - Multiple Chainage**. The following panel shows how the option to select the right chainage or station is displayed:



| Key  | Description   |
|------|---|
| OK   | To select the highlighted chainage or station equation and return to the stakeout panel.                                  |
| More | To switch the value displayed in the last column to show the end chainage or station of the chainage or station equation. |

#### Description of metadata

| Metadata | Description   |
|----------|---|
| End      | Shows the end chainage or station for the chainage or station equation. <b>End</b> shows to which chainage or station, the current chainage or station equation is valid. If for the first part of the alignment, no chainage or station equation exists, <b>Ahead</b> stays empty for the first row. |

### 46.6.6

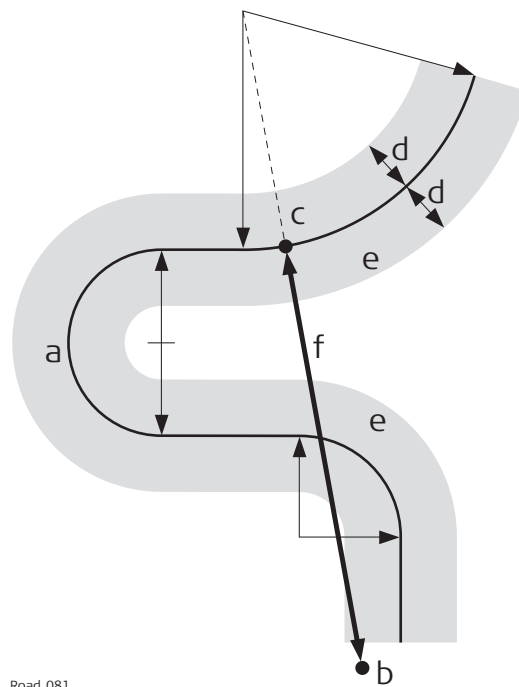
#### Road - Working Corridor

##### Description

A working corridor defines the valid offset range left and right of the centreline. When working with irregular alignments such as traffic islands and parking lots, working corridors are useful to avoid displaying results from the wrong centreline element.

The following example shows the result if working without a defined working corridor. For the measured position (b), the app finds the centreline point (c) with the minimum perpendicular offset (f).

With a defined working corridor (e), the app would display a message advising that the measured position is outside of the defined centreline.





- a Centreline
- b Measured position
- c Projected point on the centreline
- d Defined offset range for the working corridor
- e Working corridor
- f Offset from the centreline, if no working corridor is used

The working corridor is defined in **Road Settings, Design** page. Refer to [46.3 Configuring Roads Apps](#) for more information.

## 46.6.7

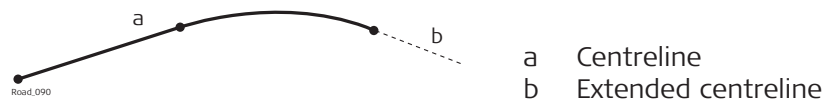
### Road - Extension of the Centreline

#### Description

Whenever centrelines must be extended, for example, at the start and end area of an alignment or slope. The projection of the measured position to the centreline is made using the tangent of the start/end point of the centreline. In this case, a warning appears informing that the original design is exceeded. The app advises as soon as a measured position is within the design area once again.

#### Concept

When expanding the centreline the geometry will be continued using the tangent of the start/end point of the centreline.



#### Method

##### Description

When staking out in the region of the start/end area of the design centreline, situations occur where an expansion of the centreline is useful. As soon as measurements are outside the defined centreline, the app prompts if and with which method the centreline should be expanded.



The extension of a centreline is made following its start/end tangent. Outside of the original design area correct results cannot be guaranteed.


## 46.6.8

### Road/Rail - Working with Heights

#### Description

Normally, heights stored with the design data are used. The Rail app offers the possibility to switch to either:

- a height which is entered manually.
 

This option enables the manual definition of a height, which can be applied for staking out or checking. This height is entered in the  page.
- a height which is retrieved from an existing height layer, as defined in the DTM job associated with the project. The layer from the DTM is applied and used as a height reference for the staking out or checking of alignments. 2D and 3D are possible.

This option is configured in the toolbox.

#### Understanding priorities of various heights

| Type of height   | Overrules         | Stake Height Diff |
|------------------|-------------------|-------------------|
| Manually entered | All other heights | Considered        |

| Type of height           | Overrules         | Stake Height Diff |
|--------------------------|-------------------|-------------------|
| Of individual point      | All other heights | Considered        |
| From height layer of DTM | Design height     | Considered        |
| From design              | No other heights  | Considered        |

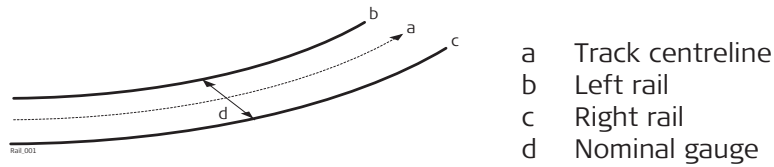
#### 46.6.9

### Rail - Working with a Single Track

#### Terms and expressions

| Term / expression  | Description  |
|--|--|
| <b>Track</b>   | A track comprises two separate rails.  |
| <b>Single track</b>  | A single track is defined as one track with one centreline and two rails. All chainages are calculated from the centreline.  |
| <b>Track centreline</b>                                    | Geometric alignment in two or three dimensions to which all design elements of the project are referenced. It could be that the vertical component of the alignment does not coincide with the plan component. In this case the vertical part of the alignment will generally coincide with the lowest rail.   |
| <b>Chainage or station</b>                                 | The cumulative distance along the centreline, frequently but not always starting at zero.  |
| <b>Left/right rail</b>                                     | <p>Planimetric position of the left/right rail of a track.</p> <p>The sense of the left/right rail is given by the direction of increasing chainage.</p> <p>When a section of the track is viewed in the direction of increasing chainage, the left rail is to the left of the centre of the track.</p>  |
| <b>Nominal gauge</b>                                       | The nominal distance between the active (internal) faces of the left and right rails.  |
| <b>Superelevation base</b>                                 | The distance over which the superelevation is applied. This distance is normally the distance between the centre of the left and right rail.   |
| <b>Left/right superelevation</b><br><b>Left/right cant</b> | <p>The superelevation or height difference of each rail with respect to the track centreline. Usually expressed in millimetres.</p> <p>If one of the rails is used to rotate the track section, or the height of the vertical alignment coincides with the lowest rail, the superelevation of the rotation point or lowest rail will be zero.</p> <p>Superelevation is also known by the term cant. These two words can be interchanged.</p> |

## Diagram - Plan

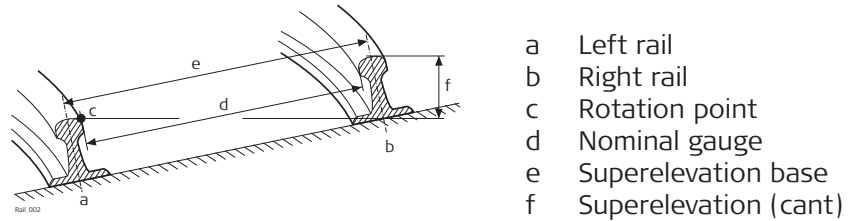


## Diagram - Section

Two generic methods can be used to define the section of the track.

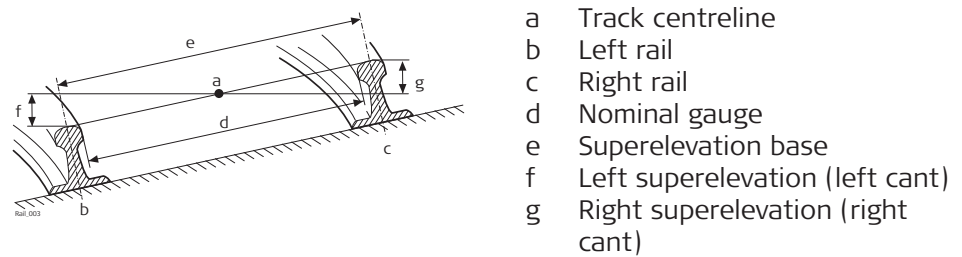
### Method 1 - A definition using rotation around a known point

This method involves rotating the section around a known point, normally the lowest rail.



### Method 2 - A definition using relative height distances

This method uses height differences relative to the vertical alignment to define the height of the left and right rail.



## 46.6.10

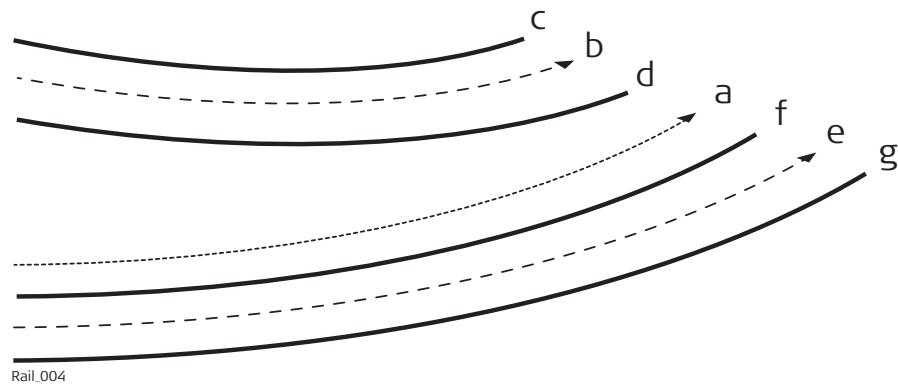
### Rail - Working with Multiple Tracks

#### Description

Multiple tracks are used when more than one track share a common centreline, from which all chainages are calculated.

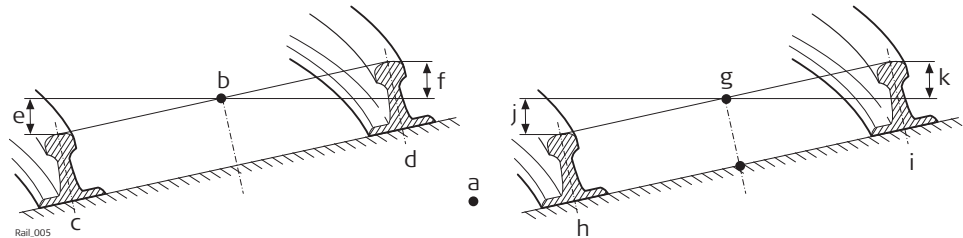
When there are multiple tracks with independent centrelines for each track, each track is then considered as a single track. Refer to [46.6.9 Rail - Working with a Single Track](#) for details on single tracks.

## Diagram - Plan



- a Chainage centreline
- b Left track centre line
- c Left track left rail
- d Left track right rail
- e Right track centreline
- f Right track left rail
- g Right track right rail

## Diagram - Section



- a Chainage centreline
- b Left track centreline
- c Left track left rail
- d Left track right rail
- e Left track left rail superelevation
- f Left track right rail superelevation
- g Right track centreline
- h Right track left rail
- i Right track right rail
- j Right track left rail superelevation
- k Right track right rail superelevation

## Calculations

For multiple tracks, the chainage centreline is used only to calculate the chainage. The superelevation of each track is calculated with respect to the corresponding (left / right) vertical alignment. The chainage centreline can consist of a plan and a vertical component. Although the vertical component of the chainage centreline is not used for any calculation.

### 46.6.11

### Rail - Check Elements and Stakeout Elements

#### Description

Points can be staked with respect to three basic elements of the track:

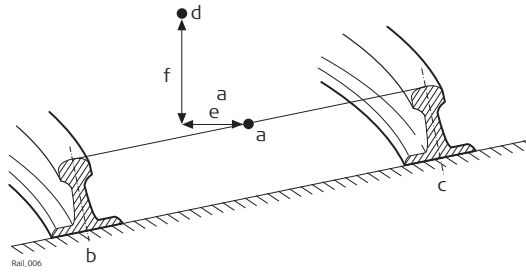
- Track centreline
- Left rail
- Right rail

## Centreline stakeout

### Description

The line to stake out can be a track centreline or, in the case of multiple tracks, the left or right track centreline. In both cases, a horizontal offset with respect to the centreline can be applied. Additionally, if a vertical alignment is available for a track centreline, a vertical offset can be applied.

### Diagram - Single track elements



- a Track centreline
- b Left rail
- c Right rail
- d Point to stake
- e Horizontal offset from track centreline
- f Vertical offset from track centreline

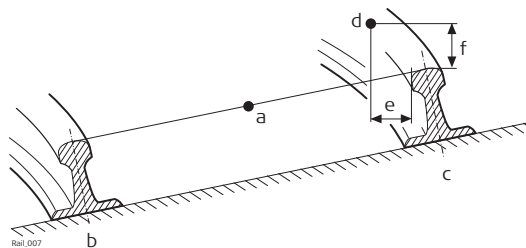
## Left/right rail stakeout

### Description

The left or right rail of a track can be staked out:

- directly,
- horizontal and/or vertical offsets can be used to stake any point relative to either rail.

### Diagram - Staking out a point relative to the right rail



- a Track centreline
- b Left rail
- c Right rail
- d Point to stake
- e Horizontal offset from right rail
- f Vertical offset from right rail



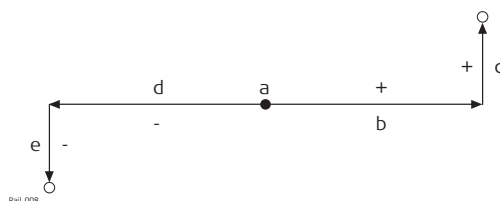
The position from which the horizontal and rail offsets will be applied depends on how the left and right rails were defined in the imported design data. Using standard practice, the horizontal offset would be defined from the active face of the rail, and the height offset would be defined from the highest part of the rail, as shown in the diagram.

### 46.6.12

### Rail - Working with Offsets

#### Sign convention for offsets

The sign convention for offsets is:



- a Centreline
- b Positive horizontal offset
- c Positive vertical offset
- d Negative horizontal offset
- e Negative vertical offset

### 46.6.13

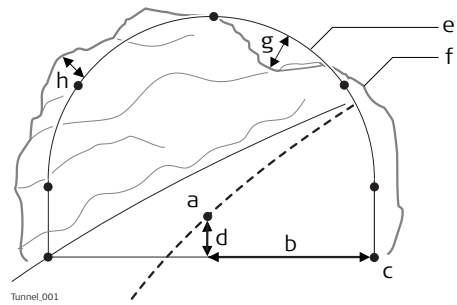
### Tunnel - Basic Terms

#### Terms and expressions

| Term/Expression                  | Description  |
|----------------------------------|--|
| <b>Centreline</b>                | Geometric alignment in two or three dimensions to which all design elements of the project are referenced.   |
| <b>Chainage or station</b>       | The cumulative distance along the centreline, frequently but not always starting at zero.  |
| <b>Design Profile</b>            | Geometric description of the designed shape of the cross-section of the tunnel. The design profile can contain straight or curve elements.                     |
| <b>Excavated Profile</b>         | Shape of the cross-section of the tunnel that has been excavated.  |
| <b>Underbreak</b>                | When the excavated profile is inside the design profile, the underbreak is the perpendicular distance between the design profile and the excavated profile.    |
| <b>Overbreak</b>                 | When the excavated profile is outside of the design profile, the overbreak is the perpendicular distance between the design profile and the excavated profile. |
| <b>Tunnel Portal</b>             | The open end of a tunnel.  |
| <b>Tunnel Face</b>               | The point where the excavated tunnel meets existing terrain.   |
| <b>Superelevation (Rotation)</b> | Angle of rotation of a design profile. Used to take into account the velocity of a moving vehicle through a curve.   |

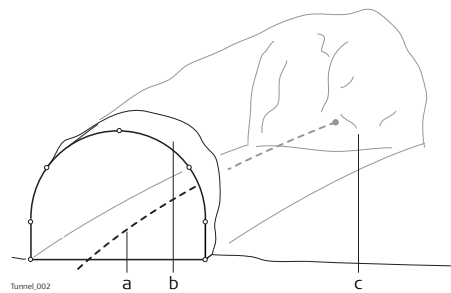
| Term/Expression       | Description  |
|-----------------------|--|
| <b>Rotation Point</b> | The point about which the design profile is rotated. This point may or may not coincide with the centreline. |

### General terms



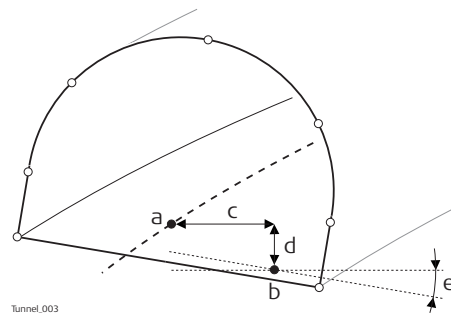
- a Centreline
- b Centreline offset
- c Point on design profile
- d Centreline height offset
- e Design profile
- f Excavated profile
- g Underbreak
- h Overbreak

### 3D View



- a Centreline or axis
- b Tunnel portal
- c Tunnel face

### Superelevation



- a Centreline or axis
- b Rotation point
- c Centreline offset
- d Centreline height offset
- e Superelevation (Rotation)

## 46.6.14

### Tunnel - Elements for Stake and Check Measurements

#### Tunnel face

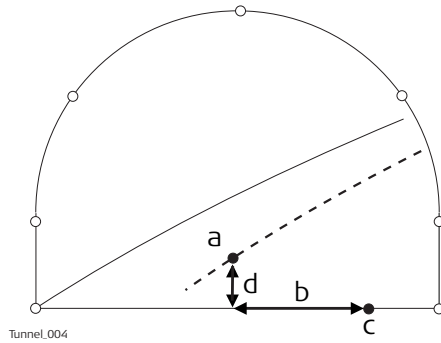
##### Staking tunnel faces

It is usually required to stake out the tunnel face to indicate the position to excavate when certain tunnelling methods are used. For example, Drill and Blast or excavation using a roadheader.

The points to stake on the tunnel face can be defined in various ways:

### Horizontal and vertical offsets

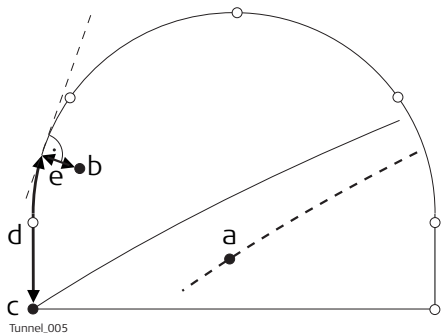
By horizontal and vertical offsets with respect to the centreline:



- a Centreline
- b Point on tunnel face to stake
- c Centreline offset
- d Centreline height offset

### Distance along profile

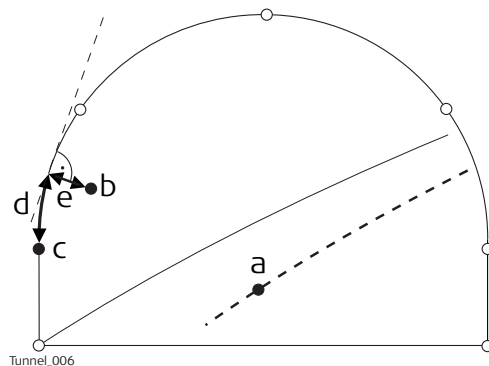
By the distance from the start of the design profile and an offset from the design profile.



- a Centreline
- b Point on tunnel face to stake
- c Point defining start of design profile
- d Distance from start of design profile
- e Offset perpendicular to design profile

### Distance along a particular element

By the distance along a particular element of the design profile and an offset from the element.



- a Centreline
- b Point on tunnel face to stake
- c Element of design profile to stake
- d Distance from start of design profile element
- e Offset perpendicular to design profile

## Tunnel profiles

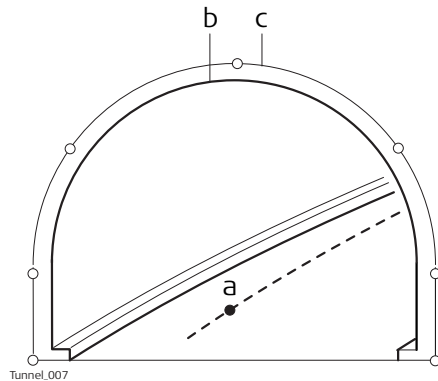
### Staking tunnel profiles

Tunnel profiles are normally staked after excavation to indicate the position of tunnel design elements or services such as lighting or ventilation.



### Basic terms

Usually a tunnel under construction is designed and built in various stages such that a given chainage can have various design profiles. For example shotcrete or final lining. Each design profile is called a layer.



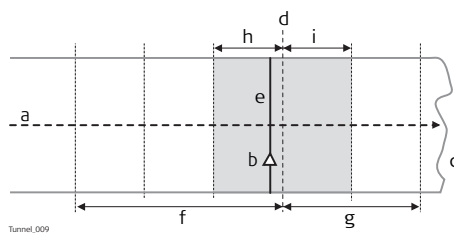
- a Centreline or axis
- b Final lining
- c Shotcrete

### Measuring tunnel profiles

Tunnel profiles are normally measured after excavation to compare the excavated profile with the design profile. This check can occur during the excavation phase of the project or for quality control checks of the built tunnel.

When measuring tunnel profiles, it is possible to scan various profiles from one instrument position. The profiles to scan are defined with respect to a defined chainage. Profiles can be scanned at a given forward and back interval within a given forward and back distance from the defined profile.

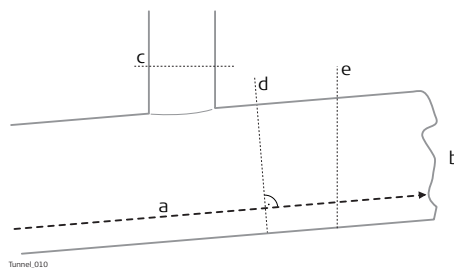
### Measuring tunnel profiles - Plan view



- a Centreline
- b Instrument position
- c Tunnel face
- d Defined profile to scan
- e Instrument profile
- f Back distance
- g Forward distance
- h Back interval
- i Forward interval

### Profile view

Tunnel profiles can be measured vertically, horizontally or perpendicular to the tunnel centreline.



- a Centreline
- b Tunnel face
- c Horizontal profile
- d Profile perpendicular to centreline
- e Vertical profile

**Description**

When working on site, often design data does not match the measured data. For example, an existing road surface that should intersect with the design surface may be 15 cm higher than the plans indicate. For a smooth intersection, this difference is distributed over the remaining 100 m of paving. To handle these situations, the app allows the possibility of adding shifts to the existing design data. A shift is applied when selecting the element to stake out/check.

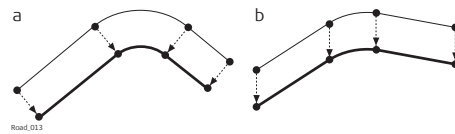


Shifts do not change the stored design. They are applied temporarily for stake out purposes.

**Centreline shifts**

**Horizontal and vertical shifts**

Horizontal shifts are always perpendicular to the centreline whereas vertical shifts are applied along the plumb line.

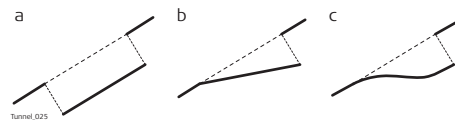


- a Horizontal alignment with constant shift (plan view)
- b Vertical alignment with constant shift (profile view)

**Constant and linear shifts are supported**

For both horizontal and vertical shifts, two different types can be applied:

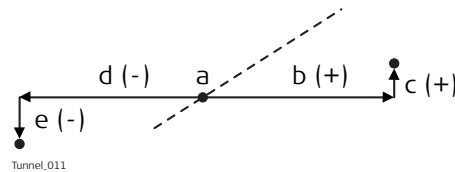
- Constant:** The shift remains the same from its start chainage or station to the end chainage or station.
- Linear:** The shift is linearly interpolated along the chainage or station.



- a Constant shift
- b Linear shift

**Sign convention**

The sign convention for design shifts is identical to the conventions used for centreline offset and height shifts difference.

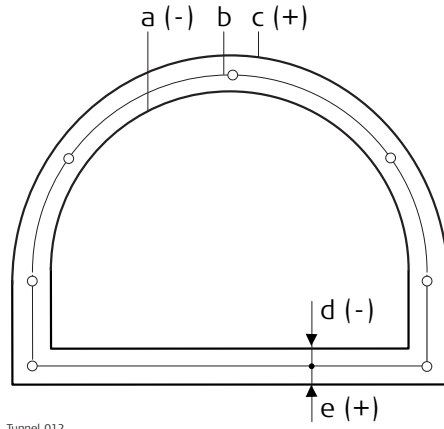


- a Centreline
- b Positive horizontal shift
- c Positive vertical shift
- d Negative horizontal shift
- e Negative vertical shift

**Design profile shift**

A shift can be applied to the design profile. The shift is applied perpendicularly to the design profile at any point along the design profile.

A positive shift will increase the size of the profile, a negative shift will decrease the size of the profile.



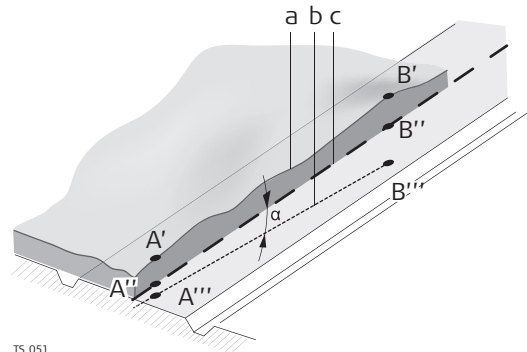
Tunnel\_012

- a Design profile with negative shift
- b Original design profile
- c Design profile with positive shift
- d Negative shift
- e Positive shift

**Description**

A road surface can be thought of three different types of design elements:

- the horizontal alignment
- the vertical alignment
- the cross section

**Basic concepts**

TS.051

- a - Natural surface.
- b - The vertical alignment.
- c - The horizontal alignment.
- A''/B'' - Points on horizontal alignment
- A'/B' - Points on real surface
- A'''/B''' - Points on vertical alignment

Any point A in a project has ENH coordinates in a determined coordinate system. Each point has three different positions:

- A' - Point on real surface
- A'' - Point on horizontal alignment
- A''' - Point on vertical alignment

By adding a second point B to the project an alignment is defined. The alignment can be thought in three ways:

- Horizontal alignment (A''-B'')
- Projection of the horizontal alignment onto the real surface (A'-B')
- Vertical alignment (A'''-B''')

The angle between the horizontal and the vertical alignment is the grade ( $\alpha$ ).

**Geometric elements**

A road design is fitted to a base plan or map using the three basic geometric elements:

- Straight
- Curve
- Spiral



Refer to [I Glossary](#) for a definition of the terms.

## 47.2

## Starting Alignment Editor

### 47.2.1

### Accessing Alignment Editor

#### Access

Select **Leica Captivate - Home: Alignment editor**.

#### Alignment Editor

Alignment Editor

An alignment is required. What do you want to do?

- Create new alignment
- Edit existing alignment
- Import alignment from file

Fn OK Fn

| Key         | Description  |
|-------------|--|
| OK          | To select the highlighted option and to continue with the subsequent panel.        |
| Fn Settings | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

#### Next step

Select an option and press **OK**.

### 47.2.2

### Creating a New Alignment

#### Access

Select **Create new alignment** in **Alignment Editor** and press **OK**.

#### New Alignment

New Alignment

Name: 123

Description: -----

Creator: -----

Alignment type: Road

Store alignment to: SD card

Fn OK Fn

| Key         | Description  |
|-------------|--|
| OK          | To accept the panel entries and continue.  |
| Fn Settings | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

#### Description of fields

| Field       | Option         | Description                                    |
|-------------|----------------|--|
| Name        | Editable field | The name of the new raw alignment.             |
| Description | Editable field | Optional description of the new raw alignment. |

| Field                     | Option          | Description  |
|---------------------------|-----------------|--|
| <b>Creator</b>            | Editable field  | Optional description of the creator of this alignment.   |
| <b>Alignment type</b>     | Selectable list | Defines if the alignment is for roads or rails.  |
| <b>Store alignment to</b> | Selectable list | The device on which the new raw alignment is stored. Depending on the inserted data storage devices, this field may be a display only field. |

#### Next step

Press **OK** to access the **Alignment Editor Menu**. Refer to [47.2.5 Alignment Editor Menu](#).

### 47.2.3

### Modifying an Existing Alignment

#### Access

Select **Edit existing alignment** in **Alignment Editor** and press **OK**.

#### Choose Alignment

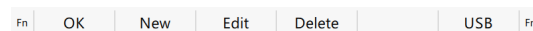
#### Description of fields

| Field                 | Option          | Description   |
|-----------------------|-----------------|---|
| <b>Alignment name</b> | Selectable list | All existing raw alignments currently stored in the \Data\XML folder with the file extension *.xml. |
| <b>Alignment type</b> | Selectable list | Defines if the alignment is for roads or rails.   |

#### Next step

Highlight the **Alignment name** field and press **ENTER**.

#### Alignments



| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To select the highlighted raw alignment and continue.                                     |
| <b>New</b>    | To create a new raw alignment. Refer to <a href="#">47.2.2 Creating a New Alignment</a> . |
| <b>Edit</b>   | To edit the name and description of an existing raw alignment.                            |
| <b>Delete</b> | To delete an existing raw alignment.  |

| Key                             | Description  |
|---------------------------------|--|
| <b>USB, Internal or SD card</b> | To change between viewing jobs stored on another data storage device or internal memory.           |
| <b>Fn Settings</b>              | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .                 |
| <b>Fn Backup</b>                | To restore a raw alignment file with the extension *.xmb currently stored in the \Data\XML folder. |

### Next step

Press **OK** to select the highlighted raw alignment and return to the **Choose Alignment** panel.

Press **OK** to access the **Alignment Editor Menu**. Refer to [47.2.5 Alignment Editor Menu](#).

## 47.2.4

### Importing Alignment Data

#### Access step-by-step

1. Select **Import alignment from file** in **Alignment Editor** and press **OK**.
2. Create a new alignment in the **New Alignment** panel. Refer to [47.2.2 Creating a New Alignment](#).
3. Press **OK**.

#### Import Line

Fn OK Fn

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To import the selected alignment data to active raw alignment.                     |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

#### Description of fields

| Field           | Option                    | Description                                |
|-----------------|---------------------------|--|
| <b>From job</b> | <b>Job</b>                | To import lines from the selected job.     |
|                 | <b>Road design</b>        | To import lines from an existing Road job. |
|                 | <b>Road+ (GSI format)</b> | To import GSI alignment data.              |
|                 | <b>Rail design</b>        | To import lines from an existing Rail job. |

| Field                        | Option                                 | Description  |
|------------------------------|--|--|
| <b>From job</b>              | Selectable list                        | All jobs are available for selection. Available for <b>Job, Road design</b> and <b>Rail design</b> .   |
| <b>Coordinate system</b>     | Display only                           | The coordinate system currently attached to the selected <b>Job, Road design</b> or <b>Rail design</b> .   |
| <b>Line</b>                  | Selectable list                        | Line element from the selected job. Available for <b>Job</b> .   |
| <b>Alignment</b>             | Selectable list                        | Line from the selected Road job. The line must be stored in the \dbx folder of the data storage device to be selectable. Available for <b>Road design</b> and <b>Rail design</b> .   |
| <b>Alignment (.aln) file</b> | Selectable list or <b>&lt;None&gt;</b> | Horizontal alignment file in GSI format. The GSI alignment file must be stored in the \GSI folder of the data storage device to be selectable. Available for <b>Road+ (GSI format)</b> .<br>When opening the list, folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder.<br>To select files from the root directory, highlight <b>..</b> and press <b>Return</b> . |
| <b>Vertical (.prf) file</b>  | Selectable list or <b>&lt;None&gt;</b> | Vertical alignment file in GSI format. The GSI alignment file must be stored in the \GSI folder of the data storage device to be selectable. Available for <b>Road+ (GSI format)</b> .<br>When opening the list, folders are written as \FolderName. When a folder is highlighted, press <b>Open</b> to open the folder.<br>To select files from the root directory, highlight <b>..</b> and press <b>Return</b> .   |

#### Next step

**OK** imports the selected alignment data and accesses the **Alignment Editor Menu**. Refer to [47.2.5 Alignment Editor Menu](#).

## 47.2.5

### Alignment Editor Menu

#### Access

This panel is always accessed after successfully creating, editing or importing an alignment file from the **Alignment Editor** panel.

#### Alignment Editor Menu

#### Description of options

| Option                           | Description  |
|----------------------------------|--|
| <b>Edit horizontal alignment</b> | Depending on the setting for <b>Use PI instead of element for horizontal alignment definition</b> in <b>Settings, Advanced</b> page: <ul style="list-style-type: none"> <li>To create, edit and delete elements of a horizontal alignment. Refer to <a href="#">47.4 Edit Horizontal Alignments Using Elements</a>.</li> </ul> |



| Option                              | Description  |
|-------------------------------------|--|
|                                     | <ul style="list-style-type: none"> <li>To create, edit and delete PIs of a horizontal alignment. Refer to <a href="#">47.5 Edit Horizontal Alignments Using PIs</a>.</li> </ul>  |
| <b>Edit vertical alignment</b>      | <p>Depending on the setting for <b>Use PVI instead of element for vertical alignment definition</b> in <b>Settings, Advanced</b> page:</p> <ul style="list-style-type: none"> <li>To create, edit and delete elements of a vertical alignment. Refer to <a href="#">47.6 Edit Vertical Alignments Using Elements</a>.</li> <li>To create, edit and delete PVIs of a vertical alignment. Refer to <a href="#">47.7 Edit Vertical Alignments Using PIs</a>.</li> </ul> |
| <b>Edit cross section templates</b> | To create, edit and delete cross section templates. Refer to <a href="#">47.8 Edit Cross Section Templates</a> . Only available for road jobs.   |
| <b>Edit cross section assignmt</b>  | To create, edit and delete cross section assignments. Refer to <a href="#">47.9 Edit Cross Section Assignments</a> . Only available for road jobs.   |
| <b>Edit chain-age equation</b>      | To create, edit and delete chainage equations. Refer to <a href="#">47.10 Edit Chainage Equation</a> .   |
| <b>Convert to job</b>               | To convert existing LandXML alignments to a job. Refer to <a href="#">47.11 Convert to job</a> .   |

To be able to convert alignments to a job, at least a horizontal alignment must exist.

## 47.3

## Configuring Alignment Editor

### Access

Select **Leica Captivate - Home: Alignment editor**. Press **Fn Settings**.

### Settings, Quality control page

Settings

Quality control Advanced

Check horizontal deflection

Horizontal deflection tolerance

Check vertical deflection

Vertical deflection tolerance

Confirm end coordinates of segment before storing

OK Page

| Key         | Description                               |
|-------------|---|
| <b>OK</b>   | To accept the panel entries and continue. |
| <b>Page</b> | To change to another page on this panel.  |

### Description of fields

| Field                              | Option    | Description  |
|------------------------------------|-----------|--|
| <b>Check horizontal deflection</b> | Check box | Possibility to do a deflection check for the horizontal alignment. |

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Horizontal deflection tolerance</b>                   | Editable field | The deflection tolerance for horizontal alignments. The tolerance value used for determining deflection errors. A deflection error occurs when the beginning curve tangent of an element does not match the ending tangent of the previous element. If the current error in deflection is greater than this value, the error is reported. |
| <b>Check vertical deflection</b>                         | Check box      | Possibility to do a deflection check for the vertical alignment.  |
| <b>Vertical deflection tolerance</b>                     | Editable field | The deflection tolerance for vertical alignments.   |
| <b>Confirm end coordinates of segment before storing</b> | Check box      | If this box is checked, then each time a new alignment element has been entered, a confirmation message displays the end coordinates for confirmation.  |

#### Next step

Page changes to the **Advanced** page.

#### Settings, Advanced page

#### Description of fields

| Field  | Option             | Description  |
|--|--------------------|--|
| <b>Vertical parabola definition</b>                                  | <b>Parameter p</b> | Parameter defining the parabola.   |
|  | <b>K factor</b>    | K factor = Parameter p/100.  |
| <b>Use PI instead of element for horizontal alignment definition</b> | Check box          | When this box is not checked, elements such as straights, curves and parabolas define the horizontal alignment.  |
|  |                    | <p>When this box is checked, the horizontal alignment is defined by <b>Points of Intersection</b>. PIs are tangent or geometrical points.</p> <ul style="list-style-type: none"> <li>Horizontal alignments are defined by the coordinates of the PI and, for circular curves, the curve radius.</li> <li>Horizontal transitions are defined by coordinate of PI, the circular curve radius plus tangent length in and tangent length out.</li> </ul> |

| Field   | Option    | Description   |
|---|-----------|---|
| <b>Use PVI instead of element for vertical alignment definition</b> | Check box | <p>When this box is not checked, elements such as straights, curves and parabolas define the vertical alignment.</p> <p>When this box is checked, the vertical alignment is defined by <b>Points of Vertical Intersection</b>. PVIs are tangent or geometrical points.</p> <ul style="list-style-type: none"> <li>Vertical alignments with symmetrical curves are defined by the PVI chainage, the elevation of PVI and the total length of curve, where the tangent length is half the total length of the VC.</li> <li>Vertical Alignments with non-symmetrical curves are defined by the PVI chainage, the elevation of the PVI and both tangent lengths.</li> </ul> |

## 47.4

## Edit Horizontal Alignments Using Elements

### 47.4.1

### Overview

#### Description

Allows creating, editing and deleting of the following elements:

- Start Point
- Straight (Tangent)
- Curve
- Clothoid
- Cubic Parabola
- Partial Bloss

as well as checking the horizontal alignment.

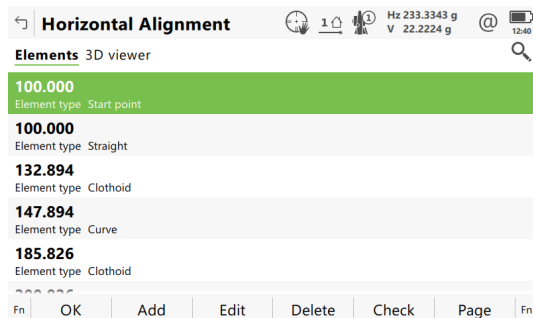
#### Access

In **Alignment Editor Menu** highlight **Edit horizontal alignment**. Press **OK**.



**Use PI instead of element for horizontal alignment definition** must be unchecked in **Measure Settings, Advanced** page.

#### Horizontal Alignment, Elements page



| Key       | Description  |
|-----------|--|
| <b>OK</b> | To accept the panel entries and return to the <b>Alignment Editor Menu</b> . |

| Key                | Description  |
|--------------------|--|
| <b>Add</b>         | To add a new horizontal element after the highlighted element.   |
| <b>Edit</b>        | To edit the highlighted element of the horizontal alignment.   |
| <b>Delete</b>      | To delete the highlighted element of the horizontal alignment. Either all following elements or only the next element can be adjusted. |
| <b>Check</b>       | To check the horizontal alignment.   |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .   |

## 47.4.2

### Editing the Start Point

#### Access

In **Horizontal Alignment**, highlight the start point and press **Edit**.

#### Horizontal Start Point

Fn OK Get point Meas app Fn

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To accept the panel entries and continue.  |
| <b>Get point</b>   | To apply coordinates or heights from an existing point in the job.                 |
| <b>Meas app</b>    | To go to <b>Measure</b> and measure a point.                                       |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |
| <b>Fn Reset</b>    | To reset all panel entries.  |

#### Description of fields

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Easting</b>        | Editable field | Easting of the start point of the horizontal alignment.  |
| <b>Northing</b>       | Editable field | Northing of the start point of the horizontal alignment. |
| <b>Start chainage</b> | Editable field | Start chainage of the horizontal alignment.              |

## 47.4.3

### Inserting/Editing an Element in a Horizontal Alignment

#### Access

In **Horizontal Alignment, Elements** page, highlight the start point, or an element if one exists, and press **Add** or **Edit**.



Elements can be added after the start point and either before or after other elements.



Creating and editing an alignment element are similar processes. For simplicity, only the creation of an alignment element is explained and differences are clearly outlined.

## Add Horizontal Element

### Description of fields

| Field               | Option                | Description   |
|---------------------|-----------------------|---|
| <b>Element type</b> | <b>Straight</b>       | To insert/edit a straight to/in a horizontal alignment.       |
|                     | <b>Curve</b>          | To insert/edit a curve to/in a horizontal alignment.          |
|                     | <b>Spiral</b>         | To insert/edit a clothoid to/in a horizontal alignment.       |
|                     | <b>Cubic parabola</b> | To insert/edit a cubic parabola to/in a horizontal alignment. |
|                     | <b>Bloss</b>          | To insert/edit a blossom curve to/in a horizontal alignment.  |

The options available for the field **Method** depend on the **Element type** selected.

#### For **Element type: Straight**

| Field         | Option                            | Description   |
|---------------|-----------------------------------|---|
| <b>Method</b> | <b>Azimuth &amp; length</b>       | Using the azimuth and the length of the straight.       |
|               | <b>Azimuth &amp; end chainage</b> | Using the azimuth and the end chainage of the straight. |
|               | <b>End coordinates</b>            | Using the end coordinates of the straight.              |

#### For **Element type: Curve**

| Field         | Option                               | Description   |
|---------------|--------------------------------------|---|
| <b>Method</b> | <b>Radius &amp; length</b>           | Using the radius of the curve and its length.                             |
|               | <b>Radius &amp; deflection angle</b> | Using the radius and the delta angle of the curve.                        |
|               | <b>Radius &amp; end chainage</b>     | Using the radius of the curve and the end chainage.                       |
|               | <b>Radius &amp; end coordinates</b>  | Using the radius and the end coordinates of the curve.                    |
|               | <b>Centre point &amp; end coords</b> | Using the coordinates of the centre point and the end point of the curve. |

| Field | Option   | Description         |
|-------|----------|---------------------|
|       | 3 points | Using three points. |

For **Element type: Spiral**

| Field         | Option                              | Description   |
|---------------|-------------------------------------|---|
| <b>Method</b> | <b>Radius &amp; length</b>          | Using the radius of the clothoid and its length.              |
|               | <b>Radius &amp; end chainage</b>    | Using the radius of the clothoid and the end chainage.        |
|               | <b>Parameter &amp; length</b>       | Using the parameter A and the length of the connecting curve. |
|               | <b>Parameter &amp; end chainage</b> | Using the parameter A and the end chainage of the spiral.     |
|               | <b>Radius &amp; parameter</b>       | Using the parameter A and the radius.                         |

For **Element type: Cubic parabola**

| Field         | Option                           | Description  |
|---------------|----------------------------------|--|
| <b>Method</b> | <b>Radius &amp; length</b>       | Using the radius of the cubic parabola and its length.       |
|               | <b>Radius &amp; end chainage</b> | Using the radius of the cubic parabola and the end chainage. |

For **Element type: Bloss**

| Field         | Option                                 | Description  |
|---------------|--|--|
| <b>Method</b> | <b>Radius &amp; length</b>             | Using the radius of the connecting curve and its length.           |
|               | <b>Radius &amp; end chainage</b>       | Using the radius of the connecting curve and its end chainage.     |
|               | <b>Radius, length &amp; end coords</b> | Using the radius, length and end coordinates of the blossom curve. |

**Next step**

**OK** to access the next panel.

Horizontal Straight/  
Horizontal Curve/  
Horizontal Clothoid/  
Horizontal Cubic  
Parabola/  
Horizontal Bloss,  
Input page

Fn OK Inverse Last inv Page Fn

| Key         | Description   |
|-------------|---|
| OK          | To accept the panel entries and continue.   |
| Inverse     | To calculate the distance and angle between two points from the job.  |
| Last inv    | To select values from the last inverse calculations.  |
| Get point   | To apply coordinates or heights from an existing point in the job. Available when coordinates must be typed in. |
| Meas app    | To go to <b>Measure</b> and measure a point. Available when coordinates must be typed in.                       |
| Page        | To change to another page on this panel.  |
| Fn Settings | To configure the Alignment editor app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .             |
| Fn Reset    | To reset all panel entries.   |

Description of fields

| Field          | Option       | Description  |
|----------------|--------------|--|
| Start chainage | Display only | The end chainage of the start point/previous element is automatically used and cannot be edited. |

The other fields and options available depend on the **Method** and **Element type** selected in **Add Horizontal Element**.

For **Element type: Straight**

| Field        | Option         | Description   |
|--------------|----------------|---|
| Azimuth      | Editable field | The azimuth displayed is from the previous element. Another value can be entered manually. Available for <b>Method:Azimuth &amp; length</b> or <b>Method:Azimuth &amp; end chainage</b> . |
| End chainage | Editable field | Chainage at the end of the element. Available for <b>Method:Azimuth &amp; end chainage</b> .  |
| End easting  | Editable field | Easting for the end chainage. Available for <b>Method:End coordinates</b> .   |
| End northing | Editable field | Northing for the end chainage. Available for <b>Method:End coordinates</b> .  |
| Length       | Editable field | Length of the straight element. Available for <b>Method:Azimuth &amp; length</b> .  |

For **Element type: Curve**

| Field                   | Option                      | Description   |
|-------------------------|-----------------------------|---|
| <b>Start azimuth</b>    | Editable field              | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited. Available for <b>Method:Radius &amp; length</b> , <b>Method:Radius &amp; deflection angle</b> or <b>Method:Radius &amp; end chainage</b> .  |
| <b>CP easting</b>       | Editable field              | Easting of the centre point of the curve. Available for <b>Method:Centre point &amp; end coords</b> .   |
| <b>CP northing</b>      | Editable field              | Northing of the centre point of the curve. Available for <b>Method:Centre point &amp; end coords</b> .  |
| <b>Curve direction</b>  | <b>Right</b> or <b>Left</b> | The direction of the curve when looking in the direction of increasing chainage. Available for <b>Method:Radius &amp; length</b> , <b>Method:Radius &amp; deflection angle</b> , <b>Method:Radius &amp; end chainage</b> or <b>Method:Radius &amp; end coordinates</b> .  |
| <b>Radius</b>           | Editable field              | Radius of the curve. The signs are set by the system depending on the curve direction defined in <b>Curve direction</b> . Available for <b>Method:Radius &amp; length</b> , <b>Method:Radius &amp; deflection angle</b> , <b>Method:Radius &amp; end chainage</b> or <b>Method:Radius &amp; end coordinates</b> . |
| <b>Deflection angle</b> | Editable field              | The deflection angle. Available for <b>Method:Radius &amp; deflection angle</b> .   |
| <b>Length</b>           | Editable field              | Length from the start to the end point of the curve. Available for <b>Method:Radius &amp; length</b> .  |
| <b>End chainage</b>     | Editable field              | The end chainage of the curve element can be typed in. Available for <b>Method:Radius &amp; end chainage</b> .  |
| <b>Int easting</b>      | Editable field              | Easting of the intermediate point of the 3-pt-arc. Available for <b>Method:3 points</b> .   |
| <b>Int northing</b>     | Editable field              | Northing of the intermediate point of the 3-pt-arc. Available for <b>Method:3 points</b> .  |
| <b>End easting</b>      | Editable field              | Easting for the end chainage. Available for <b>Method:Radius &amp; end coordinates</b> , <b>Method:Centre point &amp; end coords</b> and <b>Method:3 points</b> .   |
| <b>End northing</b>     | Editable field              | Northing for the end chainage. Available for <b>Method:Radius &amp; end coordinates</b> , <b>Method:Centre point &amp; end coords</b> and <b>Method:3 points</b> .  |



For **Element type: Spiral**

| Field                     | Option                                | Description   |
|---------------------------|---------------------------------------|---|
| <b>Start azimuth</b>      | Editable field                        | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited.   |
| <b>Spiral direction</b>   | <b>Right</b> or <b>Left</b>           | The direction of the clothoid looking in the direction of increasing chainage.  |
| <b>Spiral in/out</b>      | <b>Spiral in</b><br><b>Spiral out</b> | For transition from tangent to curve.<br>For transition from curve to tangent.  |
| <b>Radius</b>             | Editable field                        | Radius of the clothoid. Available for <b>Method:Radius &amp; length</b> , <b>Method:Radius &amp; end chainage</b> and <b>Method:Radius &amp; parameter</b> .  |
| <b>Parameter A</b>        | Editable field                        | The parameter A defining the clothoid. Available for <b>Method:Parameter &amp; end chainage</b> , <b>Method:Parameter &amp; length</b> and <b>Method:Radius &amp; parameter</b> .   |
| <b>Length</b>             | Editable field                        | Length of the clothoid element. Available for <b>Method:Parameter &amp; length</b> and <b>Method:Radius &amp; length</b> .  |
| <b>Start radius</b>       | Editable field                        | The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in <b>Spiral direction</b> . Available for <b>Method:Radius &amp; length</b> and <b>Method:Radius &amp; end chainage</b> when <b>Use partial spiral</b> is checked. |
| <b>End radius</b>         | Editable field                        | The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in <b>Spiral direction</b> . Available for <b>Method:Radius &amp; length</b> and <b>Method:Radius &amp; end chainage</b> when <b>Use partial spiral</b> is checked.  |
| <b>End chainage</b>       | Editable field                        | The end chainage of the clothoid can be typed in. Available for <b>Method:Radius &amp; end chainage</b> and <b>Method:Parameter &amp; end chainage</b> .  |
| <b>Use partial spiral</b> | Check box                             | To create a partial clothoid. Available for <b>Method:Radius &amp; length</b> and <b>Method:Radius &amp; end chainage</b> .   |

For **Element type: Cubic parabola**

| Field                   | Option                                | Description   |
|-------------------------|---------------------------------------|---|
| <b>Start azimuth</b>    | Editable field                        | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited. |
| <b>Spiral direction</b> | <b>Right</b> or <b>Left</b>           | The direction of the cubic parabola looking in the direction of increasing chainage.                                    |
| <b>Spiral in/out</b>    | <b>Spiral in</b><br><b>Spiral out</b> | For a transition from tangent to curve.<br>For a transition from curve to tangent.                                      |

| Field                     | Option         | Description   |
|---------------------------|----------------|---|
| <b>Radius</b>             | Editable field | Radius of the cubic parabola.   |
| <b>Start radius</b>       | Editable field | The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in <b>Spiral direction</b> . Available when <b>Use partial spiral</b> is checked. |
| <b>End radius</b>         | Editable field | The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in <b>Spiral direction</b> . Available when <b>Use partial spiral</b> is checked.  |
| <b>Length</b>             | Editable field | Length of the cubic parabola element. Available for <b>Method:Radius &amp; length</b> .   |
| <b>End chainage</b>       | Editable field | The end chainage of the cubic parabola element can be typed in. Available for <b>Method:Radius &amp; end chainage</b> .   |
| <b>Use partial spiral</b> | Check box      | To create partial cubic parabolas.  |

For **Element type: Bloss**

| Field                   | Option                                | Description  |
|-------------------------|---------------------------------------|--|
| <b>Start azimuth</b>    | Editable field                        | The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited.  |
| <b>Spiral direction</b> | <b>Right</b> or <b>Left</b>           | The direction of the blossom looking in the direction of increasing chainage.  |
| <b>Spiral in/out</b>    | <b>Spiral in</b><br><b>Spiral out</b> | For a transition from tangent to curve.<br>For a transition from curve to tangent.   |
| <b>Radius</b>           | Editable field                        | Radius of the blossom.   |
| <b>Start radius</b>     | Editable field                        | The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in <b>Spiral direction</b> . Available for <b>Method:Radius, length &amp; end coords</b> . |
| <b>End radius</b>       | Editable field                        | The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in <b>Spiral direction</b> . Available for <b>Method:Radius, length &amp; end coords</b> .  |
| <b>Length</b>           | Editable field                        | Length of the blossom curve element. Available for <b>Method:Radius &amp; length</b> and <b>Method:Radius, length &amp; end coords</b> .   |
| <b>End chainage</b>     | Editable field                        | The end chainage of the blossom curve element can be typed in. Available for <b>Method:Radius &amp; end chainage</b> .   |
| <b>End easting</b>      | Editable field                        | Easting for the end chainage. Available for <b>Method:Radius, length &amp; end coords</b> .  |
| <b>End northing</b>     | Editable field                        | Northing for the end chainage. Available for <b>Method:Radius, length &amp; end coords</b> .   |

### Next step

**Page** changes to the **Details** page, where all entered and calculated elements are displayed.

## 47.5

## Edit Horizontal Alignments Using PIs

### 47.5.1

### Overview

#### Description

Allows creating, editing and deleting PIs by chainage, easting and northing.

#### Access

In **Alignment Editor Menu** highlight **Edit horizontal alignment**. Press **OK**.



**Use PI instead of element for horizontal alignment definition** must be checked in **Measure Settings, Advanced** page.

#### Horizontal Alignment, PI page

| PI         | 3D viewer            |               |                  |
|------------|----------------------|---------------|------------------|
| -19846.790 | Northing 5301045.974 | Radius ----   | Length in ----   |
| -19879.838 | Northing 5301124.833 | Radius 25.000 | Length in 15.000 |
| -19797.900 | Northing 5301112.481 | Radius 10.000 | Length in 15.000 |
| -19794.705 | Northing 5301127.813 | Radius 10.000 | Length in ----   |
| -19817.548 | Northing 5301165.530 | Radius ----   | Length in ----   |

Fn OK Add Edit Delete More Page Fn

| Key    | Description   |
|--------|---|
| OK     | To accept the panel entries and return to the <b>Alignment Editor Menu</b> .  |
| Add    | To add a new horizontal PI after the highlighted PI.<br>The chainage values must be added in the correct order.                   |
| Edit   | To edit the highlighted PI of the horizontal alignment.   |
| Delete | To delete the highlighted PI of the horizontal alignment. Either all following elements or only the next element can be adjusted. |
| More   | To display information about the length in/out and the parameter in/out.  |

### 47.5.2

### Inserting/Editing a PI in a Horizontal Alignment

#### Access

In **Horizontal Alignment, PI** page, highlight a PI and press **Add** or **Edit**.



A PI can also be selected on the **3D viewer** page.



Elements are added after the highlighted PI.



Creating and editing an alignment PI are similar processes. For simplicity, only the creation of an alignment PI is explained and differences are clearly outlined.

## Add PI

| Field              | Value           |
|--------------------|-----------------|
| Easting            | 0.000 m         |
| Northing           | 500.000 m       |
| Element type at PI | Spiral - curve  |
| Spiral type        | Clothoid        |
| Method             | Radius & length |
| Radius             | -----           |
| Length in          | -----           |

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To accept the panel entries and return to the <b>Alignment Editor Menu</b> .  |
| <b>Get point</b>   | To apply coordinates from an existing point in the job. Available when <b>Easting</b> or <b>Northing</b> is highlighted.  |
| <b>Meas app</b>    | To go to <b>Measure</b> and measure a point. Available when <b>Easting</b> or <b>Northing</b> is highlighted.   |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Radius</b> , <b>Length in</b> , <b>Length out</b> , <b>Parameter in</b> or <b>Parameter out</b> is highlighted. |
| <b>Last inv</b>    | To recall previous results from COGO inverse calculations. Available when <b>Radius</b> , <b>Length in</b> , <b>Length out</b> , <b>Parameter in</b> or <b>Parameter out</b> is highlighted.                        |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the Alignment editor app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .   |
| <b>Fn Reset</b>    | To reset all panel entries.   |

### Description of fields

| Field                              | Option                         | Description                                   |
|------------------------------------|--------------------------------|---|
| <b>Easting</b> and <b>Northing</b> | Editable field                 | The coordinates of the PI.                    |
| <b>Element type at PI</b>          | <b>None</b>                    | No element is defined at the PI.              |
|                                    | <b>Curve</b>                   | A curve is defined at the PI.                 |
|                                    | <b>Spiral</b>                  | A spiral is defined at the PI.                |
|                                    | <b>Spiral - curve</b>          | Spiral - curve is defined at the PI.          |
|                                    | <b>Curve - spiral</b>          | Curve - spiral is defined at the PI.          |
|                                    | <b>Spiral spiral</b>           | Two spirals are defined at the PI.            |
|                                    | <b>Spiral - curve - spiral</b> | Spiral - curve - spiral is defined at the PI. |

The other fields on the panel depend on the **Element type at PI** selected.

For **Element type at PI: Curve**

| Field         | Option         | Description                    |
|---------------|----------------|--------------------------------|
| <b>Radius</b> | Editable field | Using the radius of the curve. |

For **Element type at PI: Spiral**

| Field                                 | Option                                   | Description   |
|---------------------------------------|--|---|
| <b>Spiral type</b>                    | <b>Clothoid, Cubic parabola or Bloss</b> | <b>Bloss</b> is available for Rail jobs only.   |
| <b>Spiral in/out</b>                  | Selectable list                          | The type of spiral.   |
| <b>Method</b>                         |  | Available for <b>Spiral type: Clothoid</b> .  |
|                                       | <b>Radius &amp; lengths</b>              | Using the radius of the clothoid and its length.  |
|                                       | <b>Radius &amp; parameters</b>           | Using the radius of the clothoid and its parameters.  |
| <b>Radius</b>                         | Editable field                           | The radius of the clothoid, parabola or blossom. Available unless <b>Use partial spiral</b> is checked.   |
| <b>Radius in and Radius out</b>       | Editable field                           | The radius of the partial spiral for a clothoid or parabola. Available when <b>Use partial spiral</b> is checked.   |
| <b>Length in and Length out</b>       | Editable field                           | The lengths of the clothoid, parabola or blossom.   |
| <b>Parameter in and Parameter out</b> | Editable field                           | Depending on the setting, the parameters P or factors K of the clothoid. Available for <b>Spiral type: Clothoid</b> with <b>Method: Radius &amp; parameters</b> . |
| <b>Use partial spiral</b>             | Check box                                | To create a partial clothoid. Available for <b>Spiral type: Clothoid</b> and <b>Spiral type: Cubic parabola</b> .   |

For **Element type at PI: Spiral - curve** and **Element type at PI: Curve - spiral**

| Field            | Option                         | Description  |
|------------------|--------------------------------|--|
| <b>Method</b>    |                                | Available for <b>Spiral type: Clothoid</b> .         |
|                  | <b>Radius &amp; lengths</b>    | Using the radius of the clothoid and its length.     |
|                  | <b>Radius &amp; parameters</b> | Using the radius of the clothoid and its parameters. |
| <b>Radius</b>    | Editable field                 | The radius of the curve.                             |
| <b>Length in</b> | Editable field                 | The lengths of the connecting curve.                 |

| Field               | Option         | Description   |
|---------------------|----------------|---|
| <b>Parameter in</b> | Editable field | Depending on the setting, the parameters P or factors K of the clothoid. Available for <b>Spiral type: Clothoid</b> with <b>Method: Radius &amp; parameters</b> . |

For **Element type at PI: Spiral spiral** and **Element type at PI: Spiral - curve - spiral**

| Field                                 | Option                         | Description   |
|---------------------------------------|--------------------------------|---|
| <b>Method</b>                         |                                | Available for <b>Spiral type: Clothoid</b> .  |
|                                       | <b>Radius &amp; lengths</b>    | Using the radius of the clothoid and its length.  |
|                                       | <b>Radius &amp; parameters</b> | Using the radius of the clothoid and its parameters.  |
| <b>Radius</b>                         | Editable field                 | The radius of the curve.  |
| <b>Length in and Length out</b>       | Editable field                 | The lengths of the connecting curve.  |
| <b>Parameter in and Parameter out</b> | Editable field                 | Depending on the setting, the parameters P or factors K of the clothoid. Available for <b>Spiral type: Clothoid</b> with <b>Method: Radius &amp; parameters</b> . |

#### Next step

OK to access the next panel.

## 47.6

## Edit Vertical Alignments Using Elements

### 47.6.1

### Overview

#### Description

Allows creating, editing and deleting of the following elements:

- Start Point
- Straight (Tangent)
- Parabola
- Asymmetric parabola
- Curve

as well as checking the vertical alignment.

Throughout the whole component height and elevation is used for local orthometric height. If no local orthometric height is available, the local ellipsoidal height is used instead.

#### Access

In **Alignment Editor Menu** highlight **Edit vertical alignment**. Press **OK**.



**Use PVI instead of element for vertical alignment definition** must be unchecked in **Measure Settings, Advanced** page.

#### Vertical Alignment, Elements page

The available keys are identical to the keys in **Horizontal Alignment**. Refer to the paragraph [Horizontal Alignment, Elements page](#).

## 47.6.2

## Editing the Start Point

### Access

In **Vertical Alignment**, highlight the start point and press **Edit**.

### Vertical Start Point

Vertical Start Point

Height 3.000 m

Start chainage 5.000 m

Fn OK Fn

| Key         | Description  |
|-------------|--|
| OK          | To accept the panel entries and continue.  |
| Get point   | To apply heights from an existing point in the job.                                |
| Meas app    | To go to <b>Measure</b> and measure a point.                                       |
| Fn Settings | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |
| Fn Reset    | To reset all panel entries.  |

### Description of fields

| Field          | Option         | Description  |
|----------------|----------------|--|
| Height         | Editable field | Elevation at the start chainage of the vertical alignment. |
| Start chainage | Editable field | Start chainage of the vertical alignment.                  |

## 47.6.3

## Inserting/Editing an Element in a Vertical Alignment

### Access

In **Vertical Alignment, Elements** page, highlight the start point and press **Add** or **Edit**.



Creating and editing an alignment element are similar processes. For simplicity, only the creation of an alignment element is explained and differences are clearly outlined.



For grade units, the system settings are applied. Refer to [29.3 Regional](#) to change the system setting.

### Add Vertical Element

#### Description of fields

| Field        | Option   | Description   |
|--------------|----------|---|
| Element type | Straight | To insert/edit a straight to/in a vertical alignment.           |
|              | Parabola | To insert/edit a quadratic parabola to/in a vertical alignment. |

| Field | Option       | Description  |
|-------|--------------|--|
|       | <b>Curve</b> | To insert/edit a curve to/in a vertical alignment. |

The options available for the field **Method** depend on the **Element type** selected.

For **Element type: Straight**

| Field         | Option                           | Description   |
|---------------|----------------------------------|---|
| <b>Method</b> | <b>Length &amp; end height</b>   | Using the length and the end elevation of the straight.   |
|               | <b>End chainage &amp; height</b> | Using the end chainage and the elevation of the straight. |
|               | <b>Length &amp; grade</b>        | Using the length and the grade of the straight.           |
|               | <b>End chainage &amp; grade</b>  | Using the end chainage and the grade of the straight.     |

For **Element type: Parabola**

| Field         | Option                            | Description  |
|---------------|-----------------------------------|--|
| <b>Method</b> | <b>Length &amp; grades</b>        | Using the length and the grades of the parabola.             |
|               | <b>End chainage &amp; grades</b>  | Using the end chainage and the grades of the parabola.       |
|               | <b>Parameter &amp; end height</b> | Using the parameter and the end elevation of the parabola.   |
|               | <b>3 heights</b>                  | Using three elevations at defined chainages of the parabola. |

For **Element type: Curve**

| Field         | Option                           | Description  |
|---------------|----------------------------------|--|
| <b>Method</b> | <b>Radius &amp; length</b>       | Using the radius of the curve and its length.                          |
|               | <b>Radius &amp; end chainage</b> | Using the radius and the end chainage of the curve.                    |
|               | <b>Radius &amp; grades</b>       | Using the radius and the grades of the curve.                          |
|               | <b>Length &amp; grades</b>       | Using the length and the grades of the curve.                          |
|               | <b>End chainage &amp; grades</b> | Using start, intermediate and end elevation and chainage of the curve. |

**Next step**

**OK** to access the next panel.



## Vertical Straight/ Vertical Parabola/ Vertical Curve, Input page

Vertical Straight

Input Details 3D viewer

Start chainage **114.649 m**

Start height **418.991 m**

Length **5.000 m**

End height **3.000 m**

Fn OK Get point Meas app Page Fn

| Key                      | Description   |
|--------------------------|---|
| <b>OK</b>                | To accept the panel entries and continue.   |
| <b>Inverse</b>           | To calculate the distance and angle between two points from the job.  |
| <b>Last inv</b>          | To select values from the last inverse calculations.  |
| <b>Get point</b>         | To apply coordinates or heights from an existing point in the job. Available when coordinates must be typed in. |
| <b>Meas app</b>          | To go to <b>Measure</b> and measure a point. Available when elevation must be typed in.                         |
| <b>Page</b>              | To change to another page on this panel.  |
| <b>Fn Settings</b>       | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .                              |
| <b>Fn Reset</b>          | To reset all panel entries.   |
| <b>Fn %/V:H/<br/>H:V</b> | To switch between <b>h:v</b> , <b>v:h</b> and <b>%(v/h x 100)</b> for the grade unit.                           |

### Description of fields

| Field                 | Option       | Description  |
|-----------------------|--------------|--|
| <b>Start chainage</b> | Display only | The end chainage of the previous element is automatically used and cannot be edited. |
| <b>Start height</b>   | Display only | The end height of the previous element is automatically used and cannot be edited.   |

The other fields and options available depend on the **Method** and **Element type** selected in **Add Vertical Element**.

For **Element type: Straight**

| Field               | Option         | Description  |
|---------------------|----------------|--|
| <b>Length</b>       | Editable field | Length of the straight element as slope distance. Available for <b>Method:Length &amp; end height</b> and <b>Method:Length &amp; grade</b> . |
| <b>End chainage</b> | Editable field | Chainage at the end of the element. Available for <b>Method:End chainage &amp; height</b> and <b>Method:End chainage &amp; grade</b> .       |

| Field             | Option         | Description   |
|-------------------|----------------|---|
| <b>End height</b> | Editable field | Height at the end of the element. Type in manually or, alternatively, press <b>Get point</b> when the focus is on this line to select the height from an existing point in the job. Available for <b>Method:Length &amp; end height</b> and <b>Method:End chainage &amp; height</b> . |
| <b>Grade</b>      | Editable field | The grade of the straight element. Positive inclines have positive values, negative inclines have negative values. Available for <b>Method:Length &amp; grade</b> and <b>Method:End chainage &amp; grade</b> .  |

For **Element type: Parabola**

| Field                                       | Option         | Description  |
|---|----------------|--|
| <b>Curve type</b>                           | <b>Crest</b>   | The curve type is convex. Available for <b>Method:Parameter &amp; end height</b> .   |
|   | <b>Sag</b>     | The curve type is concave. Available for <b>Method:Parameter &amp; end height</b> .  |
| <b>Parameter p</b><br>or<br><b>K factor</b> | Editable field | Parameter of the parabola. Available for <b>Method:Parameter &amp; end height</b> . The field name depends on the value chosen for the <b>Vertical parabola definition</b> in the <b>Settings, Advanced</b> page.  |
| <b>Length</b>                               | Editable field | Length of the parabola as horizontal distance. Available for <b>Method:Length &amp; grades</b> and <b>Method:Parameter &amp; end height</b> .  |
| <b>Int chainage</b>                         | Editable field | Chainage of the second elevation. Available for <b>Method:3 heights</b> .  |
| <b>Int height</b>                           | Editable field | Second elevation. Type in manually or press <b>Get point</b> when the focus is on this line to select the height from an existing point in the job. Available for <b>Method:3 heights</b> .  |
| <b>End chainage</b>                         | Editable field | Chainage at the end of the element. Available for <b>Method:End chainage &amp; grades</b> and <b>Method:3 heights</b> .  |
| <b>End height</b>                           | Editable field | Height at the end of the element. Type in manually or, alternatively, press <b>Get point</b> when the focus is on this line to select the height from an existing point in the job. Available for <b>Method:Parameter &amp; end height</b> and <b>Method:3 heights</b> . |
| <b>Grade in</b>                             | Editable field | The grade at the beginning of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for parabolas with <b>Method:Length &amp; grades</b> and <b>Method:End chainage &amp; grades</b> .                                 |

| Field            | Option         | Description   |
|------------------|----------------|---|
| <b>Grade out</b> | Editable field | The grade at the end of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for <b>Method:Length &amp; grades</b> and <b>Method:End chainage &amp; grades</b> . |

For **Element type: Curve**

| Field               | Option         | Description   |
|---------------------|----------------|---|
| <b>Curve type</b>   | <b>Crest</b>   | The curve type is convex.   |
|                     | <b>Sag</b>     | The curve type is concave.  |
| <b>Radius</b>       | Editable field | Radius of the curve. Available for <b>Method:Radius &amp; length</b> , <b>Method:Radius &amp; end chainage</b> and <b>Method:Radius &amp; grades</b> .  |
| <b>Length</b>       | Editable field | Length of the curve along the segment. Available for <b>Method:Radius &amp; length</b> and <b>Method:Length &amp; grades</b> .  |
| <b>End chainage</b> | Editable field | Chainage at the end of the element. Available for <b>Method:End chainage &amp; grades</b> and <b>Method:Radius &amp; end chainage</b> .   |
| <b>End height</b>   | Editable field | Height at the end of the element. Type in manually or, alternatively, press <b>Get point</b> when the focus is on this line to select the height from an existing point in the job. Available for <b>Method:Radius &amp; length</b> and <b>Method:Radius &amp; end chainage</b> . |
| <b>Grade in</b>     | Editable field | The grade at the beginning of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for <b>Method:Radius &amp; grades</b> , <b>Method:Length &amp; grades</b> and <b>Method:End chainage &amp; grades</b> .                     |
| <b>Grade out</b>    | Editable field | The grade at the end of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for <b>Method:Radius &amp; grades</b> , <b>Method:Length &amp; grades</b> and <b>Method:End chainage &amp; grades</b> .                           |

#### Next step

**Page** changes to the **Details** page, where all entered and calculated elements are displayed. Press **Ch & ht** to query the elevation for a given chainage.

## 47.7

### Edit Vertical Alignments Using PIs

#### 47.7.1

#### Overview

#### Description

Allows creating, editing and deleting PIs by chainage, elevation and if required an element type (parabola, curve).

## Access

In **Alignment Editor Menu** highlight **Edit vertical alignment**. Press **OK**.



**Use PVI instead of element for vertical alignment definition** must be unchecked in **Measure Settings, Advanced** page.

## Vertical Alignment, PVI page

The available keys are identical to the keys in **Horizontal Alignment**. Refer to the paragraph [Add PVI](#).

## 47.7.2

### Inserting/Editing a PVI in a Vertical Alignment

## Access

In **Vertical Alignment, PVI** page, highlight a PVI and press **Add** or **Edit**.



Creating and editing an alignment PVI are similar processes. For simplicity, only the creation of an alignment PVI is explained and differences are clearly outlined.

## Add PVI

Fn OK Fn

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To accept the panel entries and return to the <b>Alignment Editor Menu</b> .  |
| <b>Get point</b>   | To apply heights from an existing point in the job. Available when <b>Height</b> is highlighted.  |
| <b>Meas app</b>    | To go to <b>Measure</b> and measure a point. Available when <b>Height</b> is highlighted.   |
| <b>Inverse</b>     | To calculate the values for the distance and the offset from two existing points. Available when <b>Radius</b> or <b>Length</b> is highlighted. |
| <b>Last inv</b>    | To recall previous results from COGO inverse calculations. Available if <b>Radius</b> or <b>Length</b> is highlighted.                          |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .  |
| <b>Fn Reset</b>    | To reset all panel entries.   |

### Description of fields

| Field                      | Option         | Description                                |
|----------------------------|----------------|--|
| <b>Chainage</b>            | Editable field | The chainage of the vertical PVI.          |
| <b>Height</b>              | Editable field | The elevation of the vertical PVI.         |
| <b>Element type at PVI</b> | <b>None</b>    | No element is defined at the vertical PVI. |

| Field | Option          | Description  |
|-------|-----------------|--|
|       | <b>Curve</b>    | A curve is defined at the vertical PVI.              |
|       | <b>Parabola</b> | A quadratic parabola is defined at the vertical PVI. |

The other fields on the panel depend on the **Element type at PVI** selected.

For **Element type at PVI: Curve**

| Field         | Option         | Description                        |
|---------------|----------------|------------------------------------|
| <b>Method</b> | <b>Length</b>  | To define the curve by its length. |
|               | <b>Radius</b>  | To define the curve by its radius. |
| <b>Length</b> | Editable field | The length of the curve.           |
| <b>Radius</b> | Editable field | The radius of the curve.           |

For **Element type at PVI: Parabola**

| Field              | Option           | Description  |
|--------------------|------------------|--|
| <b>Method</b>      | <b>Length</b>    | To define the parabola by its length.                                    |
|                    | <b>Parameter</b> | To define the parabola by its parameter.                                 |
| <b>Length</b>      | Editable field   | The length of the parabola.  |
| <b>Parameter p</b> | Editable field   | Depending on the setting, the parameters P or factors K of the parabola. |

**Next step**

**OK** to access the next panel.

## 47.8

## Edit Cross Section Templates

### 47.8.1

### Overview

#### Description

Allows creating, editing, deleting and duplicating of cross section templates.

#### Access

In **Alignment Editor Menu** highlight **Edit cross section templates**. Press **OK**.

#### Templates



| Key         | Description                                     |
|-------------|---|
| <b>OK</b>   | To accept the panel entries and continue.       |
| <b>New</b>  | To create a cross section template.             |
| <b>Edit</b> | To edit the highlighted cross section template. |

| Key              | Description                                       |
|------------------|---|
| <b>Delete</b>    | To delete the highlighted cross section template. |
| <b>Duplicate</b> | To duplicate the highlighted template.            |
| <b>Page</b>      | To change to another page on this panel.          |

## 47.8.2

### Creating/Editing a Cross Section Template

#### Access

#### In Templates

press **New** to create a new cross section template

OR

highlight an existing template and press **Edit**.



Creating and editing a cross section template are similar processes. For simplicity, only the creation of a cross section template is explained and differences are clearly outlined.

#### New Template, General page

Fn OK Page Fn

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To accept the panel entries and continue.  |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

#### Description of fields

| Field  | Option         | Description  |
|--|----------------|--|
| <b>Template name</b>                                       | Editable field | Name of the cross section template to be created/edited.   |
| <b>Allow absolute heights for cross section definition</b> | Check box      | If this box is checked, in addition to relative to line input methods, absolute heights can also be entered to define cross section segments.                              |
| <b>Centre height</b>                                       | Editable field | To be able to create segments using absolute heights, a centre height must be defined. Available if <b>Allow absolute heights for cross section definition</b> is checked. |

## Next step

**Page** changes to the **Layers** page where the layers of the template are listed.

### 47.8.3

### Add/Edit a Layer

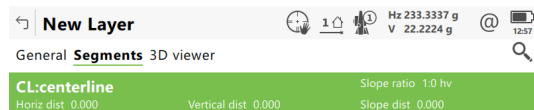
#### Access

In **New Template, Layers** page or when editing a template, press **New** or **Edit**.



Creating and editing a layer of a cross section template are similar processes. For simplicity, only the creation of a layer is explained and differences are clearly outlined.

#### New Layer, Segments page



Fn OK Add Edit Delete More Page Fn

| Key       | Description  |
|-----------|--|
| OK        | To accept the panel entries and continue.  |
| Add       | To create and add a segment.   |
| Edit      | To edit the highlighted segment.   |
| Delete    | To delete the highlighted segment.   |
| More      | To switch between <b>Horizontal offset to centreline, Slope distance, Horizontal distance</b> in the second column and between <b>Vertical offset to centreline, Slope ratio, Vertical distance</b> in the metadata. |
| Page      | To change to another page on this panel.   |
| Fn Mirror | To mirror the entered segments to the other side of the cross section.   |

#### Description of metadata

| Column                                 | Description   |
|--|---|
| -                                      | The name of the segment.                            |
| <b>Horizontal offset to centreline</b> | Horizontal offset to the centreline of the segment. |
| <b>Vertical offset to centreline</b>   | Vertical offset to the centreline of the segment.   |
| <b>Slope distance</b>                  | Slope distance to the neighbouring vertex.          |
| <b>Slope ratio</b>                     | Slope ratio of the segment.                         |

| Column                     | Description                                     |
|----------------------------|---|
| <b>Horizontal distance</b> | Horizontal distance to the neighbouring vertex. |
| <b>Vertical distance</b>   | Vertical distance to the neighbouring vertex.   |

### Next step

**Add** to add a segment.

## Add Segment, Input page

**Add Segment** Details 3D viewer

Template name: 55

Layer name: centerline

Method: Horizontal distance & slope

Horizontal distance: -----

Slope ratio: -----

Fn OK % Page Fn

| Key                        | Description  |
|----------------------------|--|
| <b>OK</b>                  | To accept the panel entries and continue.  |
| <b>Inverse</b>             | Available when <b>Horizontal distance</b> , <b>Horizontal offset to centreline</b> or <b>Slope distance</b> is highlighted. To calculate the distance and angle between two points from the job. |
| <b>Last inv</b>            | Available when <b>Horizontal distance</b> , <b>Horizontal offset to centreline</b> or <b>Slope distance</b> is highlighted. To select values from the last inverse calculations.                 |
| <b>%/<br/>V:H/<br/>H:V</b> | To switch between <b>h:v</b> , <b>v:h</b> and <b>%(v/h x 100)</b> for the slope ratio.   |
| <b>Page</b>                | To change to another page on this panel.   |
| <b>Fn Settings</b>         | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> .   |
| <b>Fn Reset</b>            | To reset all panel entries.  |

### Description of fields

| Field                | Option                                 | Description  |
|----------------------|--|--|
| <b>Template name</b> | Display only                           | Name of the cross section template to be edited.                           |
| <b>Layer name</b>    | Display only                           | Name of the layer to be edited.  |
| <b>Method</b>        |  | Method to be used for defining the segment.                                |
|                      | <b>Horizontal distance &amp; slope</b> | Using a horizontal distance and slope ratio to define the segment.         |
|                      | <b>Horiz &amp; vertical distance</b>   | Using a horizontal distance and a vertical distance to define the segment. |



| Field                                  | Option                               | Description  |
|--|--------------------------------------|--|
|  | <b>CL offsets</b>                    | Using a horizontal and vertical offset in relation to the centreline.  |
|  | <b>Slope distance &amp; ratio</b>    | Using a slope distance and slope ratio to define the segment.  |
|  | <b>Horiz distance &amp; height</b>   | Using a horizontal and absolute height to define the segment. Only available for templates with <b>Allow absolute heights for cross section definition</b> enabled.                |
|  | <b>Offset &amp; ht to centreline</b> | Using a horizontal offset in relation to the centreline and absolute height. Only available for templates with <b>Allow absolute heights for cross section definition</b> enabled. |
| <b>Horizontal distance</b>             | Editable field                       | Horizontal distance of the segment. Available for <b>Method: Horizontal distance &amp; slope</b> and <b>Method: Horiz &amp; vertical distance</b> .                                |
| <b>Vertical distance</b>               | Editable field                       | Vertical distance of the segment. Available for <b>Method: Horiz &amp; vertical distance</b> .   |
| <b>Horizontal offset to centreline</b> | Editable field                       | Horizontal centreline offset of the segment. Only available for <b>Method: CL offsets</b> .  |
| <b>Vertical offset to centreline</b>   | Editable field                       | Vertical centreline offset of the segment. Only available for <b>Method: CL offsets</b> .  |
| <b>Slope distance</b>                  | Editable field                       | Slope distance of the segment. Only available for <b>Method: Slope distance &amp; ratio</b> .  |
| <b>Slope ratio</b>                     | Editable field                       | Slope ratio of the segment. Available for <b>Method: Horizontal distance &amp; slope</b> and <b>Method: Slope distance &amp; ratio</b> .   |

#### Next step

**Page** changes to the **Details** page, where all entered and calculated elements are displayed.

## 47.9

### Edit Cross Section Assignments

#### 47.9.1

#### Overview

#### Description

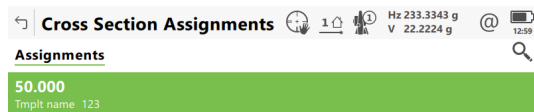
Allows the creation, editing and deleting of cross section assignments as well as checking the cross section assignments.

A cross section assignment defines from which chainage on a cross section template is to be used.

#### Access

In **Alignment Editor Menu** highlight **Edit cross section assignmt**. Press **OK**.

## Cross Section Assignments



Fn OK New Edit Delete Check Fn

| Key         | Description  |
|-------------|--|
| OK          | To accept the panel entries and continue.  |
| New         | To create a cross section assignment.  |
| Edit        | To edit a cross section assignment.  |
| Delete      | To delete a cross section assignment.  |
| Check       | To check the cross section assignments.  |
| Fn Settings | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

### 47.9.2

### Creating/Editing a Cross Section Assignment

#### Access

In **Cross Section Assignments** press **New** or **Edit**.

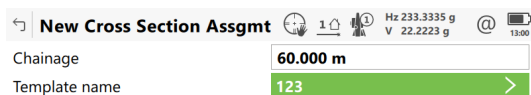


Creating and editing a cross section assignment are similar processes. For simplicity, only the creation of a cross section assignment is explained and differences are clearly outlined.



Assigned cross section templates must contain the same number of vertices.

#### New Cross Section Assgmt



Fn OK Fn

| Key         | Description  |
|-------------|--|
| OK          | To accept the panel entries and continue.  |
| Start chng  | To take the start chainage of the vertical alignment for <b>Chainage</b> .         |
| End chng    | To take the end chainage of the vertical alignment for <b>Chainage</b> .           |
| Fn Settings | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

## Description of fields

| Field                | Option          | Description   |
|----------------------|-----------------|---|
| <b>Chainage</b>      | Editable field  | The chainage to which the cross section template is assigned to.<br><br>Type in or edit the value for Chainage. Alternatively press <b>Start chng</b> or <b>End chng</b> to apply the start or end chainage of the vertical alignment.              |
| <b>Template name</b> | Selectable list | The cross section template to be assigned to. All existing cross section templates currently stored to the alignment can be selected.<br><br>Select an existing template from the list or create a template to be assigned to the <b>Chainage</b> . |

## 47.10

### Edit Chainage Equation

#### 47.10.1

#### Overview

#### Description

Allows creating, editing and deleting of:

- Gaps
- Overlaps

#### Access

In **Alignment Editor Menu** highlight **Edit chainage equation**. Press **OK**.

#### Chainage Equation



| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To accept the panel entries and continue.  |
| <b>New</b>         | To create a chainage equation.   |
| <b>Edit</b>        | To edit a chainage equation.   |
| <b>Delete</b>      | To delete a chainage equation.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">47.3 Configuring Alignment Editor</a> . |

#### 47.10.2

#### Creating/Editing a Chainage Equation

#### Access

In **Chainage Equation** press **New** or **Edit**.



Creating and editing a Chainage equation are similar processes. For simplicity, only the creation of a Chainage equation is explained and differences are clearly outlined.

## New Chainage Equation

### Description of fields

| Field                 | Option         | Description                                |
|-----------------------|----------------|--|
| <b>Chainage back</b>  | Editable field | Chainage back. Type in or edit the value.  |
| <b>Chainage ahead</b> | Editable field | Chainage ahead. Type in or edit the value. |

### Next step

OK to create the chainage equation or to store the edited chainage equation.

## 47.11

### Convert to job

#### Description



Allows the onboard conversion of existing LandXML alignments including horizontal alignment, vertical alignment, cross sections and chainage equations to a Roads job.

#### Access

In **Alignment Editor Menu** highlight **Convert to job**. Press **OK**.

#### Convert to Road Job/ Convert to Rail Job

### Description of fields

| Field                           | Option                                | Description   |
|---------------------------------|---------------------------------------|---|
| <b>Convert alignment</b>        | Display only                          | Displays the modified or newly created alignment to be converted.   |
| <b>To road job</b>              | Selectable list                       | The Road job to which the alignment is converted. Create a job. Available if the <b>Alignment type</b> is set to <b>Road</b> in <b>Choose Alignment</b> .<br><br> If a new job with the same name as an existing job must be created, then the existing job must be deleted first. |
| <b>To rail job</b>              | Selectable list                       | The Rail job to which the alignment is converted. Create a job. Available if the <b>Alignment type</b> is set to <b>Rail</b> in <b>Choose Alignment</b> .<br><br> If a new job with the same name as an existing job must be created, then the existing job must be deleted first. |
| <b>Geometry to be converted</b> |                                       | Defines the mode to be used for the conversion process.   |
|                                 | <b>Horiz &amp; vertical alignment</b> | Only horizontal and vertical alignment is converted.  |

| Field | Option                                | Description  |
|-------|---------------------------------------|--|
|       | <b>Horizontal alignment only</b>      | Only horizontal alignment is converted.  |
|       | <b>Horiz, vertical, cross section</b> | Horizontal alignment, vertical alignment and cross sections are converted. Only available for road jobs. |

---

### Next step

Press **OK** to start the conversion.

Alignment Editor creates a report sheet during the conversion. The file LandXml2Dbx.log can be found in the \DataXML folder on the data storage device.

After the successful conversion, press **OK** to return to the **Leica Captivate - Home** on the instrument.

---

## 48

## Roads - Road

### 48.1

### Creating a New Road Job

#### Description

There are two ways of creating road/rail jobs:

Typing them in manually by using the **Alignment editor** app.

OR

Converting data created in a design package.

#### Manually entered data

Data can be typed in and edited with **Alignment editor**. Refer to [47 Roads - Alignment Editor](#) for information on how to enter data manually.

#### Converted data

The **Import data** functionality in the job menu supports different formats like dxf, LandXml, MxGenio, Terramodel, Carlson.

The Design to Field component of Infinity offers converters from several road/rail design and CAD packages. Several design packages also include a built-in converter to Roads/Rail. As different design packages follow different philosophies in representation, creation and storage of data the conversion process differs slightly.

Infinity can be found on the Infinity DVD.

The latest version of the Design to Field importers can be found in the downloads section of:

- <https://myworld.leica-geosystems.com>

#### Job selection

Refer to [46.2.1 Accessing Roads Apps](#).

### 48.2

### Defining the Work

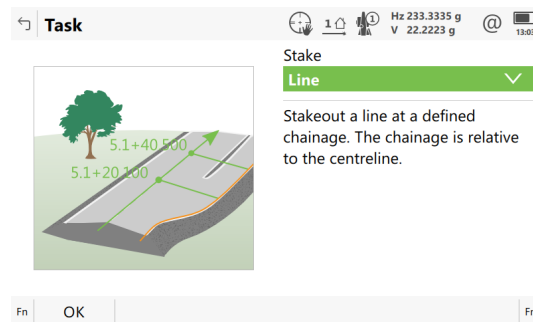
#### 48.2.1

#### Defining the Method and the Task

#### Access

Select **Leica Captivate - Home: Stake road** or **Check road**.

#### Task



| Key         | Description  |
|-------------|--|
| OK          | To continue to the next panel.   |
| Fn Settings | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> . |
| Fn Method   | To define what is shown in the selectable list for <b>Stake</b> .            |

## Description of the methods

| Method                    | Description  |
|---------------------------|--|
| <b>Line</b>               | To stake/check any type of line, for example a centreline or kerb. Chainage information is related to the centreline.  |
| <b>Local line</b>         | Like the previous method when staking/checking any line of a layer. The stake/check is always in relation to the chainage of the line itself and not the centreline of the layer.  |
| <b>Surface grade</b>      | To stake/check a surface grade defined by the road design. Two lines define the surface grade.   |
| <b>Manual slope</b>       | To stake/check a manually defined slope relative to an existing centreline. The slope is defined by one line and the slope direction with ratio. The stake/check is always in relation to the chainage of the line itself and not the centreline of the layer. |
| <b>Local manual slope</b> | To stake/check a manually defined slope relative to an existing hinge line. The slope is defined by one line and the slope direction with ratio.   |
| <b>Slope</b>              | To stake/check a slope defined by two lines of the 3D road design.   |
| <b>Crown</b>              | To stake/check a road crown defined by two surface grades and one common line. The information for both surface grades is displayed at the same time.  |
| <b>Layer</b>              | To stake/check a layer surface defined by the road design relative to the layer centreline.  |
| <b>DTM</b>                | To check a DTM surface. Available for <b>Check road</b> only.  |



The available methods depend on the selected job types (road or design job):

| Available method          | Road job only | Design job only | Road job, points & lines job | DTM job only |
|---------------------------|---------------|-----------------|------------------------------|--------------|
| <b>Line</b>               | ✓             | -               | ✓                            | -            |
| <b>Local line</b>         | ✓             | ✓               | ✓                            | -            |
| <b>Surface grade</b>      | ✓             | -               | -                            | -            |
| <b>Manual slope</b>       | ✓             | -               | ✓                            | -            |
| <b>Local manual slope</b> | ✓             | ✓               | ✓                            | -            |
| <b>Slope</b>              | ✓             | -               | -                            | -            |
| <b>Crown</b>              | ✓             | -               | -                            | -            |
| <b>Layer</b>              | ✓             | -               | -                            | -            |
| <b>DTM</b>                | -             | -               | -                            | ✓            |

### Next step

**OK** accesses the **Define Task** panel.

## Define Task panel

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To continue to the next panel.   |
| <b>Slope</b>       | Available for <b>Stake: Local manual slope</b> . To define the slope parameters. Refer to <a href="#">48.2.3 Advanced Slope Settings</a> .   |
| <b>Shifts</b>      | To apply horizontal and vertical shifts to the selected element. Refer to <a href="#">46.4 Working with Shifts</a> .   |
| <b>Load</b>        | To load a task. Refer to <a href="#">46.5 Tasks</a> .  |
| <b>Save task</b>   | To save the settings as a task. Refer to <a href="#">46.5 Tasks</a> .  |
| <b>Page</b>        | To change, depending on the selected method, to <b>Hinge offset</b> and/or <b>3D viewer</b> page.<br> Any line can be selected on the <b>3D viewer</b> page.<br> Import dxf lines to a design job before using for Roads. Refer to <a href="#">37.6 Context Menu</a> . |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .   |

The fields available depend on the selection for **Stake** in **Task**.

### Description of fields


Common to all methods

| Field        | Option                          | Description                         |
|--------------|---------------------------------|-------------------------------------|
| <b>Layer</b> | Display only or selectable list | The selected layer in the Road job. |

For **Stake: Line**

| Field   | Option          | Description   |
|---|-----------------|---|
| <b>Working chainage</b>                       | Editable field  | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TS and the current position for GS. |
| <b>Working line</b>                           | Selectable list | To select a line at the <b>Working chainage</b> . Or select a line on the <b>3D viewer</b> page. Refer to <a href="#">48.2.2 Selecting a Line</a> .                                     |
| <b>Show information to an additional line</b> | Check box       | When this box is checked, a second line can be selected.  |



| Field                  | Option          | Description  |
|------------------------|-----------------|--|
|                        |                 | Allows chainage, offset and height difference information to be obtained from any other string of the layer, independent from those strings currently selected for the chosen method. For example: Staking a surface grade where the height information comes from the surface grade, but the chainage information comes from a string which is not the centreline of the current layer.<br><br>For the additional line, an offset and a height difference can be defined on the  page. |
| <b>Additional line</b> | Selectable list | The lines available as second lines, independent of the <b>Working chainage</b> . Or select a line in 3D viewer.   |

For **Stake: Local line**

| Field   | Option          | Description  |
|---|-----------------|--|
| <b>Working line</b>                           | Selectable list | To select a line at the <b>Working chainage</b> . Or select a line in 3D viewer.   |
| <b>Show information to an additional line</b> | Check box       | When this box is checked, a second line can be selected.<br><br>Allows chainage, offset and height difference information to be obtained from any other string of the layer independent from those strings currently used. For example: Staking a surface grade where the height information comes from the surface grade but the chainage information comes from a string which is not the centreline of the current layer. |
| <b>Additional line</b>                        | Selectable list | The lines available as second lines, independent of the <b>Working chainage</b> . Or select a line in 3D viewer.   |

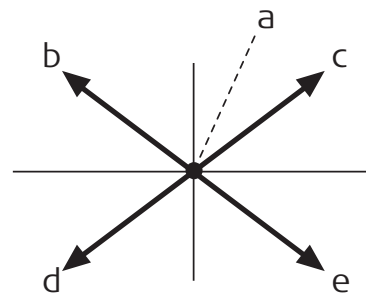
For **Stake: Surface grade**

| Field                   | Option          | Description   |
|-------------------------|-----------------|---|
| <b>Working chainage</b> | Editable field  | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TS and the current position for GS. |
| <b>Left line</b>        | Selectable list | The name of the left line defining the surface grade. Refer to <a href="#">48.2.2 Selecting a Line</a> .  |
| <b>Right line</b>       | Display only    | The name of the right line defining the surface grade.  |

| Field   | Option                                | Description  |
|---|---------------------------------------|--|
| <b>Reference line</b>                         | <b>Left line</b> or <b>Right line</b> | To select one of the lines to be used as the reference line.   |
| <b>Show information to an additional line</b> | Check box                             | When this box is checked, a second line can be selected.<br><br>Allows chainage, offset and height difference information to be obtained from any other string of the layer independent from those strings currently used. For example: Staking a surface grade where the height information comes from the surface grade but the chainage information comes from a string which is not the centreline of the current layer. |
| <b>Additional line</b>                        | Selectable list                       | The lines available as second lines, independent of the <b>Working chainage</b> . Or select a line in 3D viewer.   |

For **Stake: Manual slope** and **Stake: Local manual slope**

| Field                     | Option                      | Description   |
|---------------------------|-----------------------------|---|
| On the <b>Slope</b> page: |                             |   |
| <b>Working chainage</b>   | Editable field              | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage of selected line.                       |
| <b>Hinge line</b>         | Selectable list             | To select the hinge point of the slope. Or select a line in 3D viewer.<br><br>☞ For <b>Manual slope</b> , only lines from the Road job can be selected. |
| <b>Slope location</b>     | <b>Left</b> or <b>Right</b> | Defines if the slope is left or right of the hinge point.   |



Road\_079

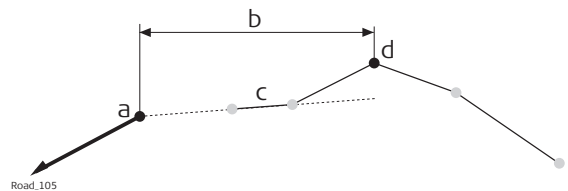
- a Hinge Point
- b Left, cut
- c Right, cut
- d Left, fill
- e Right, fill

| Field                           | Option              | Description   |
|---------------------------------|---------------------|---|
| <b>Use cut and Use fill</b>     | Check box           | When the box is checked, a cut/fill is used for the calculation. During the surveying process, the system calculates if it is a cut or a fill.<br>Check only one box to work only with cut or fill. |
| <b>Cut slope and Fill slope</b> | Editable field<br>☞ | Defines the cut/fill ratio of the slope.<br>The slope ratio format is defined as system setting in <b>Regional, Slope</b> page.   |

On the **Hinge offset** page:

|                            |  |   |
|----------------------------|--|---|
| <b>Apply hinge offsets</b> | Check box                                  | When this box is checked, a horizontal and vertical offset of the hinge point can be defined. |
| <b>Offset</b>              | Editable field                             | The horizontal offset of the hinge point from the centreline/reference line.                  |
| <b>Height offset type</b>  |  | The vertical offset type for the hinge point.   |
|                            | <b>Absolute</b>                            | The only option available for 2D lines.   |
|                            | <b>Relative to line or Relative to DTM</b> | Available for 3D lines.   |
|                            | <b>Relative to surface grade</b>           | Available for <b>Stake: Manual slope</b> . The manual slope is defined by:                    |

- Hinge offset relative to the selected hinge reference line
- Hinge height, calculated by using the hinge offset on the selected surface grade (left or right selected surface grade, depending on **Offset** - or +)



- a Hinge point of manual slope
- b Defined hinge offset (-)
- c Left surface grade of design
- d Selected hinge reference

|                          |                |   |
|--------------------------|----------------|---|
| <b>Height</b>            | Editable field | The elevation of the hinge point (absolute height). Available for <b>Height offset type: Absolute</b> .                           |
| <b>Height difference</b> | Editable field | For <b>Height offset type: Relative to line</b> : A vertical offset for the hinge point using a height difference can be defined. |

| Field | Option | Description  |
|-------|--------|--|
|       |        | For <b>Height offset type: Relative to DTM:</b><br>A height difference to the DTM height can be applied. |

For **Stake: Slope**

| Field                   | Option                                | Description   |
|-------------------------|---------------------------------------|---|
| <b>Working chainage</b> | Editable field                        | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TS and the current position for GS. |
| <b>Left line</b>        | Selectable list                       | The name of the left line defining the slope.   |
| <b>Right line</b>       | Display only                          | The name of the right line defining the slope.  |
| <b>Reference line</b>   | <b>Left line</b> or <b>Right line</b> | To select one of the lines to be used as the reference line. The reference line is the hinge line.  |

For **Stake: Crown**

| Field   | Option                                | Description  |
|---|---------------------------------------|--|
| <b>Working chainage</b>                       | Editable field                        | The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage. The default is the setup point for TS and the current position for GS.  |
| <b>Crown line</b>                             | Selectable list                       | Line defining the middle line of the crown. Refer to <a href="#">48.2.2 Selecting a Line</a> .   |
| <b>Left line</b>                              | Display only                          | The name of the line defining left line of the crown.  |
| <b>Right line</b>                             | Display only                          | The name of the line defining right line of the crown.   |
| <b>Reference line</b>                         | <b>Left line</b> or <b>Right line</b> | To select one of the lines to be used as the reference line.   |
| <b>Show information to an additional line</b> | Check box                             | When this box is checked, a second line can be selected.<br><br>Allows chainage, offset and height difference information to be obtained from any other string of the layer independent from those strings currently used. For example: Staking a surface grade where the height information comes from the surface grade but the chainage information comes from a string which is not the centreline of the current layer. |
| <b>Additional line</b>                        | Selectable list                       | The lines available as second lines.   |

For **Stake: Layer**

| Field                    | Option          | Description   |
|--------------------------|-----------------|---|
| <b>Layer</b>             | Selectable list | A list of all available layers of the selected Road job.                                      |
| <b>Centreline</b>        | Display only    | Active centreline of the selected layer.  |
| <b>Extend end slopes</b> | Check box       | When this box is checked, the left most and right most end slopes of the design are extended. |

For **Stake: DTM**, available for **Check road**

| Field                      | Option       | Description   |
|----------------------------|--------------|---|
| <b>DTM layer</b>           | Display only | A list of all DTM surfaces available in the selected DTM job. |
| <b>Number of triangles</b> | Display only | Number of triangles the selected DTM consists of.             |

### Next step

OK to access the **Stake** or **Check** panel.

## 48.2.2

### Selecting a Line

#### Access

In the Define panel, open a selectable list for a line, for example for **Working line** or **Left line**.



The selection of lines depends on:

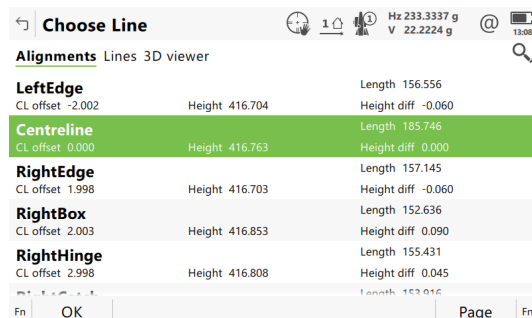
- Availability of horizontal alignments
- Availability of vertical alignment information
- View (plan or cross section view)
- Working chainage defined or not
- Selected method

#### Lines

The panel can have several pages.

- **Lines** page, if a design job is selected.
- **Alignments** page (if road alignment is selected)
- **3D viewer** page

If no working chainage has been entered, the lists show all lines of the current layer. If a working chainage is available, all lines existing at that chainage are listed only.



| Key  | Description   |
|------|---|
| OK   | To return to the previous panel.  |
| More | On the <b>Lines</b> page: To display information about the codes if stored with any line, the start time, the end time of when the last point was added to the line and the length of the line.<br><br>On the <b>Alignments</b> page: To display information about the absolute height or the height difference. Unavailable for local lines. |
| Page | To change to another page on this panel.  |

### Description of metadata

| Metadata    | Description  |
|-------------|--|
| -           | The name of the line.  |
| CL offset   | The offset from the centreline. The format is defined as system setting in <b>Regional</b> . |
| Height      | The absolute height of the line.   |
| Height diff | The height difference to the centreline.   |

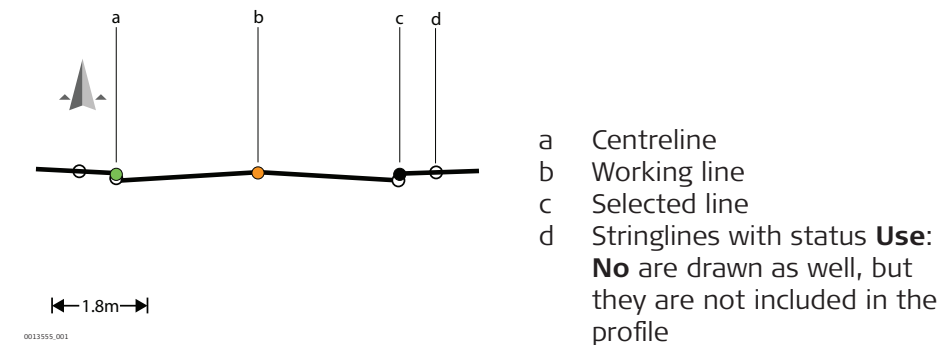


In addition to the list selection the required lines and slopes can also be selected in 3D viewer.

Lines can be selected in a graphical way by using the

- cross section view. The cross section view is available if a working chainage has been defined. The selected line (3D only) from the design job is also displayed. Unavailable for **Stake: Local manual slope**.
- planar view which is always available. The defined working chainage is displayed as a grey line. The size corresponds to the working corridor settings.

Click a line for selection.



### Colour coding

| Selected line | Colour      |
|---------------|-------------|
| Working line  | Orange      |
| Centreline    | Green       |
| Selected line | Thick black |

| Selected line    | Colour         |
|------------------|----------------|
| Other stringline | No colour fill |

### 48.2.3

## Advanced Slope Settings

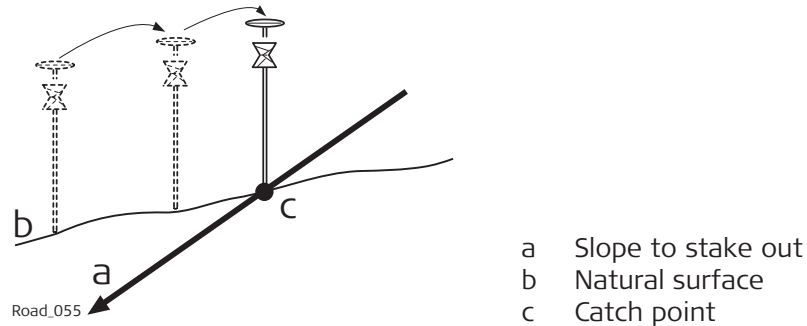
### Access

Press **Slope** in the Define panel.

### General slope stakeout

#### Description

This method involves a generic approach to slope stakeout for direct stakeout of the catch point. No special batter rails or reference point parameters are defined.



#### Workflow

As the natural surface is unknown the catch point can only be staked out iteratively. If staking out on a horizontal natural surface, the values shown for **Difference in offset** indicate how far the catch point is away. If the natural surface is not horizontal, more iterations could be needed.

### Slope Stakeout Settings

| Key   | Description  |
|-------|--|
| OK    | To return to the Define panel.                                       |
| Types | To define which slope stakeout types are shown and which are hidden. |

#### Description of fields

Common to all types

| Field                       | Option            | Description   |
|-----------------------------|-------------------|---|
| Use advanced slope stakeout | Check box         | When this box is checked, slope stakeout settings are available.  |
| Type                        | Catch point story | Stakeout of a catch point with showing the stakeout results in a specific way. Refer to <a href="#">Slope staking using Catch point story</a> . |
|                             | Reference point   | Stakeout of a reference peg with a defined offset from the catch point. Refer to <a href="#">Slope staking using Reference point</a> .          |

| Field | Option                           | Description   |
|-------|----------------------------------|---|
|       | <b>Batter rail vertical</b>      | Stakeout of batter rails using defined rail heights vertically above the batter. Refer to <a href="#">Slope staking using Batter rail vertical</a> or <a href="#">Batter rail perpendicular</a> .   |
|       | <b>Batter rail perpendicular</b> | Stakeout of batter rails using defined rail heights perpendicularly above the batter. Refer to <a href="#">Slope staking using Batter rail vertical</a> or <a href="#">Batter rail perpendicular</a> .  |
|       | <b>Ref batter vertical</b>       | Stakeout of batter rails using defined rail heights vertically above the batter. The innermost peg/stake is offset at a defined horizontal distance from the catch point. Refer to <a href="#">Slope staking using Ref batter vertical</a> or <a href="#">Ref batter perpendicular</a> .      |
|       | <b>Ref batter perpendicular</b>  | Stakeout of batter rails using defined rail heights perpendicularly above the batter. The innermost peg/stake is offset at a defined horizontal distance from the catch point. Refer to <a href="#">Slope staking using Ref batter vertical</a> or <a href="#">Ref batter perpendicular</a> . |
|       | <b>Ref point surface</b>         | Stakeout of a reference peg in the slope surface with a defined height difference to the hinge point. Slope values for the reference point cannot be entered. Refer to <a href="#">Slope staking using Ref point surface</a> .  |

For **Type: Reference point**

| Field             | Option         | Description   |
|-------------------|----------------|---|
| <b>Ref offset</b> | Editable field | The defined offset of the reference point from the catch point. |

For **Type: Batter rail vertical** and **Type: Batter rail perpendicular**

| Field                   | Option                    | Description  |
|-------------------------|---------------------------|--|
| <b>Batter type</b>      | <b>Cut</b> or <b>Fill</b> | Defines the cut or fill rail.  |
| <b>Traveller height</b> | Editable field            | Depending on the selected <b>Type</b> , the vertical or perpendicular height of the rail top above the batter. |
| <b>Rail over ground</b> | Editable field            | The vertical height of the rail over the ground.   |

For **Type: Ref batter vertical** and **Type: Ref batter perpendicular**

| Field                   | Option         | Description  |
|-------------------------|----------------|--|
| <b>Ref offset</b>       | Editable field | The defined offset of the inner peg from the catch point.  |
| <b>Traveller height</b> | Editable field | Depending on the selected <b>Type</b> , the vertical or perpendicular height of the rail above the batter. |



For **Type: Ref point surface**

The only available fields are **Use advanced slope stakeout** and **Type**.

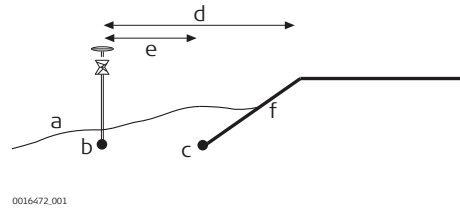
### Next step

**OK** returns to the Define panel.

## Slope staking using Catch point story

### Description

In some countries, the results of staking out catch points on Road alignments are written on the peg or lath in a specific way. The result pages allow copying the values directly onto the lath. The stakeout task becomes more efficient. Error sources that may arise if results are calculated manually are reduced.



- a Natural surface
- b Approximate staked out catch point
- c Catch point of the slope
- d Offset to hinge line
- e Offset to slope to stake out

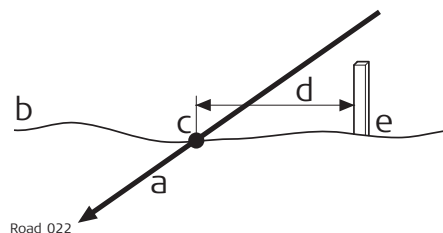
### Workflow

1. The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, the process is iterative. As soon as the measured position is close enough to the real catch point (c), it can be used as the approximate catch point. Based on this approximate catch point, the real catch point on the slope is calculated.
2. When the catch point is identified, measured and stored, a results panel is displayed. The results can be transferred to the peg or lath.
3. If required, measure an offset point relative to the measured catch point.
4. When the offset point is identified, measured and stored, the results panel is displayed again. This time, the results of the offset point and the catch point are displayed.

## Slope staking using Reference point

### Description

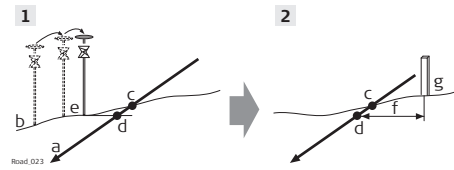
When staking out slopes using the reference point method, the catch point of the slope is marked with a reference peg using a defined offset. Grade checkers mark and control the grade of the slope.



- a Slope to stake out
- b Natural surface
- c Catch point of the slope
- d Defined reference point offset
- e Reference peg

The reference point offset guarantees that all pegs are placed with the same horizontal offset to the catch point.

## Workflow



- a Slope to stake out
- b Natural surface
- c Real catch point
- d Projected catch point
- e Approximate staked out catch point after three iterations
- f Defined reference point off-set
- g Reference peg

1. The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, the process is iterative. As soon as the measured position (e) is close enough to the real catch point (c), it can be used as the approximate catch point. Based on this approximate catch point, the projected catch point (d) on the slope is calculated.  
No reference point offset and no traveller height are taken into account for this step. The projected catch point (d) is then used as a starting point for the stakeout of the reference peg (g).

---

2. The second step is to stake out the reference point relative to the projected catch point. Select **Place reference peg** from the toolbox. Values in **Stake Slope Reference Pt** guides the user to the position to place the peg. The defined reference point offset (f) is already taken into account.  
The catch point is marked indirectly using the reference peg. Values to be marked on the reference peg can be found on **Stake Slope Reference Pt, Info** page.

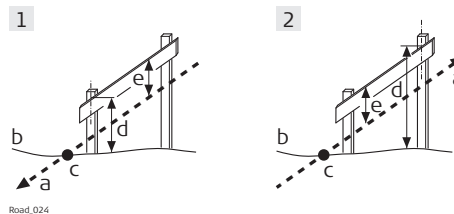
The closer the real catch point and the approximated stakeout catch point are, the closer the projected catch point gets to the real catch point.

## Slope staking using Batter rail vertical or Batter rail perpendicular

### Description

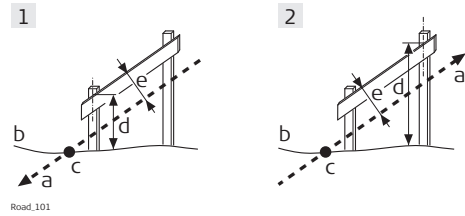
When staking out slopes with the **Batter rail vertical** or **Batter rail perpendicular** method, the grade of the slope is marked with a board. Using this method it is not necessary to stake out the catch point first.

### For Batter rail vertical



- 1 Batter rail for a cut
  - 2 Batter rail for a fill
- a Slope to stake out
  - b Natural surface
  - c Catch point of the slope
  - d Rail over ground
  - e Rail over batter, vertical

### For Batter rail perpendicular



- 1 Batter rail for a cut
- 2 Batter rail for a fill
- a Slope to stake out
- b Natural surface
- c Catch point of the slope
- d Rail over ground
- e Rail over batter, perpendicular

The defined rail over ground should guarantee that the rails are positioned as high as possible, to make them easier to use.

1. The first peg to stake out is always the peg closest to the hinge point.  
Stake out the position of the first peg of the batter by using **Difference in offset** on the Stake/Check panel. The height of the rail over ground **Rail over ground** is taken into account for **Difference in offset**. This action means that when **Difference in offset** is equal to zero the first peg is in the correct position.

---

2. Place the pole on top of the first peg. The value for **Difference in height** indicates how far below the top of the batter has to be placed.

---

3. Stake out the second peg of the batter rail by using **Difference in chainage** and place the peg.

---

4. Place the pole on the position of the batter rail to be used as a reference for the slope values to mark on the batter rail. **Difference in height** should now read zero.

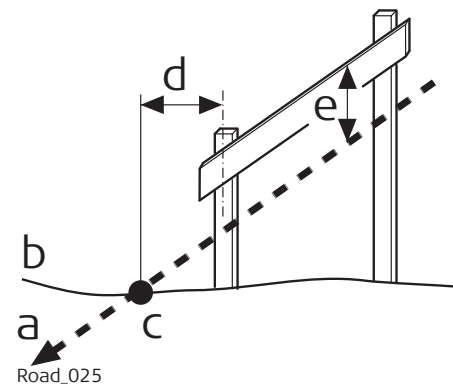
☞ All values shown under the **i** page are relative to the original slope.

### Slope staking using Ref batter vertical or Ref batter perpendicular

#### Description

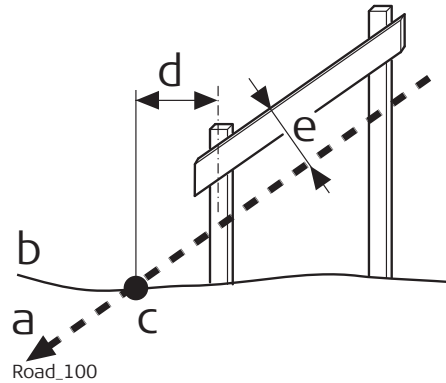
If batter rails with a constant distance from the inner peg to the catch point are required, this method is used.

#### For Ref batter vertical



- a Slope to stake out
- b Natural surface
- c Catch point of the slope
- d Defined reference point offset
- e Height of the "traveller", vertical

## For Ref batter perpendicular



- a Slope to stake out
- b Natural surface
- c Catch point of the slope
- d Defined reference point offset
- e Height of the "traveller", perpendicular

### Workflow

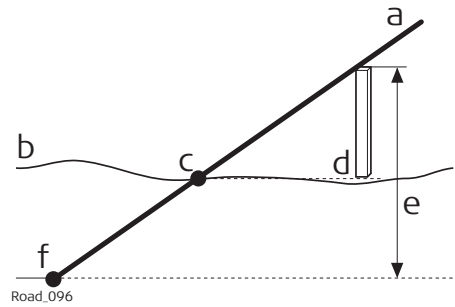
☞ The first step is to stake out the catch point of the slope. The reference point offset and traveller height are not taken in account in this step. Based on this approximate catch point the projected catch point on the slope is calculated. The projected catch point is used as a starting point for the stakeout of the reference peg.

1. Stake out the position of the catch point by using **Difference in offset** and/or **Difference in height** on the Stake/Check panel. When **Difference in offset** and **Difference in height** are equal to zero, the catch point has been located.
2. **Fn Tools** to access the Tools panel. The measured position is used as the catch point for the stake out of the reference point.
3. Select **Place reference peg** to access the stakeout panel for the reference peg.
4. Stake out the reference point using **Difference in offset**. When **Difference in offset** is equal to zero the reference peg position has been found.
5. Place the pole on top of the reference peg. The value for **Difference in height** indicates how far below the top of the peg the batter has to be placed.
6. Place the pole on the position of the batter rail to be used as a reference for the slope values to mark on the batter rail. **Difference in height** should now read zero. All values shown under the **i** page are relative to the original slope.
7. **↩** to return to **Stake Slope**. Stake out the next catch point from this panel.

## Slope staking using Ref point surface

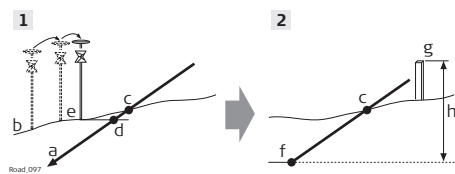
### Description

When staking out slopes using the reference point surface method, the reference peg is staked out with a defined height difference to the hinge point.



- a Slope to stake out
- b Natural surface
- c Catch point of the slope
- d Reference peg
- e Defined hinge height difference
- f Hinge point

### Workflow



- a Slope to stake out
- b Natural surface
- c Real catch point
- d Projected catch point
- e Approximate staked out catch point after three iterations
- f Hinge point
- g Reference peg
- h Defined hinge height difference



The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, the process is iterative. As soon as the measured position (e) is close enough to the real catch point (c), it can be used as the approximate catch point. Based on this approximate catch point, the projected catch point (d) on the slope is calculated.

The projected catch point (d) is then used as a starting point for the stakeout of the surface reference peg (g).

1. Stake out the position of the catch point by using **Difference in offset** and/or **Difference in height** on the Stake/Check panel. When **Difference in offset** and **Difference in height** are equal to zero, the catch point has been located.
2. Define the hinge height difference.  
**Fn Tools** to access the Tools panel.
3. Select **Place surface reference peg** to access the define panel for the reference peg field. The measured position from step 1. is used as the catch point for the stake out of the reference point. The **Actual hinge height diff** field displays the **Hinge ht diff** value from the Stake/Check panel. Type in the appropriate value for **Defined hinge ht diff**.
4. Stake out the surface reference point relative to the projected catch point. Values in **Stake Slope Ref Pt Surface** guide you to the position to place the peg. The defined hinge height difference (h) is already taken into account. Values to be marked on the reference peg can be found on **Stake Slope Ref Pt Surface, Info** page.

5. ↩ to return to **Stake Slope**. Stake out the next catch point from this panel.

The closer the real catch point and the approximated stakeout catch point are, the closer the projected catch point gets to the real catch point.

## 48.3

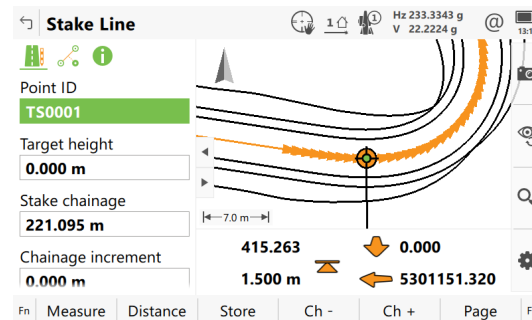
## Staking/Checking the Road

### 48.3.1

### The Stake/Check Panel

Stake,  
 page  
 Check panel,  
 page

The **Stake Line** is shown as example.  
 Only lines from the selected layer are displayed.



#### Colour coding



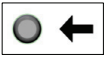

Working job data is displayed in grey. Design job data is displayed in full colour.

| Selected line | Colour      |
|---------------|-------------|
| Working line  | Orange      |
| Centreline    | Green       |
| Selected line | Thick black |

| Key            | Description   |
|----------------|---|
| <b>Measure</b> | For GS:<br>To start measuring the point being staked. The key changes to <b>Stop</b> .<br><br>For TS:<br>To measure a distance and store distance and angles.   |
| <b>Stop</b>    | For GS:<br>To end measuring the point being staked. When <b>Automatically stop point measurement</b> is checked in <b>GS Quality Control, General</b> page recording of positions ends automatically as defined by the stop criteria. The key changes to <b>Store</b> . After ending the measurements, the differences between the measured point and the point to be staked are displayed. |
| <b>Store</b>   | For GS:<br>To store the measured point. When <b>Automatically store point</b> is checked in <b>GS Quality Control, General</b> page, the measured point is stored automatically. The key changes to <b>Measure</b> .  |

| Key                | Description   |
|--------------------|---|
|                    | For TS:<br>To store angles and distance. Distance must be measured before.  |
| <b>Distance</b>    | For TS:<br>To measure a distance.   |
| <b>Ch -</b>        | Available for <b>Stake road</b> . To decrease the chainage as defined by <b>Chainage increment</b> .  |
| <b>Ch +</b>        | Available for <b>Stake road</b> . To increase the chainage as defined by <b>Chainage increment</b> .  |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .  |
| <b>Fn Position</b> | For TS:<br>To position the TS to the defined stakeout point, including defined offsets. The settings for <b>Automatic behaviour when aiming to point being staked</b> in <b>Road Settings, TS specific</b> page, apply. Refer to <a href="#">Road Settings,TS specific page</a> . |
| <b>Fn Tools</b>    | To access the method-specific toolbox. Refer to <a href="#">48.4 The Toolbox</a> .  |

#### Description of fields

| Field   | Option         | Description   |
|---|----------------|---|
|   |                | The following fields are always shown in all Stake and Check methods.   |
| <b>Point ID</b>   | Editable field | Name of the next point to be stored. The ID is incremented/decremented whenever a point gets stored.  |
| <b>Antenna height</b>   | Editable field | For GS:<br>Height of the antenna.   |
| <b>Target height</b>  | Editable field | For TS:<br>Height of the prism.   |
|  |                | The following fields are always shown in all Stake methods, except for method <b>Layer</b> .  |
| <b>Stake chainage</b>   | Editable field | Nominal chainage of the point to be staked out.<br><br>To get the information relative to the current measured TS position or the current GS location without leaving the app: <ol style="list-style-type: none"> <li>1 Tap into the <b>Stake chainage</b> field.</li> <li>2 Use the Backspace button to delete the whole content in the field. </li> <li>3 Press the ENTER button. </li> </ol> <p>---- is displayed.</p> |

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| Field | Option | Description  |
|-------|--------|--|
|       |        | In 3D viewer, the current chainage is displayed without arrow symbols. |
|       |        |  |

|                           |                |  |
|---------------------------|----------------|--|
| <b>Chainage increment</b> | Editable field | Chainage increment. Value by which the nominal chainage increases/decreases when pressing <b>Ch -/Ch +</b> . |
|---------------------------|----------------|--|

### Next step

**Page** changes to the page.

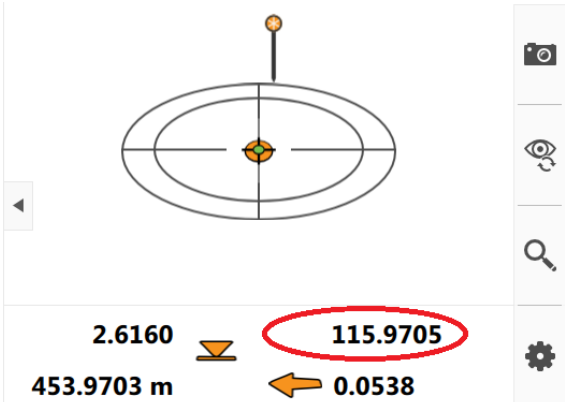
### Stake/Check panel, page

#### Description of fields

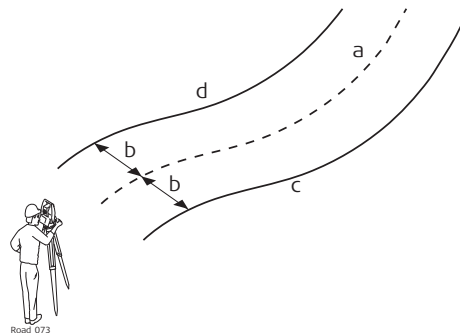
| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Stake chainage</b> | Editable field | <p>Nominal chainage of the point to be staked out.</p> <p>To get the information relative to the current measured TS position or the current GS location without leaving the app:</p> <ol style="list-style-type: none"> <li>1 Tap into the <b>Stake chainage</b> field.</li> <li>2 Use the Backspace button to delete the whole content in the field. </li> <li>3 Press the ENTER button. </li> </ol> <p>---- is displayed.</p> |

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| Field | Option | Description  |
|-------|--------|--|
|       |        | <p>In 3D viewer, the current chainage is displayed without arrow symbols.</p>  |

|                        |                |   |
|------------------------|----------------|---|
| <b>CL stake offset</b> | Editable field | Available for Stake with <b>Layer</b> . The horizontal offset from the centreline define the Easting and Northing values for staking. The height is derived from the layer. |
| <b>Height offset</b>   | Editable field | Available for Stake. Vertical offset from the reference line or surface of the point to stake.  |
| <b>Toggle off-sets</b> | Check box      | When this box is checked, points can be staked/checked on the left/right side of the selected line in one process.  |





- a Line
- b Defined **Offset**
- c Parallel right line
- d Parallel left line

This functionality is available for the following stake out/check methods:

- **Line:** Toggle between line left and right.
- **Surface grade:** Toggle between left and right line of the surface grade.
- **Crown:** Toggle between left and right surface grade.

The app automatically detects which side of the centreline is being used and selects the appropriate line as a reference.

| Field  | Option   | Description  |
|--|--|--|
|  |  | <b>Auto position</b><br>When pressing auto position <b>Fn Position</b> , available in TS mode, a message box comes up prompting if either the left or right side should be staked out/checked. |
| <b>Check off-set</b>   | Editable field   | Available for Check. Horizontal offset from the reference line, as defined by the chosen method, of the point to stake.  |
| <b>Centreline check off-set</b>  | Editable field   | Available for Check with <b>Layer</b> . The horizontal offset from the centreline define the Easting and Northing values for checking. The height is derived from the layer.                   |
| <b>Check height diff</b>   | Editable field   | Available for Check. Vertical offset from the reference line or surface, as defined by the chosen method, of the point to stake.   |
|   | The following field is shown for the Stake methods <b>Line, Local line, Local manual slope</b> and <b>Manual slope</b> .   |  |
| <b>Use non-perpendicular offset</b>  | Check box  | When this box is not checked the measured point is projected in a right angle to the selected line.<br>When this box is checked, any projection angle can be defined.                          |
| <b>Offset angle</b>  | Editable field   | Manually defined projection angle.   |
|  | The following fields are shown in the <b>Line, Local line, Surface grade</b> and <b>Crown</b> methods when <b>Show information to an additional line</b> is checked in the Define panel. |  |
| <b>Apply off-sets to additional line</b>   | Check box  | When this box is checked, an offset to the additional line can be defined.   |
| <b>Horizontal offset</b>   | Editable field   | Horizontal stake/check offset to the additional line.  |
| <b>Vertical off-set</b>  | Editable field   | Vertical stake/check height difference to the additional line.   |

### Next step

Page changes to the  page.

### Understanding priorities of various heights

| Type of height  | Overrules         | Height offset |
|---|-------------------|---------------|
| Manually entered<br>OR<br>Obtained from individual point            | All other heights | Considered    |
| Use DTM height for stakeout (toolbox: <b>Use heights from DTM</b> ) | Design height     | Considered    |
| From design   | No other heights  | Considered    |

| Type of height   | Overrules  | Height offset |
|--|--|---------------|
| Show DTM height difference on <b>Info</b> page (toolbox: <b>Use heights from DTM</b> ) | No influence on priorities<br>For additional info only | -             |

**Stake/Check panel, Info page**

A user-definable **i** page exists for each of the stake methods and check methods. Refer to the chapters from [46.3.2 Road Line - Info Page](#) to [46.3.8 Road DTM - Info Page](#).

Refer to [Road Settings, Info page](#) for information on all available items for the **i** page and how to select them.

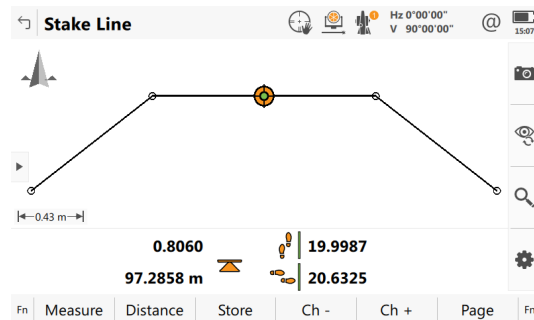
**Stake/Check panel, 3D viewer**

3D viewer for Stake shows information about the measured point relative to the design. The design is defined by the selected layer and line, and the values entered on the **General** page.

3D viewer for Check and Stake are similar. Stake contains the Stake view, along with 2D/3D view, cross section view and navigation view.

For Check and when only a DTM job is used, 3D viewer shows the DTM and the lines of selected Road layer - always in plan view.

At the top, DTM height and delta height are shown.



Refer to [Stake, page Check panel, page](#) for a description of the icons.

For Stake, extra information is shown at the bottom:

1. Difference in chainage is shown with some footsteps
2. Horizontal offset is shown with some footsteps
3. Height difference is shown as an arrow
4. Current height
5. The element to stake is shown as an orange and green dot
6. The plot can be shown as profile view, plan view, orbital view and navigation view.

**48.3.2**

**Measuring Points by Catch Point Story**

**Requirements**

**Type:** **Catch point story** is selected in **Slope Stakeout Settings**. Refer to [48.2.3 Advanced Slope Settings](#).


**Catch Point Story, Catch point page**

1. Select the slope to be staked.
2. Access the **Stake Slope** panel.

3. Measure and store the points. When the catch point is measured and stored, the **Catch Point Story** opens.

| Key       | Description  |
|-----------|--|
| OK        | To return to the <b>Stake Slope</b> panel.                               |
| Offset pt | To measure an offset point. The offset values relate to the catch point. |

#### Description of fields

| Field              | Option       | Description  |
|--------------------|--------------|--|
| Hinge line         | Display only | The line will be used as reference in the <b>Define Slope</b> panel. The line appears as solid and orange in the cross section view.   |
| CP Chainage        | Display only | The catch point chainage is the current chainage.  |
| Slope cut & fill   | Display only | The current difference in height. Vertical offset between the defined position and the current position.<br>C = Cut, difference is negative<br>F = Fill, difference is positive            |
| Slope offset       | Display only | The current difference in offset. Horizontal offset between the defined position and the current position.<br>L = Left, difference is positive<br>R = Right, difference is negative        |
| Hinge cut & fill   | Display only | The current hinge height difference. Height difference from the hinge point of the slope.<br>C = Cut, difference is negative<br>F = Fill, difference is positive                           |
| Hinge offset       | Display only | The current hinge offset. Horizontal offset from the hinge point of the slope.<br>L = Left, difference is positive<br>R = Right, difference is negative                                    |
| Slope design ratio | Display only | Ratio of the slope.<br> The display format is defined as system setting in <b>Regional, Slope</b> page. |

Information relative to the cross section. The information is calculated from the Road design. The values are independent of the catch point. Each alignment contained in the design is shown in a separate info block until the end of the cross section.

|                   |              |  |
|-------------------|--------------|--|
| Next line         | Display only | The name of next alignment to the hinge line.  |
| Vertical distance | Display only | The difference calculated from the elevations of both alignments. Example: Height of R1 - height of R2.<br>C = Cut, difference is negative<br>F = Fill, difference is positive |

Catch Point Story, Offset point page

| Field                      | Option       | Description   |
|----------------------------|--------------|---|
| <b>Horizontal distance</b> | Display only | The difference between the offsets of the alignments to the centre line. The horizontal distance between the nodes when looking the road cross section.<br>Always displayed as positive values. |

| Key              | Description   |
|------------------|---|
| <b>OK</b>        | To return to the <b>Stake Slope</b> panel.  |
| <b>Offset pt</b> | To measure an additional offset point. The offset values relate to the catch point. |

Description of fields

| Field                    | Option       | Description  |
|--------------------------|--------------|--|
| <b>Chainage</b>          | Display only | The current chainage.  |
| <b>CP cut &amp; fill</b> | Display only | The current difference in height. Vertical offset between the catch point and the offset.<br>C = Cut, difference is negative<br>F = Fill, difference is positive   |
| <b>Distance to CP</b>    | Display only | The current difference in offset. Horizontal offset between the catch point and the offset.<br>Indicates how much and in which direction to go, whilst the offset values show the relative position to the point of interest.<br>L = Left, difference is positive<br>R = Right, difference is negative |

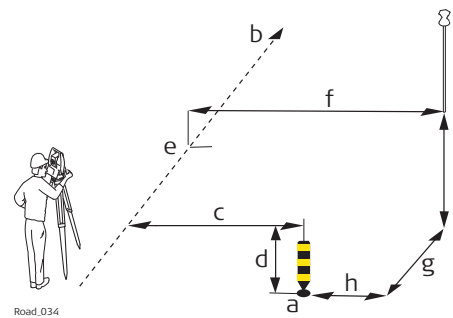
 In additionn, the fileds from the **Catch point** page are displayed. Refer to [Catch Point Story,Catch point page](#).

48.3.3

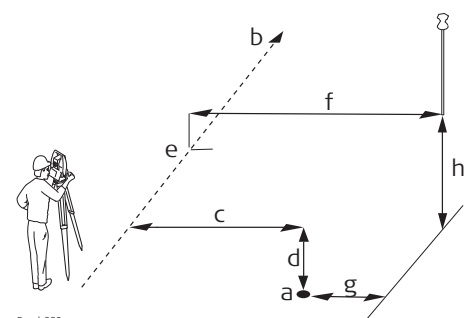
Measuring Points by Chainage and Offset

Graphical overview

Stake road



Check road



- |   |   |   |   |
|---|---|---|---|
| a | Position to stake out, defined by chainage, stake offset and, optionally, stake height difference | a | Position to check, defined by check offset and, optionally, check height difference |
| b | Centreline/line that the position is defined relative to  | b | Centreline/line that the position is defined relative to                            |
| c | <b>Offset</b>   | c | <b>Check offset</b>   |
| d | <b>Height offset</b>  | d | <b>Check height diff</b>  |
| e | <b>Working chainage</b>   | e | <b>Working chainage</b>   |
| f | <b>CL offset</b>  | f | <b>CL offset</b>  |
| g | <b>Difference in chainage</b>   | g | <b>Difference in offset</b>   |
| h | <b>Difference in offset</b>   | h | <b>Difference in height</b>   |
| i | <b>Difference in height</b>   |   |   |

**Description**

- When staking points, the points are defined by the stake chainage and, if enabled, by the stake offset and the stake height difference relative to an existing 2D or 3D centreline or line.
- When checking points, the points are defined by the check offset and the check height difference relative to an existing 2D or 3D centreline or line.

**Required elements**

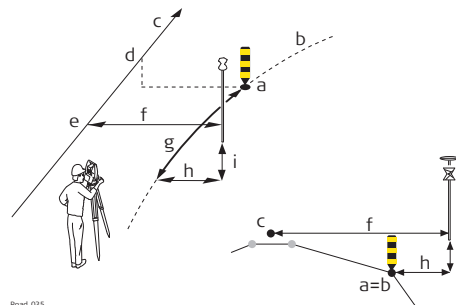
- For 2D, a horizontal centreline is required.
- For 3D, a 3D centreline is required.

**48.3.4**

**Measuring Lines Relative to a Centreline**

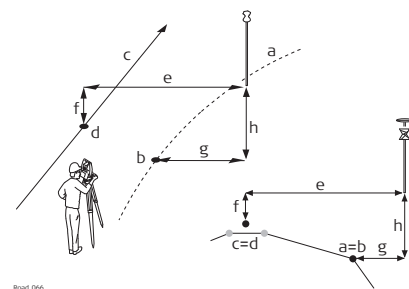
**Graphical overview**

**Stake road**



- a Position to stake out
- b Line to stake out
- c Centreline
- d **Stake chainage**
- e **Chainage**
- f **CL offset**
- g **Difference in chainage**
- h **Difference in offset**
- i **Difference in height**

**Check road**



- a Line to check
- b Projected point on line
- c Centreline
- d **Chainage**
- e **CL offset**
- f **CL height difference**
- g **Difference in offset**
- h **Difference in height**

**Description**

- Lines define various elements, including:
  - Centreline of the design
  - Change in slope ratio, for example, the edge of a carriage way
  - Gutter, cable, pipeline or any other type of alignment element
- Refer to [46.6.3 Road - Basic Elements for Stake and Check Measurements](#) for information on the usage of lines.

## Required elements

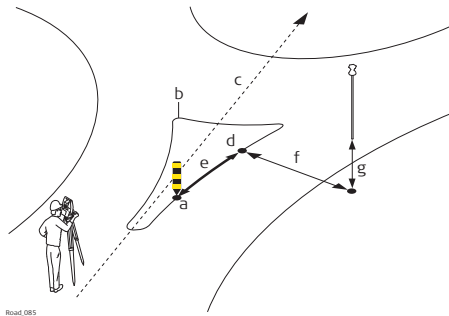
- For 2D, at least a 2D line and a 2D centreline are required.
- For 3D, a 3D line and a 2D or 3D centreline are required.

### 48.3.5

### Measuring Local Lines without Centrelines

#### Graphical overview

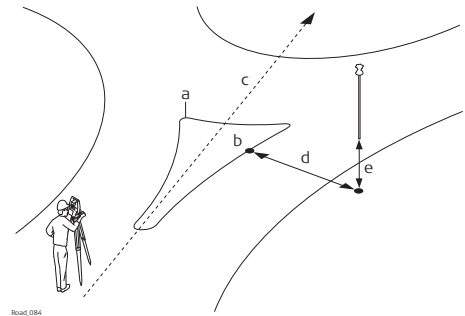
#### Stake road



#### Stakeout of Roundabout

- a Position to stake out
- b Line to stake out
- c Centreline of the layer- is not used for the local line
- d **Chainage**
- e **Difference in chainage**
- f **Difference in offset**
- g **Difference in height**

#### Check road



#### Checking a Roundabout

- a Line to check
- b **Chainage**
- c Centreline of the layer- is not used for the local line
- d **Difference in offset**
- e **Difference in height**

#### Description

This process is different to lines, where the stake/check is always relative to the centreline defined for the layer. Local lines no longer have a relationship to an overall centreline. Local lines are used to check roundabouts, parking bays, subdivision works and any other type of lines. The different lines to stake/check can be stored within one layer, which does not require a defined centreline. This ability is different to the stake/check of any other type which always require a centreline.

#### Required elements

A 2D or 3D design of the line to stake/check is required.

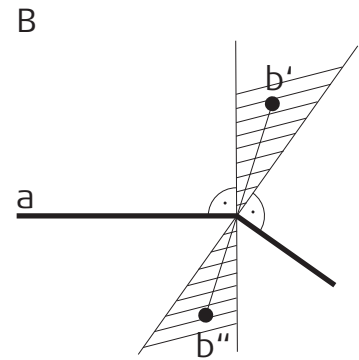
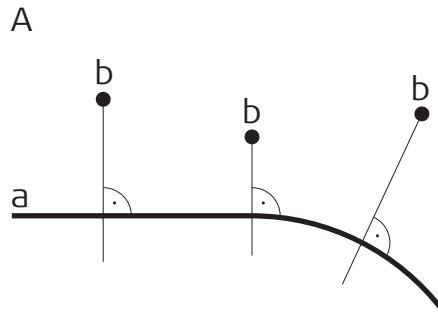
### 48.3.6

### Indefinite Triangle

#### Description

In almost all situations, a measured position is shown relative to the local line by the line chainage and a square offset to the line. However, situations can arise where a road design has extreme changes in the deflection angle of tangent points. In these cases, it is not always possible to show a measured position by the nominal chainage and offset. An indefinite triangle is a region in which these situations arise. Points measured within an indefinite triangle are shown relative to the tangent point.

Graphic



Road\_091

**Road Design A**

- a Local line
- b Measured position, displayed relative to the line by chainage and square offset

**Road Design B**

- a) Local line with extreme changes in the deflection angle of tangent points
- b') Measured position within indefinite triangle  
This position **cannot** be shown in the usual manner and is displayed relative to the tangent point
- b'') Measured position within indefinite triangle  
This position **can** be shown in the usual manner. Chainage and square offset display the position.

**Panel**

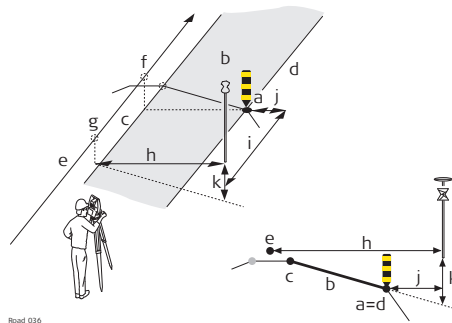
Points measured within an indefinite triangle are always shown relative to the tangent point.

48.3.7

**Measuring Surface Grades**

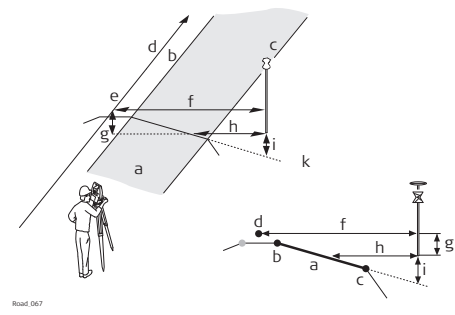
Graphical overview

**Stake road**



Road\_036

**Check road**



Road\_067



- a Position to stake out
- b Surface grade to stake out
- c Left line
- d Right line
- e Centreline
- f **Stake chainage**
- g **Chainage**
- h **CL offset**
- i **Difference in chainage**
- j **Difference in offset**
- k **Difference in height**

- a Surface grade to check
- b Left line
- c Right line
- d Centreline
- e **Chainage**
- f **Difference in offset**
- g **Difference in height**
- h **Surface grade offset**
- i **Surface grade ht diff**

**Description**

- Surfaces such as the final carriage way, are often staked/checked using surface grades. A surface grade consists of a combination of two lines.
- Refer to [46.6.3 Road - Basic Elements for Stake and Check Measurements](#) for information on the usage of surface grades.

**Required elements**

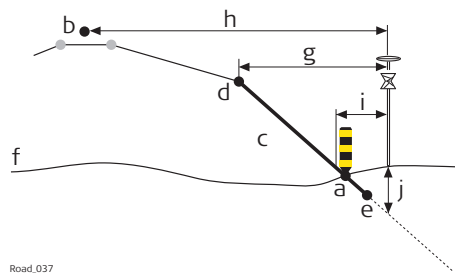
A 3D design of the road is required.

**48.3.8**

**Measuring Manual Slopes, Local Manual Slopes and Design Slopes**

**Graphical overview**

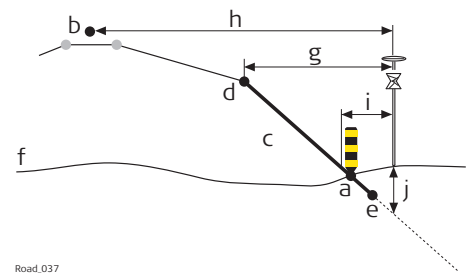
**Stake road**



Road\_037

- a Catch point
- b Centreline
- c Slope to stake out
- d Hinge point = left line
- e Second/right line
- f Natural surface
- g **Hinge offset**
- h **CL offset**
- i **Difference in offset**
- j **Difference in height**

**Check road**



Road\_037

- a Catch point
- b Centreline
- c Slope to check
- d Hinge point
- e Second line of the slope
- f Natural surface
- g **Hinge offset**
- h **CL offset**
- i **Slope offset**
- j **Slope height diff**

**Description**

- Surfaces, such as the end slopes of a cut or fill, are staked/checked using slope methods.
- Slopes are defined by two lines. Refer to [46.6.3 Road - Basic Elements for Stake and Check Measurements](#).
- When staking slopes, the point of interest is the intersection of the defined slope with the natural surface (= catch point). Refer to [48.2.3 Advanced Slope Settings](#) for information on the slope staking methods supported.
- When checking slopes, the slope check is independent of the slope method selected.

### Description of manual slopes

The slope is defined manually relative to a selected 3D centreline, slope direction and slope ratio or relative to a 2D line using a manual height, slope direction and slope ratio. Chainage information is related to the centreline.

### Description of local manual slopes

The slope is defined manually relative to a selected 3D line, slope direction and slope ratio or relative to a 2D line using a manual height, slope direction and slope ratio. Chainage information is related to the selected line itself and not the centreline of the layer.

### Description of design slopes

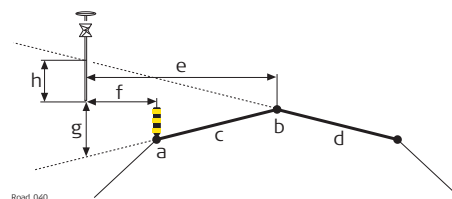
For this method, a 3D representation of the slope, defined by two lines, is required.

## 48.3.9

### Measuring Road Crowns

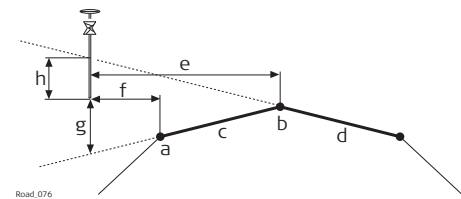
#### Graphical overview

##### Stake road



- a Position to stake out, in this case the left line of the crown
- b Middle line of the crown, in this case also the centreline
- c Left surface grade to stake out
- d Right surface grade to stake out
- e **CL offset**
- f **Difference in offset**
- g **Diff in ht to left surface**
- h **Diff in ht to right surface**

##### Check road



- a Left line of the crown
- b Middle line of the crown, common for both surface grades
- c Left surface grade to check
- d Right surface grade to check
- e **CL offset**
- f **Difference in offset**
- g **Diff in ht to left surface**
- h **Diff in ht to right surface**

#### Description

- Staking road crowns allows the stake out of two surface grades at the same time. If **Toggle offsets** is checked, the reference for **Difference in offset** is automatically switched between the right and left surface grade depending on whether the measured position is to the right or left of the middle line.
- When checking road crowns, it allows the check of two surface grades at the same time. The information for both surface grades is shown at the same time.

#### Required elements

A 3D design of the road, defining a crown consisting of three lines, is required.

Specific fields

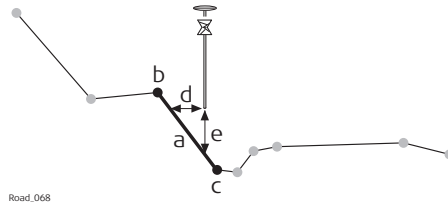
| Field  | Option       | Description  |
|--|--------------|--|
| <b>Diff in ht to left surface/<br/>Diff in ht to right surface</b> | Display only | Vertical offset to the left/right surface grade defining the road crown. |

48.3.10

Measuring Road Layers

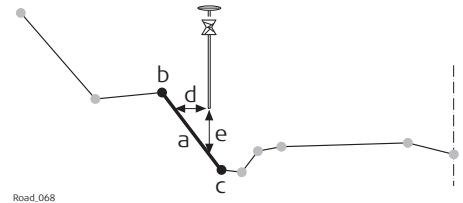
Graphical overview

Stake road



- a Relevant part of the layer for the current position
- b Left line **Left name**
- c Right line **Right name**
- d **Difference in offset**
- e **Difference in height**

Check road



- a Relevant part of the layer for the current position
- b Left line **Left name**
- c Right line **Right name**
- d **Slope offset**
- e **Layer ht diff**

Description

All lines are grouped in layers. Such a layer describes a surface of the road. When staking/checking out a layer, it is automatically detected the line left and right of the measured position.

Required elements

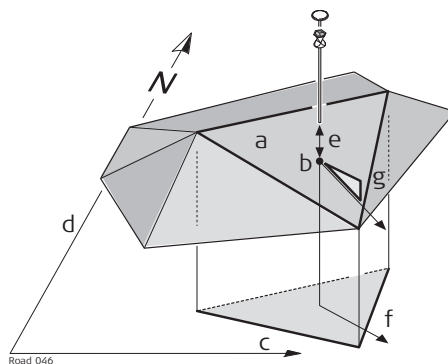
A 3D design of the road is required.

48.3.11

Measuring Digital Terrain Models (DTM)

Graphical overview

Check road



- a Relevant triangle of the DTM
- b Projected point on DTM
- c Easting
- d Northing
- e **DTM height diff**
- f **Flow direction**
- g **Flow ratio**

Description

A DTM check returns the height difference between the current height and the height of the DTM at the measured position.

## Required elements

A DTM job is required.

---

## 48.4

## The Toolbox

---

### 48.4.1

### Overview

#### Access

Press **Fn Tools** on any page of the Stake/Check panel.

#### Description

The toolbox contains additional functionality for each of the stake and check methods. This functionality is additional to those already existing functions which are available via the function keys.

The functionality differs between the stake and check methods. Refer to these subchapters for a detailed description of the functionalities:

- [48.4.2 Use heights from DTM](#)
- [48.4.3 Apply current chainage](#)
- [48.4.4 Get current angle to alignment](#)
- [48.4.5 Stake individual point](#)
- [48.4.6 COGO Road - Alignment info](#)
- [48.4.7 COGO Road - Create points](#)
- [48.4.8 Additional Layer Info](#)
- [48.4.9 Box / base definition](#)
- [48.4.10 Get current slope](#)
- [48.4.11 Manual Slope](#)
- [48.4.12 Reset slope to design](#)
- [48.4.13 Shift reference line](#)
- [48.4.14 Recalculate chainage](#)
- [48.4.15 Stake intersection point](#)



Some functionalities can be accessed by a hot key or a favourites key.

---

### 48.4.2

### Use heights from DTM

#### Availability

This menu function is available for the following stake/check methods: Line, local line, surface grade, crown, layer.

#### Description

The app offers the possibility to

- switch to a height which is retrieved from an existing height layer, as defined in the selected DTM job. The layer from the DTM is applied and used as a height reference for the staking out or checking of alignments.
- retrieve heights from an existing layer, as defined in the DTM job associated with the project. The DTM used is not considered for the stake values. Three new information lines are added to the **i** page: **DTM height diff**, **DTM height** and **DTM layer**.
- show the DTM triangles in the planar view and in the cross section view in 3D viewer.

Once defined, each layer remains active until it is turned off. DTM heights can be used for both 2D and 3D alignments.

## Use Heights From DTM

| Key | Description  |
|-----|--|
| OK  | To confirm the settings and return to the Stake/Check panel. |

### Description of fields

| Field                                       | Option          | Description   |
|---|-----------------|---|
| DTM   | Display only    | DTM from the selected DTM job.  |
| DTM layer                                   | Selectable list | When selecting a DTM layer the relevant triangle of the DTM is shown in 3D viewer.  |
| Use DTM height for stake out                | Check box       | When this box is checked, a layer of the DTM is used as a height reference. When this box is not checked, no DTM heights are applied for stakeout or check.   |
| Show DTM height difference on Info page tab | Check box       | When this box is checked, a layer of the DTM to be used as a height reference on the  page. When this box is not checked, no additional height information relative to the DTM is shown on the  page.                                     |
| DTM layer                                   | Selectable list | Available when <b>Show DTM height difference on Info page tab</b> is checked. Layer of the DTM to be used as a height reference. When selecting a DTM layer the relevant triangle of the DTM is shown in cross section view in 3D viewer. |

### 48.4.3

#### Apply current chainage

##### Availability

This menu function is available for all stake methods except layer.

##### Description

To set **Stake chainage** on the page of the stakeout to the current chainage.

### 48.4.4

#### Get current angle to alignment

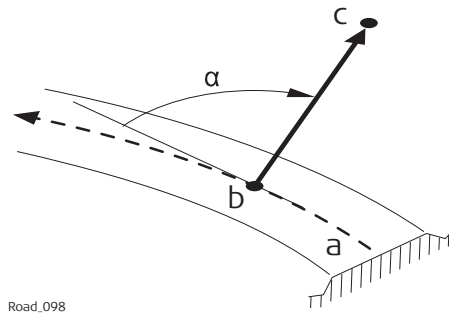
##### Availability

This menu function is available for the stake/check of lines and local lines.

##### Description

To project a measured point to the alignment considering the entered **Stake chainage**. This functionality is only available when **Use non-perpendicular offset** is checked in the Stake panel on the page.


## Graphic



Road\_098

- a Alignment
- b Defined chainage
- c Current position
- $\alpha$  Angle to alignment

## Workflow

1. Measure a point:  
For TS:  
**Distance**  
For GS:  
**Measure and Stop**
2. Press **Fn Tools** to access the toolbox.
3. Select **Get current angle to alignment**.
4. At the defined chainage, the angle between the tangent direction and the direction to the current position is calculated. This angle is set as **Offset angle** for **Use non-perpendicular offset** on the  page.
5. Continue with staking out using the calculated **Stake chainage** and **Offset angle** values. These values are valid until new values are defined manually or by using **Get current angle to alignment**.

### 48.4.5

#### Stake individual point

## Availability

This menu function is available for the stake/check of lines and local lines.

## Description

To stake out points with known Easting, Northing and Height. Points can either be selected from the job or manually typed in.

If a design job has been selected, a point from the design job can be selected. When staking out/checking an individual point, the selected point is set in relation to the alignment and all line relevant values are calculated and displayed.

The **Stake chainage** and **Offset** of the Stake panel are calculated based on the coordinates of the selected point.



If the chosen point has no height the design height is used. If the point has a height it is possible to use that one or continue working with the design height.

### 48.4.6

#### COGO Road - Alignment info

## Availability

This menu function is available for staking/checking a line/local line.

## Description

This function allows

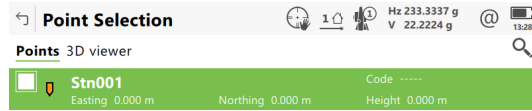
- the selection of existing single or multiple points from a job.
- viewing the selected points along the alignment.
- displaying the respective alignment chainage and offset information.

Any job containing points from any data storage device can be used.



The calculated alignment information is stored and a report sheet can be used for extracting the data.


## Point Selection

To select a point, check the box in front of the point ID.



Fn Calculate More Page Fn

| Key                             | Description  |
|---------------------------------|--|
| <b>Calculate</b>                | To perform the chainage and offset calculation and to continue with the subsequent panel. Calculated COGO points are not yet stored.   |
| <b>More</b>                     | To display information about the codes if stored with any point, the Easting, Northing, Elevation, time, date and 3D coordinate quality.   |
|                                 | <p> The order in which the Easting and Northing columns are shown depends on the <b>Grid format</b> configured to be used in <b>Regional, Coordinates</b> page.</p> <p> The Easting, Northing and Elevation values are shown in the unit configured in <b>Regional, Distance</b> page.</p> |
| <b>Page</b>                     | To change to another page on this panel.   |
| <b>Fn None</b> or <b>Fn All</b> | To deactivate or activate all points for the COGO calculation.   |

 Point selection/deselection is possible on the **3D viewer** page.

| IF  | THEN  |
|---|---|
| a single point is to be selected/deselected   | tap on the point.   |
| multiple points are to be selected/deselected | drag the stylus on the panel in a diagonal line to make a rectangular area. |
| all points are to be selected                 | press <b>All</b> or <b>None</b> .   |

### Next step

**Calculate** computes the alignment information.

## Alignment Results, Points page

Displayed is information about the calculated alignment information: Horizontal offset from the line, height difference from the defined line and horizontal offset from the centreline.

| Key                | Description   |
|--------------------|---|
| <b>Store</b>       | To store the results. Points are stored in the job together with the alignment information. The points can be exported with a report sheet later. The information is the same as if the points had been measured along the alignment. |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure if the calculated points are stored with the original point ID, a prefix or a suffix.  |

### Next step

**Page** changes to another page.

The fields and information displayed on the  page are as defined in **Road Settings, Info** page. Refer to [Road Settings, Info page](#).

3D viewer displays all the calculated points against the design data.

## Settings

### Description of fields

| Field                      | Option               | Description  |
|----------------------------|----------------------|--|
| <b>Store point ID with</b> | <b>Same point ID</b> | The same point ID from the selected job is used when storing to the job. If a point exists with the same point ID in the job a warning appears. Choose to overwrite the existing point or not. |
|                            | <b>Prefix</b>        | Adds the setting for <b>Store point ID with</b> in front of the original point IDs.  |
|                            | <b>Suffix</b>        | Adds the setting for <b>Store point ID with</b> at the end of the original point IDs.  |
| <b>Prefix / suffix</b>     | Editable field       | The identifier with up to four characters is added in front of or at the end of the ID of the calculated COGO points.  |

## 48.4.7

### COGO Road - Create points

#### Availability

This menu function is available for staking/checking a line/local line.

#### Description

This function allows creating points by defining a distance between points along the working line and offsets to the working line.



## Define Line Segmentation

Define Line Segmentation

Calculate segment from: **Number of points**

Start chainage: **100.000 m**

End chainage: **150.000 m**

Line length: **50.000 m**

Number of points: **5**

Chainage increment: **8.333 m**

Horizontal offset: **0.000 m**

Apply on both sides:

Calculate

| Key              | Description   |
|------------------|---|
| <b>Calculate</b> | To perform the point calculation and to continue with the subsequent panel. Calculated points are not yet stored. |
| <b>Init Ch</b>   | Available when <b>Start chainage</b> is highlighted. To insert the initial chainage of the line.                  |
| <b>Final Ch</b>  | Available when <b>End chainage</b> is highlighted. To insert the final chainage of the line.                      |

### Description of fields

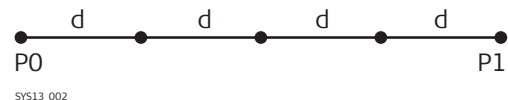
| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

**Calculate segment from**

**Number of points**

How the line is divided. Depending on the selection, the following fields are editable or display only fields.

The number of points defines the distance between the points.



P0 **Start chainage**

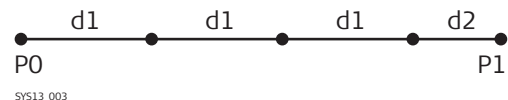
P1 **End chainage**

d Equally spaced segments result from dividing a line by a certain number of points.

**Chainage increment**

The line along which the points are created is defined by **Start chainage** and **End chainage**.

The distance between the points is fixed by a constant distance (**Chainage increment**).



P0 **Start chainage**

P1 **End chainage**

d1 **Chainage increment**

d2 Remaining segment

| Field                      | Option                         | Description  |
|----------------------------|--------------------------------|--|
|                            | <b>Create single point</b>     | One point will be created at a defined chainage and with the offsets entered.  |
| <b>Chainage</b>            | Editable field                 | Available for <b>Calculate segment from: Create single point</b> .<br>The position of the new point along the line.  |
| <b>Start chainage</b>      | Editable field                 | Available for <b>Calculate segment from: Chainage increment</b> and <b>Calculate segment from: Number of points</b> .<br>The beginning chainage of the line.   |
| <b>End chainage</b>        | Editable field                 | Available for <b>Calculate segment from: Chainage increment</b> and <b>Calculate segment from: Number of points</b> .<br>Chainage at the end of the line.  |
| <b>Line length</b>         | Display only                   | Calculated line length between <b>Start chainage</b> and <b>End chainage</b> .   |
| <b>Number of points</b>    | Editable field or display only | Available for <b>Calculate segment from: Chainage increment</b> .<br>The number of points that fits between <b>Start chainage</b> and <b>End chainage</b> , considering the defined <b>Chainage increment</b> .  |
| <b>Chainage increment</b>  | Editable field or display only | Available for <b>Calculate segment from: Chainage increment</b> .<br>The constant distance between the points.   |
| <b>Last segment length</b> | Display only                   | Available for <b>Calculate segment from: Chainage increment</b> . The length of the remaining segment.   |
| <b>Horizontal offset</b>   | Editable field                 | The perpendicular distance between the line and the point. A positive offset is to the right, a negative offset is to the left.  |
| <b>Apply on both sides</b> | Check box                      | Available for <b>Calculate segment from: Chainage increment</b> and <b>Calculate segment from: Number of points</b> .<br>When this box is checked, the points are created on both sides of the line no matter if the value entered for <b>Horizontal offset</b> is positive or negative. |
| <b>Vertical offset</b>     | Editable field                 | Vertical height difference from the line to the point. A positive offset is above the line, a negative offset is below the line.   |



For multiple chainages refer to [46.6.5 Road - Chainage or Station Equations](#).

### Next step

**Calculate** to access **COGO Store Results**.

**COGO Store Results, Storage page**

Enter additional data before storing the calculated points.

← **COGO Road Store Results** Hz 0.0004 g V 0.0002 g 13:59

**Storage** Overview 3D Viewer

Store points to job

Starting point ID

Point ID increment

Point code

Code description -----

Store New attrb Last Default Page

| Key   | Description                              |
|-------|--|
| Store | To store the result.                     |
| Page  | To change to another page on this panel. |

### Description of fields

| Field                      | Option          | Description  |
|----------------------------|-----------------|--|
| <b>Store points to job</b> | Selectable list | The calculated COGO points are stored in this job.   |
| <b>Starting point ID</b>   | Editable field  | Available for <b>Calculate segment from: Chainage increment</b> and <b>Calculate segment from: Number of points</b> .<br>The point ID to be assigned to the first new point on the line. The selected point ID templates from <b>ID Templates</b> are not applied. |
| <b>Point ID increment</b>  | Editable field  | Available for <b>Calculate segment from: Chainage increment</b> and <b>Calculate segment from: Number of points</b> .<br>Is incremented numerically for the second, third, and so on, point on the line.   |
| <b>Point ID</b>            | Editable field  | Available for <b>Calculate segment from: Create single point</b> .<br>The name of the new point.   |
| <b>Code</b>                | Selectable list | Select a point code for the setup point if desired. The codes from the job codelist are used.  |
| <b>Code description</b>    | Display only    | A description of the code.   |

### Next step

**Page** changes to the **Overview** page.

### COGO Store Results, Overview page

The variables used for the calculation are displayed.

| Key   | Description                              |
|-------|--|
| Store | To store the result.                     |
| Page  | To change to another page on this panel. |

## Description of fields

| Field                             | Option                               | Description  |
|-----------------------------------|--------------------------------------|--|
| <b>Number of new points</b>       | Display only                         | Number of points being calculated.<br>If <b>Apply on both sides</b> was checked in <b>Define Line Segmentation</b> , the number of calculated points is twice the value entered in <b>Define Line Segmentation</b> . |
| <b>Chainage increment</b>         | Display only                         | Available for <b>Calculate segment from: Chainage increment</b> and <b>Calculate segment from: Number of points</b> .<br>The constant distance between the points.   |
| <b>Chainage</b>                   | Display only                         | Available for <b>Calculate segment from: Create single point</b> .<br>The position of the new point along the line.  |
| <b>Horizontal offsets applied</b> | <b>No, To left, To right or Both</b> | Indicates if and to which side a horizontal offset was applied.  |
| <b>Vertical offsets applied</b>   | <b>No, Up, Down</b>                  | Indicates if and to which side a vertical offset was applied.  |

## Next step

Page changes to the **3D Viewer** page.

## 48.4.8

## Additional Layer Info

### Availability

This menu function is available for all stake/check methods except layer.

### Description

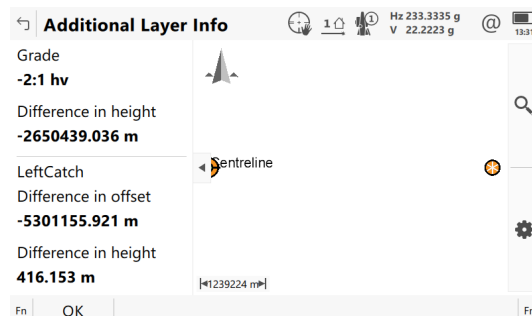
This function allows additional road data to be obtained during a check or stake survey of a road element.

Road elements include centrelines, kerb and gutters and slopes.

The map shows cross section view only and allows setting the vertical exaggeration.

### Additional Layer Info

Tap on the relevant element for selection. The information displayed shows the current slope ratio and the height difference of the element. Also displayed are the offset and height differences from the left and right vertices of the element.



| Key | Description  |
|-----|--|
| OK  | To store the selected element, which is then automatically recalled. |

## 48.4.9

### Box / base definition

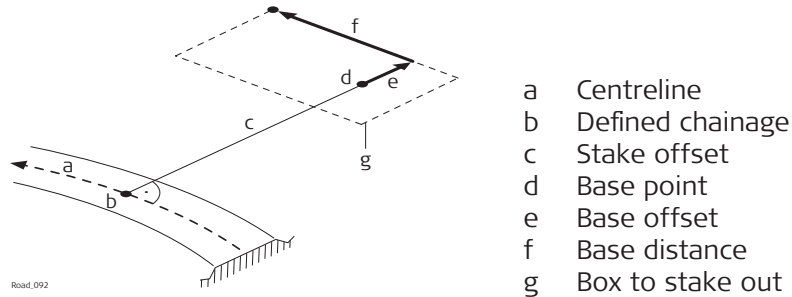
#### Availability

This menu function is available for the stake/check of lines and local lines.

#### Description

This function allows a box or similar structure to be set out during a check or stake survey of a road element. The box is set out relative to a line chainage and parallel offset. A base point of the box, user-defined dimensions of the box (a base distance and a base offset) are required.

#### Diagram



#### Box / base definition

| Box / Base Definition |               |
|-----------------------|---------------|
| Base chainage         | 221.095 m     |
| Base offset           | 0.000 m       |
| Distance box          | 0.000 m       |
| Offset box            | 0.000 m       |
| Base easting          | -19807.736 m  |
| Base northing         | 5301114.314 m |
| Base height           | 416.763 m     |
| Base direction        | 99.7621 g     |

| Key           | Description  |
|---------------|--|
| OK            | To store the selected element, which is then automatically recalled.                             |
| Define        | To overwrite the values before pressing <b>Base</b> if a different base had been defined before. |
| Base or Clear | To freeze or unfreeze the values of the base point.  |

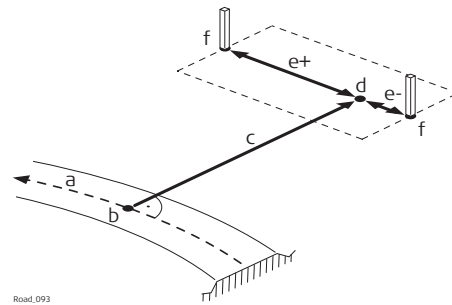
#### Description of fields

| Field         | Option         | Description   |
|---------------|----------------|---|
| Base chainage | Display only   | The position defined by <b>Stake chainage</b> .                                 |
| Base offset   | Display only   | The position defined by <b>Offset</b> .   |
| Distance box  | Editable field | The distance in the direction of increasing chainage of base point is positive. |


| Field  | Option         | Description  |
|--|----------------|--|
| <b>Offset box</b>                                  | Editable field | The offset to the right of base point is positive.                               |
| <b>Base easting, Base northing and Base height</b> | Editable field | The coordinates of the base point, either from the job or from a surveyed point. |
| <b>Base direction</b>                              | Editable field | The orientation of the local coordinate system (azimuth).                        |

### Example

The following steps describe the stakeout of two reference pegs from a centreline chainage and offset.



- a Centreline
- b Defined chainage
- c Stake offset
- d Base point
- e Base distance, positive (e+), negative (e-)
- f Peg to stake out

1. Define the base point for the box/base stakeout using **Offset** and **Height offset** from the  page.
2. Press **Fn Tools** to access the toolbox.
3. Select **Box / base definition**. Press **OK** to continue to the next panel.
4. The position defined by **Stake chainage** and **Offset** is used as **Base chainage** and **Base offset** when accessing **Box / base definition** for the first time within a stakeout session.
5. Similar to the stakeout of individual points in the toolbox. The Box/Base functionality calculates the new point to stake out and changes the values of **Stake chainage** and **Offset**.
6. To avoid these values being used as the next base point when accessing the box/base menu, press **Base** in the Box/Base Definition panel. The values of the base point freeze when pressing the key. **Base** is now replaced by **Clear**. If a different base had been defined before, use **Define** to overwrite the values before pressing **Base**.
7. Define the **Distance box** and **Offset box**. Both follow the same rules as used for the definition of offsets and chainages in general. Offset to the right = positive; distance in direction of increasing chainage = positive.
8. Press **OK** to continue to the next panel.
9. The values of **Stake chainage** and **Offset** are adjusted accordingly.
10. The fields **Difference in chainage**, **Difference in offset** and **Difference in height** guide you to the new position to stake out. Press **Fn Tools** to access toolbox.

11. Select **Box / base definition**.  
Press **OK** to continue to the next panel.

---

12. The next point of the box to stake out can now be defined.  
To change back to the original chainage and offset defined for the base point definition use **Clear**.

---

13. Start with step 1. to define a new box/base.

#### 48.4.10


#### Get current slope

##### Availability

This menu function is available for the stake/check of slopes, local manual slopes and manual slopes.

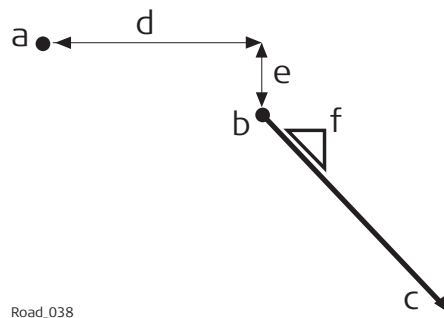
##### Description

To access **Slope Definition**. The slope ratio **Current slope ratio** of the last measured position is used as the defined **Cut slope/Fill slope**. All other values in **Slope Definition** are filled in with the last measured position. The defined manual slope is used for all points to stake out or check.

 The manual slope is active until it is turned off with **Reset slope to design** from the toolbox.

##### Graphic

Slopes are defined relative to the centreline.



- a Centreline
- b Hinge point
- c New slope
- d Defined hinge offset **Offset**
- e Defined hinge height difference **Height difference**
- f **Cut slope/Fill slope**

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##### Slope Definition

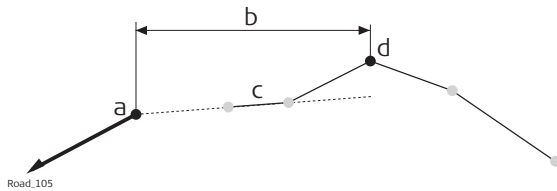
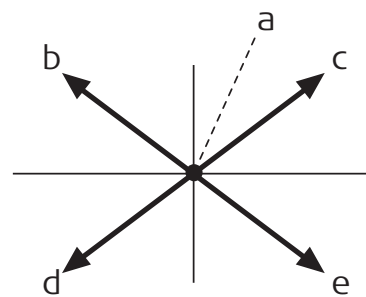
| Slope Definition   |                |
|--------------------|----------------|
| Hinge line         | Centreline     |
| Offset             | 0.000 m        |
| Height offset type | Absolute       |
| Height             | 0.000 m        |
| Slope location     | Right of hinge |
| Cut slope          | 2:1 hv         |
| Fill slope         | 1:0 hv         |

Fn OK Fn


| Key | Description   |
|-----|---|
| OK  | To accept changes and move to the next panel depending on the settings for slope staking. |

##### Description of fields

| Field      | Option       | Description                                |
|------------|--------------|--|
| Hinge line | Display only | The line the slope is defined relative to. |

| Field                     | Option                                       | Description   |
|---------------------------|--|---|
| <b>Offset</b>             | Editable field                               | The horizontal offset of the hinge point from the centreline/reference line.  |
| <b>Height offset type</b> |  | The vertical offset type for the hinge point.   |
|                           | <b>Absolute</b>                              | The only option available for 2D lines.   |
|                           | <b>Relative to line</b> or <b>Hold hinge</b> | Available for 3D lines.   |
|                           | <b>Relative to surface grade</b>             | Available for <b>Stake: Manual slope</b> . The manual slope is defined by: <ul style="list-style-type: none"> <li>• Hinge offset relative to the selected hinge reference line</li> <li>• Hinge height, calculated by using the hinge offset on the selected surface grade (left or right selected surface grade, depending on <b>Offset</b> - or +)</li> </ul> |
|                           |  |  <p>a Hinge point of manual slope<br/> b Defined hinge offset (-)<br/> c Left surface grade of design<br/> d Selected hinge reference</p>   |
| <b>Height</b>             | Editable field                               | The elevation of the hinge point (absolute height). Available for <b>Height offset type: Absolute</b> .   |
| <b>Slope location</b>     | Selectable list                              | Differentiates if the defined slope is a cut/fill and left/right.   |
|                           |  |  <p>a Hinge point<br/> b Left cut<br/> c Right cut<br/> d Left fill<br/> e Right fill</p>   |



| Field  | Option  | Description   |
|--|---|---|
| <b>Cut slope</b><br>and<br><b>Fill slope</b> | Editable field<br> | Defines the cut/fill ratio of the slope.<br>The slope ratio format is defined as system setting in <b>Regional, Slope</b> page. |

#### 48.4.11

#### Manual Slope

##### Availability

This function is available for stake/check of slopes.

##### Description

To access **Slope Definition**. Allows a manual slope to be defined. The defined manual slope is then used for all points to stake out or check. Refer to [Slope Definition](#) for a description of the panel.



The manual slope is active until it is turned off with **Reset slope to design** from the toolbox.

#### 48.4.12

#### Reset slope to design

##### Availability

This function is available for stake/check of slopes.

##### Description

This option is only available if a slope has been defined by using **Get current slope**. The manually defined slope is deactivated and reset to the design slope.

#### 48.4.13

#### Shift reference line

##### Availability

This menu function is available for the stake/check of slopes and surface grades.

The **Shift reference line** item of the toolbox stays disabled until the first measured position is available. The current chainage is used for the cross section shown to pick the reference line.

##### Description

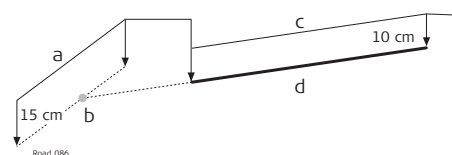
When staking out or checking different layers of the road strata, such as the subgrade, gravel or asphalt, it is often found that not all these layers are available in the design. For such cases, the app offers the possibility to apply either a negative or positive height shift to the design values.

##### Example

A gravel layer with a thickness of 10 cm for stakeout. A negative vertical shift to the final design surface is applied. This shift is applied:

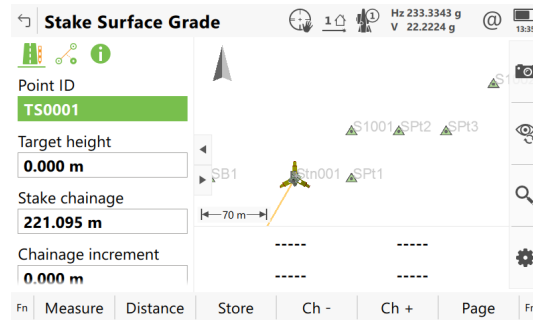
- by pressing **Shifts** in the **Define** panel and
- by applying a vertical shift of -10 cm.

As shown, the selected surface grade is shifted by 10 cm.

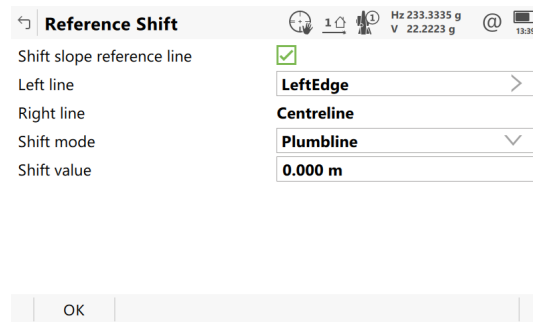


- a Reference surface
- b Shifted reference point
- c Original surface grade
- d Shifted surface grade

When staking out the newly shifted surface grade, the original left edge of the shifted surface grade is of little interest. It is the intersection with the left end slope that is of greater interest.



## Reference Shift

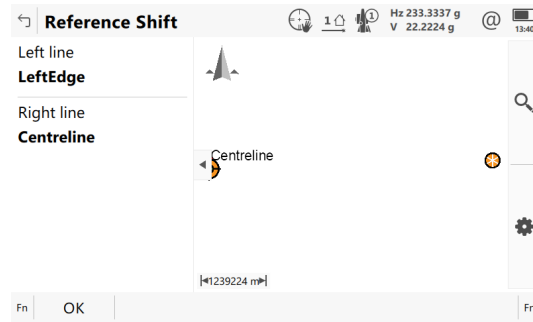


| Key | Description   |
|-----|---|
| OK  | To confirm the settings and return to the <b>Stake/Check</b> panel. |

### Description of fields

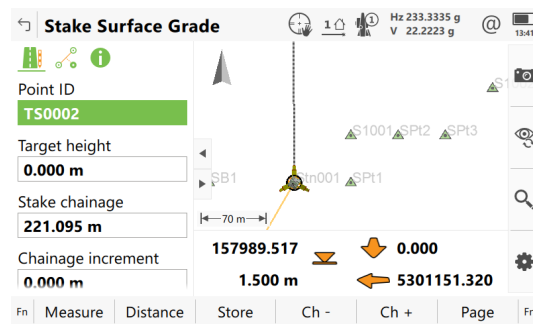
| Field                             | Option               | Description  |
|-----------------------------------|----------------------|--|
| <b>Shift slope reference line</b> | Check box            | When this box is checked, the settings for the shift can be set.                               |
| <b>Left line</b>                  | Display only         | Shows the name of the left line from the surface.  |
| <b>Right line</b>                 | Display only         | Shows the name of the right line from the surface.   |
| <b>Shift mode</b>                 |                      | The vertical shift applied to the surface selected.  |
|                                   | <b>Plumbline</b>     | The shift defined under <b>Shift value</b> gets applied following the plumb line.              |
|                                   | <b>Perpendicular</b> | The shift defined under <b>Shift value</b> gets applied perpendicular to the selected surface. |
| <b>Shift value</b>                | Editable field       | Value the selected surface gets shifted following the chosen <b>Shift mode</b> .               |

The graphical selection.



The expanded element and the shifted reference line, marked with a cross, are shown in 3D viewer.

**Difference in offset** and **Difference in height** guide you to the new shifted position.



#### 48.4.14

### Recalculate chainage

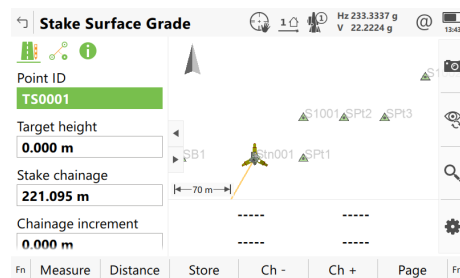
#### Availability

This menu function is available for all stake/check methods except layer.

#### Description

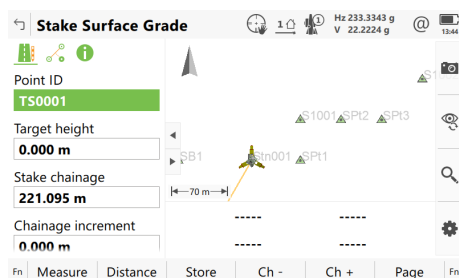
When staking or checking complex road designs it can happen that the current position is not projected to the desired segment of the alignment. The **Recalculate chainage** forces a re-projection of the current position.

#### Example



#### Before initialisation

This panel shows the projection of the current position to the left segment, although the distance to the right segment is shorter.



### After initialisation

This panel shows the projection after the reinitialisation.

## 48.4.15

### Stake intersection point

#### Availability

This menu function is available for staking a line with **Show information to an additional line** checked in **Define Line**

The additional line must be a Straight.

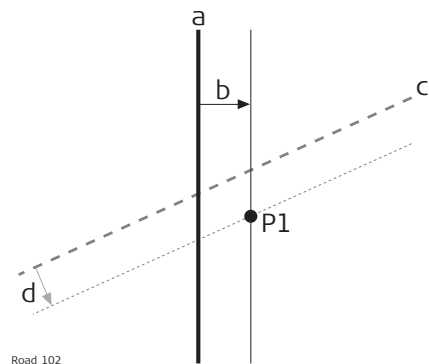
Offsets for the selected line and the additional line can be defined.



The menu function **Stake intersection point** is only available if the offsets are defined perpendicular to the selected line. **Use non-perpendicular offset** must not be checked.

#### Description

**Stake intersection point** is commonly used to stake out bridge abutment positions. The graphic shows an example.



- a Selected line, for example bridge centreline
- b Perpendicular offset from the selected line
- c Selected additional line, for example abutment line
- d Perpendicular offset from the selected line
- P1 Required intersection point for stakeout

#### Calculation of the stake intersection point and chainage

The calculation of the intersection point is based on:

- A perpendicular offset from the selected line, for example bridge centreline
- A perpendicular offset from the additional line

#### Step-by-step

##### 1. Define Line

Select the line to work with (bridge centreline) and select a second intersecting line (abutment centreline) under **Show information to an additional line**.

##### 2. Stake Line, page

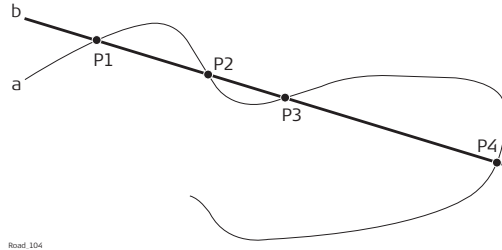
If necessary, check **Use offsets**. Type in the offset of the intersection point in relation to selected line (bridge centreline).



Non-perpendicular offsets are not allowed. If necessary, check **Apply offsets to additional line**. Type in the offset of the intersection point in relation to the selected additional line (abutment centreline).

3. **Fn Tools** to access the toolbox and select **Stake intersection point**.

In some cases, more than one intersection point can be calculated.



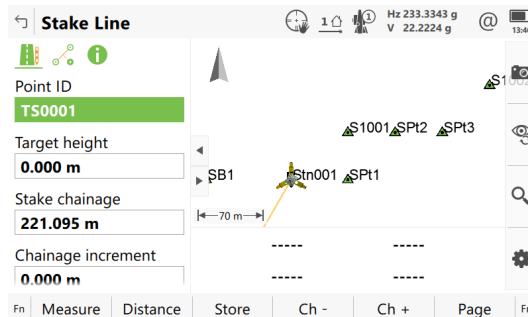
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- a Selected line
- b Additional line
- P1 Intersection point 1
- P2 Intersection point 2
- P3 Intersection point 3
- P4 Intersection point 4

In this case, a plot with the possibility to select the desired intersection point appears. The selection is made using the touch screen and a selectable list.

All intersection points are marked with a yellow flag.

The point ID and the point symbol of a selected intersection point are displayed in blue.



4. **Height confirmation**

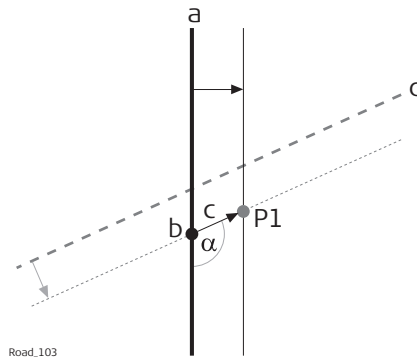
Depending on the available height information of the selected lines the following possibilities are available to define the height of the intersection point which has been selected for stakeout.

- Using the design height, which is the height of the selected line (bridge centreline). This option is used by default or by pressing **None**.
- Using the height of the additional line as manual height. This option appears when the additional line contains height information.
- Using the average height of the selected line and of the additional line as manual height. This option appears when the additional line contains height information.
- Using **Use heights from DTM** from the toolbox. This option is only available if a DTM has been selected in the job selection panel.

5. **Stake Line**,  page

Depending on the height selection, the check box **Allow editing the height of the location being staked** is enabled automatically and the selected height is used for staking out.

**Stake chainage** is the intersection of the original line (bridge centreline) and the line which is offset from the additional line. This value is updated automatically.



- a Selected line, for example bridge centreline
- b Stake chainage of intersection point
- c Non-perpendicular offset from the selected line
- d Selected additional line, for example abutment line
- $\alpha$  Non-perpendicular offset angle
- P1 Required intersection point for stakeout

6. **Stake Line**,  page

**Offset:** After pressing **Fn Tools** and selecting **Stake intersection point**, the value is updated automatically to the non-perpendicular offset of the intersection point to the selected line (bridge centreline).

**Use non-perpendicular offset:** The check box is checked automatically after pressing **Fn Tools** and selecting **Stake intersection point**. **Offset angle** is updated automatically to the non-perpendicular offset angle of the intersection point to the selected line (bridge centreline).



To stake further points along the same alignment to the additional line, update the value for **Offset** by the required distances. In this case, **Offset** is the distance along/parallel to the additional alignment.

7. **Stake Line**

To stake out the selected intersection point, all delta values must be 0.000.

---

## 49

## Roads - Rail

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### 49.1

### Creating a New Rail Job

---

#### 49.1.1

#### Overview

---

##### Description

There are two ways of creating road/rail jobs:

Typing them in manually by using the **Alignment Editor** app.

OR

Converting data created in a design package.

---

##### Manually entered data

Data can be typed in and edited with **Alignment Editor**. Refer to [47 Roads - Alignment Editor](#) for information on how to enter data manually.

---

##### Converted data

The **Alignment editor** app supports various different formats like dxf, LandXml, MxGenio, Terramodel, Carlson.

The Design to Field component of Infinity offers converters from several road/rail design and CAD packages. Several design packages also include a built-in converter to Roads/Rail. As different design packages follow different philosophies in representation, creation and storage of data the conversion process differs slightly.

Infinity can be found on the Infinity DVD.

The latest version of the Design to Field importers can be found in the downloads section of:

- <https://myworld.leica-geosystems.com>
- 

#### 49.1.2

#### Installing all necessary Software

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##### Install Infinity

Infinity runs under WindowsXP or Windows Vista and can only be installed successfully if the user is logged in as the Administrator. To install Infinity, run the setup file from the DVD and follow the instructions.

---

##### Install Design To Field

To prepare the track design for use on the instrument successfully, the data must first be converted from its original format to an onboard job. This conversion is achieved using Design to Field, a component of Infinity which is automatically installed with Infinity.

---

##### Install Importers

The field importers are used by Design to Field to read in the track design. These importers are installed separately and have the file extension \*.rri.

The latest version of the Design to Field importers can be found in the downloads section of:

- <https://myworld.leica-geosystems.com>
- 

##### Install Rail Editor

Rail Editor is a computer program for defining the height of the rails relative to the horizontal and vertical alignments (superelevation). Rail Editor is automatically installed into Infinity from the Field Importers install package, which can be found in the downloads section of the Leica Geosystems website. Rail Editor can be run either externally or within Design To Field.

---



## Importing the design

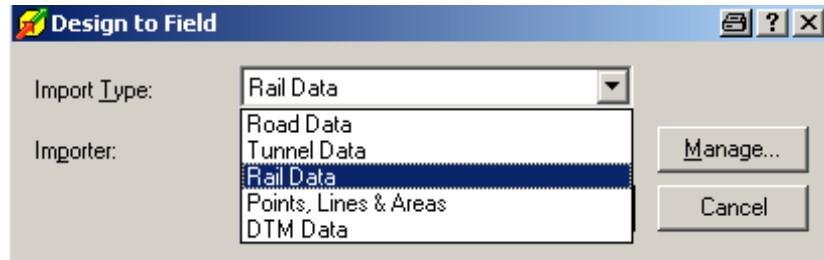
1. **Starting the Design to Field program**

To import a track centreline select Design to Field from the toolbox in Infinity.

2. **Selecting an Import Type**

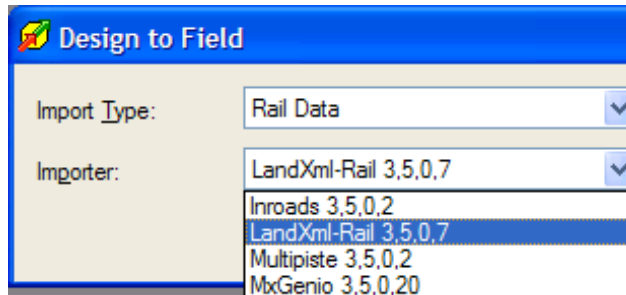
To prepare track design for onboard use successfully, it has to be converted from its original data format to an onboard job which runs on the instrument.

Select **Importer Type: Rail Data**

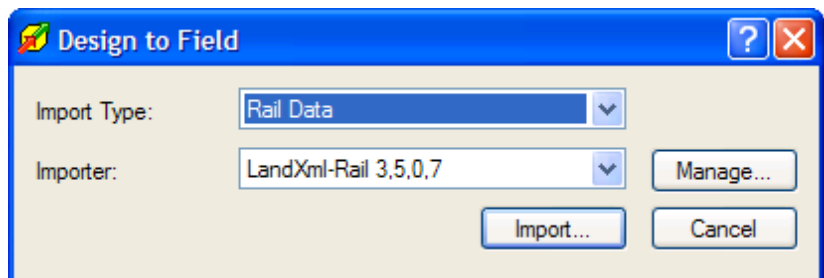
3. **Selecting a Field Importer**

Importers are used to convert the data. Additional importer formats can be added to the selectable list by clicking **Manage**.

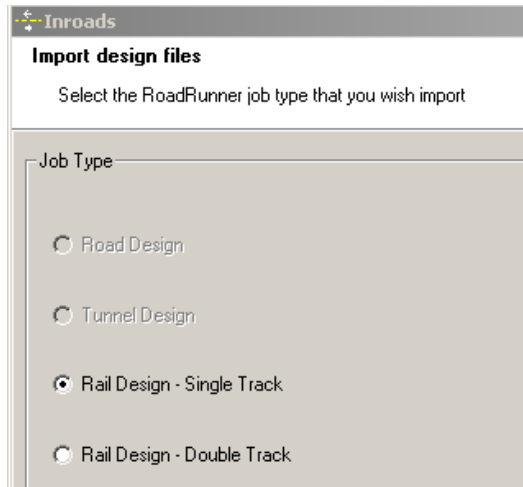
Select the importer related to the track design from the selectable list of available importers.

4. **Importing**

Click **Import** to start the file selection wizard.



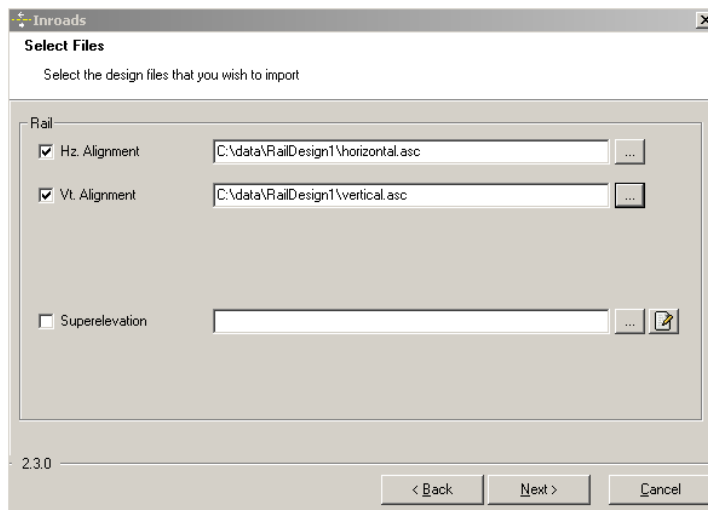
## 5. Selecting the job type



- For single tracks, select **Rail Design-Single Track**. A single track design can consist of a horizontal alignment, a vertical alignment and superelevation.
- For double tracks, select **Rail Design-Double Track**. A double track design can consist of a horizontal alignment, a vertical alignment and superelevation for each track. Alternatively, a third horizontal alignment can also be defined and used for calculating the chainage of both tracks (chainage centreline). Click **Next** to move to the next page of the wizard.

---

## 6. Selecting the horizontal and vertical alignment files



- For a single track, select the horizontal and vertical alignments using the browse button.
  - For a double track, three panels are used to define the design data. The arrows at the bottom of the panels can be used to move between the different panels.  
 First panel - Centreline: The first panel defines the horizontal and vertical alignment of the chainage centreline. If the chainage for each track is to be calculated relative to each track centreline, then it is not mandatory to select a chainage centreline. The horizontal and vertical alignment on the first panel can be left blank.  
 Second panel - Left track: The second panel defines the horizontal and vertical alignments and the rail definition (superelevation) of the left track.  
 Third panel - Right track: The third panel defines the horizontal and vertical alignments and the rail definition (superelevation) of the right track.
- Click **Next** to move to the next page of the wizard.

7. **Superelevation (rail definition)**

- Design data which is compulsory:  
A track design must contain a horizontal alignment.
- Design data which is optional:  
A track design can include a vertical alignment and a rail definition (superelevation). Superelevation is only possible when the track design includes a vertical alignment.

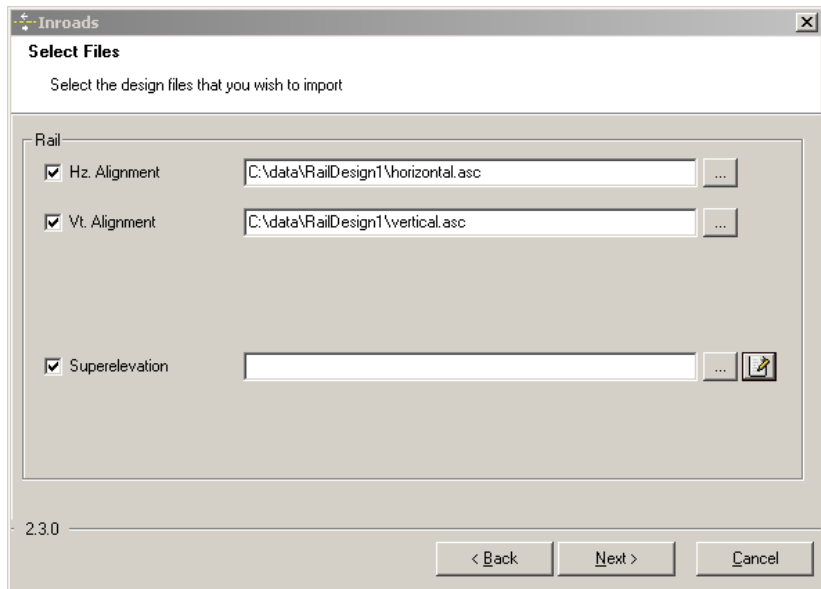
A superelevation file can be obtained in the following ways:

- by selecting an existing superelevation file.
- by selecting an existing superelevation file and modifying it with Rail Editor.
- by creating a new superelevation file with Rail Editor.

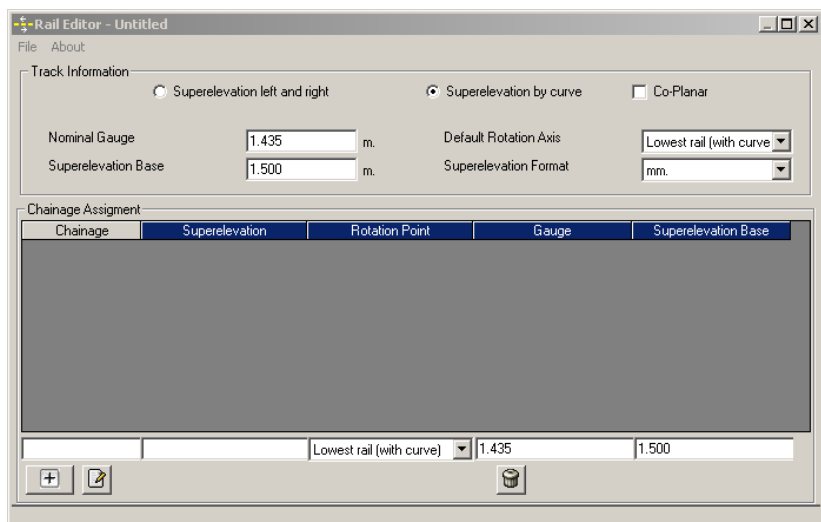
**Creating a superelevation (rail definition)**



To create a rail definition (superelevation) for any track, click the **Edit** button next to the Superelevation file name. This action starts the Rail Editor program.



The Rail Editor program is used to define the height of the rails at a given chainage. The height of the rails can be defined by a rotation point and a cant or by a left and right cant.



### Describing the panel elements - Entering Track Information

#### Superelevation left and right

To define the height of the rails using one superelevation value for the left rail and another superelevation value for the right rail.

#### Superelevation by curve

To define the rails using a rotation point and a superelevation value.



Once the method by which the superelevation values are defined has been selected, it cannot be changed

**Co-Planar (for multiple tracks)**

To define the height of the rails of the second track by extending the plane which runs through the rails of the first track.

**Nominal Gauge**

The default nominal distance between the active (internal) faces of the left and right rails. This value can be changed if necessary for any rail definition (superelevation).

**Superelevation Base**

The distance over which the superelevation is applied. This distance is normally the distance between the centre of the left and right rail. This value can be changed if necessary for any rail definition (superelevation).

**Default Rotation Axis**

If a rotation point is used, this selection is used as the default for all new rail definitions. This value can be changed if necessary for any rail definition (superelevation).

**Superelevation Format**

The format in which the superelevation values are entered.



Once all superelevation data has been entered, press the button to add the data to the chainage assignment panel.



To delete an element, select the element and press the button.



To modify an existing element, select the element, modify the data and press the button.

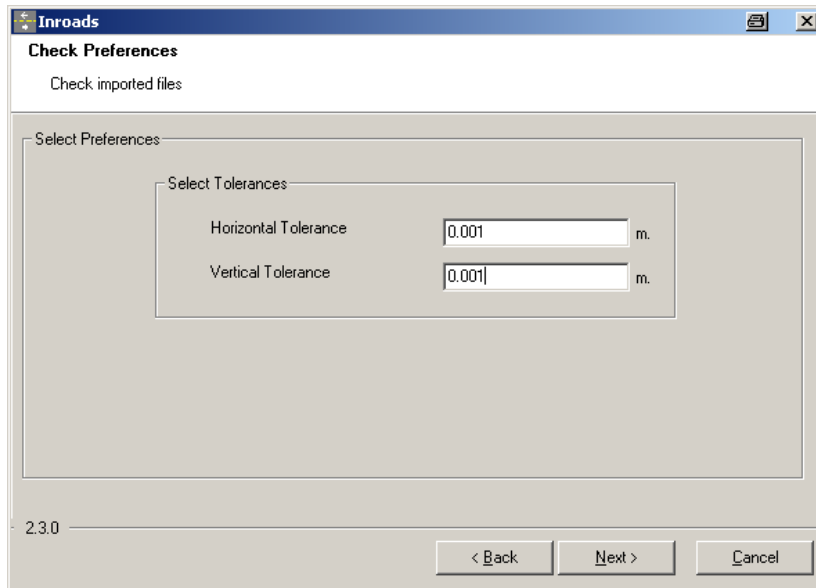
Once all values have been entered for the entire alignment, the file can be saved in an XML format using **Save** from the **File** menu.

To return to the Design To Field converter, select **Exit** from the **File** menu.

To modify an existing rail definition (superelevation) file, for example XML files, use **Load** option from the **File** menu.

8. **Entering the alignment tolerances**

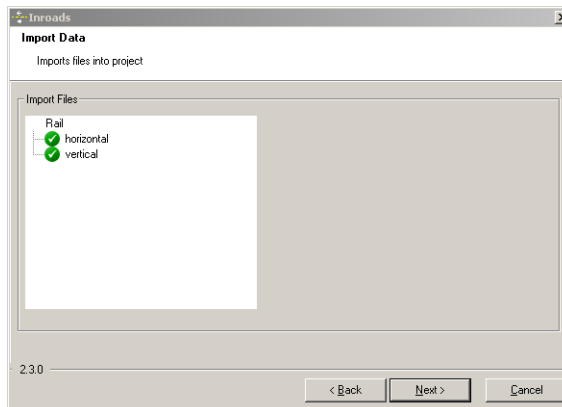
Enter the appropriate horizontal and vertical tolerances to be used during the checking of the alignments.



Click **Next** to move to the next page of the wizard.

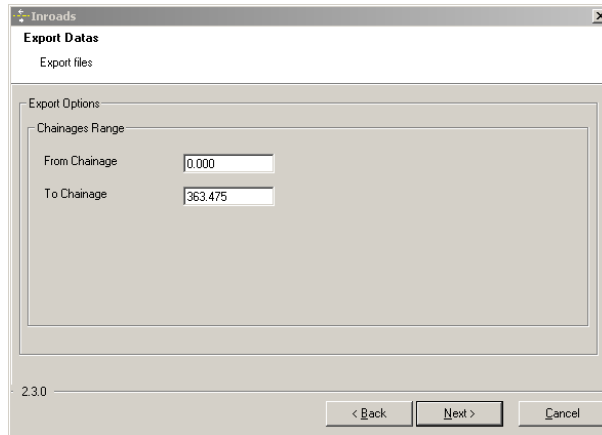
9. **Checking the track design**

When the track design has been imported, information is displayed to show the success or failure of the import.



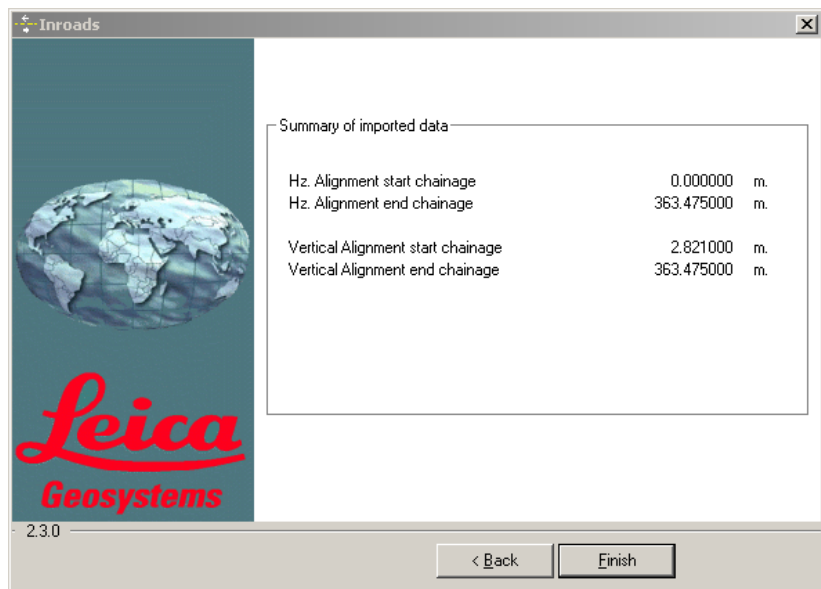
- When the import is successful: Click **Next** to move to the next page of the wizard.
- When the import is unsuccessful: Click **Back** to step back through the wizard.
- If a problem is encountered a red symbol appears. Double-click on the red symbol and a window containing a description of the problem appears.

10. **Entering the range of chainages to be used**  
Enter the range of chainages to be exported.



Click **Next** to move to the next page of the wizard.

11. **Checking the summary report**
- When the report is correct: Click **Finish** to complete the wizard.
  - When the report is incorrect: Click **Back** to step back through the wizard.

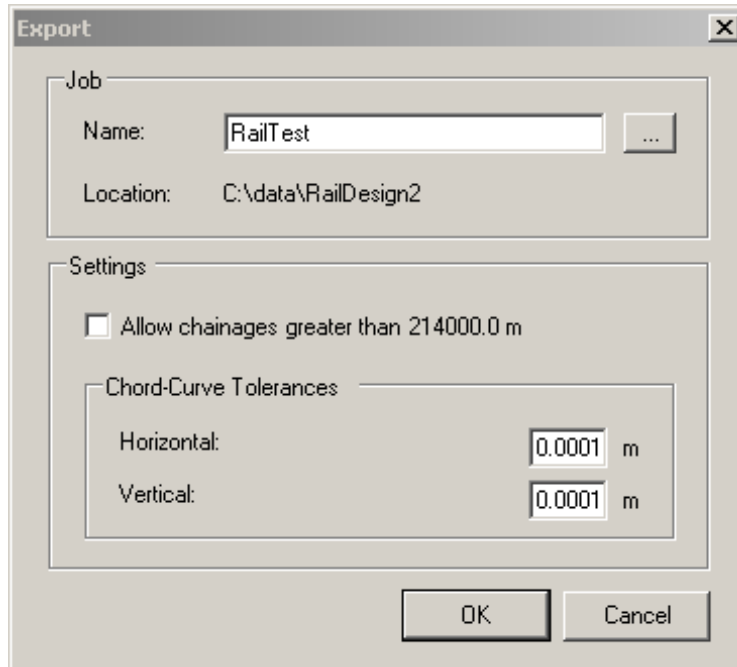


12. **Viewing the track design**  
The track design can be viewed graphically.



Click **Export** to create the files for onboard use.

13. **Creating the files for onboard use**  
The track design can now be prepared.



Click **OK** to create the files for onboard use. The database files are created and are located in the same folder as the source alignment files.



Refer to the Design to Field User Manual for details on importing various types of data with various field importers. This manual is included in the Design to Field Converters install application RR\_Design\_to\_Field.exe, which can be downloaded.

#### 49.1.4

#### Loading the Track Design onto the Instrument

##### Loading the design

Once the track design has been converted, copy all the database files to the \DBX folder of the data storage device of the instrument. Refer to [B Directory Structure of the Memory Device](#).

#### 49.2

#### Defining the Work

##### Access

1. Select **Leica Captivate - Home: Stake rail** or **Check rail**.
2. In the job selection panel, select the required jobs. Refer to [6.3 Choosing a Job](#).
3. Press **OK**.

##### Task

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To continue to the next panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> . |



## Description of the methods

| Method                          | Description   |
|---------------------------------|---|
| <b>Track</b>                    | To stake the track geometry using a pole.   |
| <b>Track &amp; gauge device</b> | To stake the track geometry using a gauge device. When a measurement is made, the values are retrieved from the gauge device. The current track geometry is checked against the theoretical track geometry. The current track geometry includes both rail position, gauge and cant.           |
| <b>Rails &amp; gauge device</b> | Available for <b>Check rail</b> only. This method does not take into account any rail design and is not intended to check the absolute positioning of the rails. However, the current position can be recorded. Chainages are only used, if the gauge device provides them from the odometer. |

## Next step

**OK** accesses the **Define Task** panel.

## Define

The screenshot shows the 'Define' panel with the following settings:



- Layer: Rehtes Gleis
- Chainage line: Centerline
- Working chainage: 140.000 m
- Working line: Centreline

At the bottom of the panel, there are 'Fn' buttons and an 'OK' button.

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To continue to the next panel.   |
| <b>Shifts</b>      | To apply horizontal and vertical shifts to the selected element. Refer to <a href="#">46.4 Working with Shifts</a> . |
| <b>Load</b>        | To load a task. Refer to <a href="#">46.5 Tasks</a> .  |
| <b>Save task</b>   | To save the settings as a task. Refer to <a href="#">46.5 Tasks</a> .  |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .   |

## Description of fields

| Field                | Option                          | Description   |
|----------------------|---------------------------------|---|
| <b>Layer</b>         | Display only or selectable list | Layers contained in the active rail job can be selected, for example layer of left or right track design. |
| <b>Chainage line</b> | Display only                    | Shows the name of the chainage line, at the selected layer.   |

| Field                               | Option                         | Description  |
|-------------------------------------|--------------------------------|--|
| <b>Working chainage</b>             | Editable field                 | Available for <b>Stake: Track</b> .<br>To enter a chainage of the chainage centreline. The chainage must range between the start chainage and end chainage. The default is the setup point for TS and the current position for GS. Only those elements which appear at the chainage can then be selected from <b>Working line</b> .  |
| <b>Working line</b>                 |                                | Available for <b>Stake: Track</b> .<br>The measured point values can be compared with the left rail, the right rail or the track centreline. The selectable list allows the selection of the line with which measured values are then compared.  |
|                                     | <b>Centreline</b>              | The track centreline.  |
|                                     | <b>Left rail or Right rail</b> | <ul style="list-style-type: none"> <li>For design data including the rails: Working with design data including the rails, the horizontal and vertical alignment of the design is used. Depending on the rail design settings, the super-elevation of the design or the manually defined superelevation can be used.</li> <li>For design data without rails (only track centreline):<br/>If the design data does not contain the rail design, then the position of the left rail is calculated. The nominal gauge entered in the settings is used for the calculation.</li> <li>When working with horizontal alignments only:<br/>The height of the rails is calculated by using the values for <b>Manual super-elevation definition</b> defined on <b>Stake Track</b>  page/<b>Check Track</b>,  page.</li> </ul> |
| <b>Director rail</b>                | Selectable list                | Available for <b>Stake: Track &amp; gauge device</b> .<br>The reference point for the delta values. The delta values displayed in the middle of 3D viewer refer to this selection.   |
| <b>Chainage increment</b>           | Selectable list                | Available for <b>Stake: Track &amp; gauge device</b> and <b>Stake: Rails &amp; gauge device</b> .<br>Determines the left/right rule the information is displayed. Distance in direction of increasing chainage = positive. The selection influences the geometry of the track in 3D viewer.  |
| <b>Position of the gauge sensor</b> | Selectable list                | Available for <b>Stake: Track &amp; gauge device</b> and <b>Stake: Rails &amp; gauge device</b> .<br>The location of the mobile part of the gauge device.  |

| Field                                  | Option         | Description  |
|--|----------------|--|
| <b>Start chainage for the odometer</b> | Editable field | Available for <b>Stake: Rails &amp; gauge device</b> . Relevant if the gauge device includes an odometer. Otherwise leave value to 0.00. |

## 49.3

## Staking/Checking the Track

### 49.3.1

### The Stake/Check Panel

#### Staking points

It is possible to stakeout points using a rail job with and without a stored rail design.

When the position of the rails is not stored in the rail job, it is possible to stake out:

- The horizontal and vertical alignment of the track centreline
- Points with a known horizontal and vertical offset from the horizontal and vertical alignment of track centreline
- The rails of the track by entering the track superelevation, superelevation base and nominal gauge
- Points with known horizontal and vertical offsets from the manually defined rails.

When the position of the rails is stored in the rail job, it is possible to stake out:

- The horizontal and vertical alignment of track centreline
- Points with a known horizontal and vertical offset from the horizontal and vertical alignment of track centreline
- The rails of the track
- Points with known horizontal and vertical offsets from the defined rails.

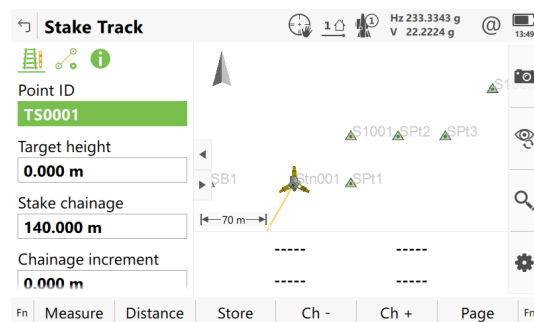
#### Checking points

Besides checking points, it is also possible to work with cants (superelevation):

- The cant value can be entered manually. The value is measured using a device to measure the cant with an inclination sensor (camber measurement instrument).
- The difference of the manually entered cant value and the current design cant can be displayed on **i** page and is stored in the DBX.
- The cant value can be measured by using the option **Second point of super-elevation** of the toolbox. A second point on the track is measured to calculate the cant using the measured height difference and the configured superelevation base.

#### Stake Track, page, Check Track, page


Information regarding the measured point can be entered. This panel allows any point of the track to be checked against design values.

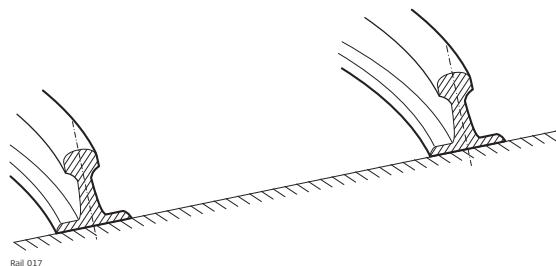


| Key                | Description   |
|--------------------|---|
| <b>Measure</b>     | For GS:<br>To start measuring the point being staked. The key changes to <b>Stop</b> .<br><br>For TS:<br>To measure a distance and store distance and angles.   |
| <b>Stop</b>        | For GS:<br>To end measuring the point being staked. When <b>Automatically stop point measurement</b> is checked in <b>GS Quality Control, General</b> page recording of positions ends automatically as defined by the stop criteria. The key changes to <b>Store</b> . After ending the measurements, the differences between the measured point and the point to be staked are displayed. |
| <b>Store</b>       | For GS:<br>To store the measured point. When <b>Automatically store point</b> is checked in <b>GS Quality Control, General</b> page, the measured point is stored automatically. The key changes to <b>Measure</b> .<br><br>For TS:<br>To store angles and distance. Distance must be measured before.  |
| <b>Distance</b>    | For TS:<br>To measure a distance.   |
| <b>Ch -</b>        | Available for <b>Stake rail</b> . To decrease the chainage as defined by <b>Chainage increment</b> .  |
| <b>Ch +</b>        | Available for <b>Stake rail</b> . To increase the chainage as defined by <b>Chainage increment</b> .  |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .  |
| <b>Fn Position</b> | For TS:<br>To position the TS to the defined stakeout point, including defined offsets. The settings for <b>Rail Settings</b> in <b>Road Settings, TS specific</b> page, apply. Refer to <a href="#">Road Settings,TS specific page</a> .   |
| <b>Fn Tools</b>    | To access the toolbox. Refer to <a href="#">49.4 The Toolbox</a> .  |

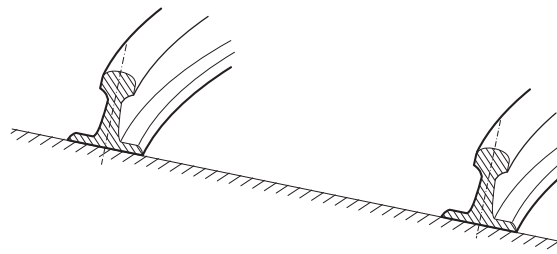

#### Description of fields

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Point ID</b>       | Editable field | Name of the next point to be stored. The ID is incremented/decremented whenever a point gets stored.   |
| <b>Antenna height</b> | Editable field | For GS:<br>Height of the antenna.  |
| <b>Antenna height</b> | Editable field | For GS:<br>Perpendicular height of the antenna. Available when the perpendicular height is configured. Refer to <a href="#">Road Settings,Rail design page</a> . |


| Field  | Option         | Description  |
|--|----------------|--|
| <b>Target height</b>                               | Editable field | For TS:<br>Height of the prism.<br>Using a gauge device, the target height is always applied perpendicular. In this case, the setting for <b>Apply target height</b> in <b>Rail Settings, Rail design</b> page is ignored.   |
| <b>Perpendicular target ht</b>                     | Editable field | For TS:<br>Perpendicular height of the prism. Available when the perpendicular height is configured. Refer to <a href="#">Road Settings, Rail design</a> page.   |
| <b>Stake chainage</b>                              | Editable field | The defined chainage of the point to be staked out. For multiple tracks that have a defined chainage centreline, the chainage to be staked out always refers to the chainage of the chainage centreline, not to the chainage of the track centreline.  |
| <b>Chainage increment</b>                          | Editable field | Value by which the nominal chainage increases/decreases when pressing <b>Ch -/Ch +</b> .<br>To stake a point at more than one chainage, define a chainage increment.   |
| <b>Allow entering the measured super-elevation</b> | Check box      | When this box is checked, the cant value (superelevation) which was measured with an inclination sensor can be entered manually. The difference of the manually entered cant value and the current design cant is displayed on  page.<br><br>When this box is not checked, no cant difference (superelevation) is calculated of the current design cant and the measured cant. The current cant can be measured using the option <b>Second point of super-elevation</b> from the toolbox. |
| <b>Measured super-elevation</b>                    | Editable field | Available when <b>Allow entering the measured super-elevation</b> is checked. Positive or negative signs must be entered. Seen in increasing chainage direction: <ul style="list-style-type: none"> <li>Negative cant value (example: -0.1900 m)</li> </ul>  |



Rail\_017

| Field                                    | Option         | Description   |
|--|----------------|---|
|  |                | <ul style="list-style-type: none"> <li>Positive cant value (example: 0.1900 m)</li> </ul>  <p style="text-align: center; font-size: small;">Rail_018</p> <p>            When <b>Second Point</b> of the tool-box is active, the current cant value is used for the cant difference calculation, not the value for <b>Measured super-elevation</b>.         </p>  |
| <b>Manual super-elevation definition</b> | Display only   | This field and the following fields are available for <b>Use super-elevation: Enter manually</b> in <b>Rail Settings, Rail design</b> page.   |
| <b>Height of lower rail</b>              | Editable field | Defines the absolute height of the lowest rail at the defined chainage.   |
| <b>Super-elevation left</b>              | Editable field | Defines the superelevation at the left rail. <ul style="list-style-type: none"> <li>When working with horizontal alignments only: If the superelevation is rotated around the left rail, the super-elevation would be zero.</li> <li>When working with horizontal and vertical alignments: If the track is rotated around the left rail, the vertical alignment would coincide with the left rail and the superelevation would thus be zero.</li> </ul>   |
| <b>Super-elevation right</b>             | Editable field | Defines the superelevation at the right rail. <ul style="list-style-type: none"> <li>When working with horizontal alignments only: If the track is rotated around the right rail, the superelevation would be zero. The total superelevation (left + right) is applied across the distance defined as the superelevation base in the settings.</li> <li>When working with horizontal and vertical alignments: If the track is rotated around the right rail, the vertical alignment would coincide with the right rail and the superelevation would thus be zero. The total superelevation (left + right) is applied across the distance defined as the superelevation base in the settings.</li> </ul> |

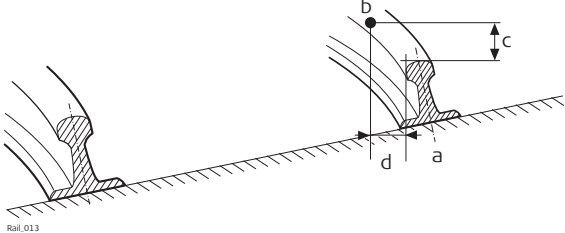
**Next step**



**Page** changes to the  page.

**Stake Track/  
Check Track,**  
 **page**

Refer to [Stake Track,page,Check Track,page](#) for a description of keys.

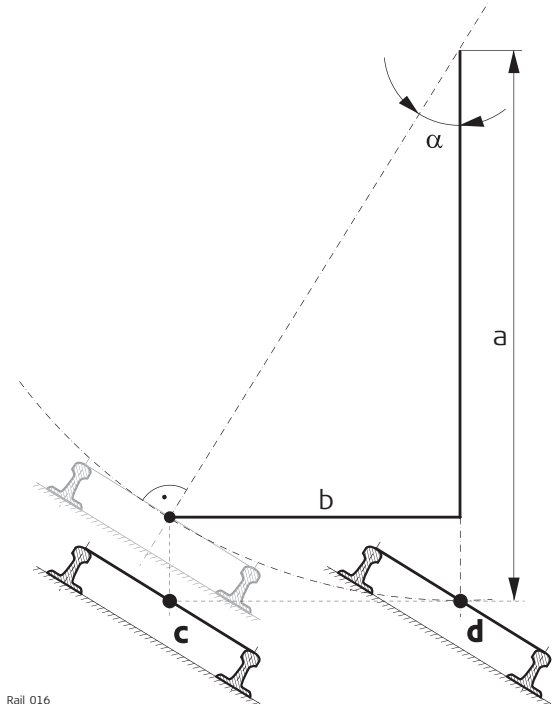
**Description of fields**

| Field              | Option              | Description   |
|--------------------|---------------------|---|
| <b>Use offsets</b> | Check box           | <p>When this box is checked, offsets can be typed in.</p> <p>Often it is necessary to stake out points with a fixed plan offset and fixed height offset from a known reference line (track centreline or rail).</p> <p>Offsets are applied in the same way, irrespective of how the rail design has been entered, whether the offsets are manually entered or if library offsets are used. The sign of the offsets conforms to the offset sign convention described in <a href="#">46.6.12 Rail - Working with Offsets</a>.</p> |
|                    |                     |  <p>a Reference line (right rail)<br/>b Point to stake<br/>c <b>Height offset</b><br/>d <b>Offset</b></p>  |
| <b>Offsets</b>     | <b>Manual</b>       | Offsets can be entered in <b>Offset/Check offset</b> or <b>Height offset/Check height diff.</b>   |
|                    | <b>From library</b> | The offset is stored as part of the rail job and recalled whenever required.  |
| <b>Offsets</b>     | Selectable list     | Available for <b>Offsets: From library</b> . The point ID of the stored stake offsets. To select a different stored offset or to create a point, highlight this field and open the selectable list. Refer to <a href="#">49.3.2 Offset Library</a> .  |
| <b>Offset</b>      | Editable field      | Available for Stake. Horizontal offset applied to the position of the reference line as defined by the design data or as calculated from manually entered data using the nominal gauge.   |

| Field                            | Option         | Description  |
|----------------------------------|----------------|--|
| <b>Height offset</b>             | Editable field | Available for Stake. Vertical offset applied to the height of the reference line as defined by the design data or as calculated from manually entered data using the superelevation and superelevation base.   |
| <b>Offset</b>                    | Editable field | Available for Check. Horizontal offset applied to the position of the reference line as defined by the design data or as calculated using manually entered data using the nominal gauge.   |
| <b>Check height diff</b>         | Editable field | Available for Check. Vertical offset applied to the height of the reference line as defined by the design data or as calculated from manually entered data using the superelevation and superelevation base.   |
| <b>Use pendular displacement</b> | Check box      | <p>This functionality is used in railway tunnels. The functionality is available for <b>Stake rail</b> and <b>Check rail</b>.</p> <p>Some rail projects require extra pendular displacement calculation for the design axis.</p> <p>The track is rotated based on a line with a defined height offset (pendulum length) from the track centreline. This action defines a horizontal displacement for the track. The vertical alignment is independent from the pendular displacement and does not change.</p> <p> The pendular displacement calculation only influences the horizontal position of the design axis. It does not change the height of the track.</p> <p>When this box is checked, a pendulum length can be entered. From the original track definition, a pendulum centre is defined exactly above the axis point. The difference in elevation of the pendulum centre is the pendulum length. With the help of the superelevation, a displacement is calculated. The effect of the pendular displacement is displayed on the  page.</p> |



| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



- a Pendulum length: The difference in elevation of the pendulum centre on the original track and above the axis point
- b Resulting pendular displacement
- c Displaced design axis based on pendular displacement calculation
- d Design axis defined in horizontal alignment
- $\alpha$  Pendulum angle

|                        |                |  |
|------------------------|----------------|--|
| <b>Pendular length</b> | Editable field | Available when <b>Use pendular displacement</b> is checked. The pendulum length as distance value. Positive values (0 - 9999.9999) point upwards. Negative values are not allowed. |
|------------------------|----------------|--|

### Next step

**Page** changes to the next page.

### Stake Line



This page is available for Stake rail only.

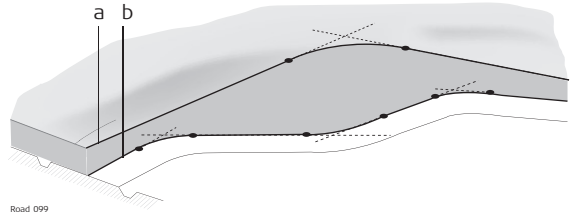


This page displays the differences between the measured point and the defined point. The position of the point to stake is reached when all difference values are close to zero.

The chainage can be de-/incremented by pressing left/right arrow key. The defined value for chainage increment is applied.

Refer to [Stake Track,page,Check Track,page](#) for a description of keys.


Refer to [54.4 Staking Out](#) for a description of the elements of the graphical display.



## Description of fields

| Field   | Option       | Description  |
|---|--------------|--|
| <b>Chainage</b>   | Display only | The current track chainage.  |
| <b>CL offset</b>  | Display only | Perpendicular horizontal offset from the centreline.   |
| <b>Difference in chainage</b>   | Display only | Difference between the defined <b>Stake chainage</b> and the current chainage <b>Chainage</b> of the measured position.<br>If no defined chainage exists, for example if staking out random chainages or checking, this field shows -----. |
| <b>Nearest hz tangent point</b>   | Display only | The chainage difference between the measured point and the nearest tangent point of the design is displayed. The nearest tangent point is the start/end point of a road segment.   |
|  <p style="text-align: center; font-size: small;">Road_099</p> <p style="text-align: center;">a Vertical alignment<br/>b Horizontal alignment</p> |              |  |
|   |              | Only tangent points are detected. A tangent point is the start/end point of a road segment.  |
| <b>Difference in offset</b>   | Display only | Horizontal offset between the defined position and the current position. The <b>Offset</b> defined on the  page is taken into account.                |
| <b>Difference in height</b>   | Display only | Vertical offset between the defined position and the current position. The <b>Height offset</b> defined on the  page is taken into account.           |


## Next step


**Page** changes to the  page.

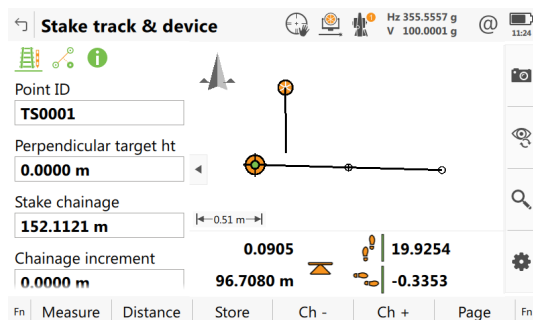
**Stake Track/  
Check Track,  
 page**

The  page displays the differences between the measured and design data. The fields viewed on this page can be configured in **Rail Settings, Info** page. Refer to [Road Settings,Info page](#) for information on all available items for the  page and how to select them.

**Stake Track/  
Check Track,  
3D viewer**

3D viewer displays a plot of the measured point related to the track design. The design is defined by the selected rail or track centreline, and the values entered on the  page.

3D viewer for Check and Stake are similar. The only difference is that the current chainage is always shown, as shown on the  page.



For Stake, extra information is shown at the bottom:

1. Difference in chainage is shown with some footsteps
2. Horizontal offset is shown with some footsteps
3. Height difference is shown as an arrow
4. Current height
5. The element to stake is shown as an orange and green dot
6. The plot can be shown as profile view, plan view, orbital view and navigation view.

#### For measurements with Stake: Track & gauge device:

The cross section view shows the geometry of the track design with two pegs in each of the rails. The current geometry retrieved from the gauge device is displayed in grey.

In the upper edges of the panel, the values referring to the left and right rails are displayed on each of the sides.

At the top, the **Director rail offset difference** and **Difference in gauge** values related to the rail director are presented.

#### For measurements with Stake: Rails & gauge device:

The cross section view shows the geometry of the track resulting from the gauge device measurements.

At the top, the chainage, gauge and cant values retrieved from the gauge device are displayed.


## 49.3.2

### Offset Library

#### Description

To select a different stored offset or to create a new point.

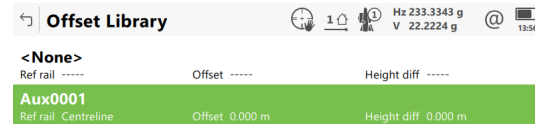
#### Access step-by-step

1. In **Stake Track/Check track**,  page, select **Offsets: From library**.
2. Highlight **Offset ID** and open the selectable list.

#### Offset library

Display of information about the reference rail or the offset and the height difference.

This panel allows offsets relative to a reference line to be defined and stored in the rail job. These points can be recalled at any time.



Fn OK Add Edit Delete Fn

| Key    | Description                                 |
|--------|---|
| OK     | To select a defined offset and to continue. |
| Add    | To enter an offset.                         |
| Edit   | To edit an existing offset.                 |
| Delete | To delete an existing offset.               |

### Next step

Press **Add** or **Edit**.

### Job name, Offsets

This panel allows the values of the stake/check offsets to be entered/edited. In addition to the horizontal and vertical offsets, an offset name (point ID) can be entered for each item.


### Next step

Press **OK** twice to return to **Stake Track/Check track**.


### 49.3.3

### Working with Pendular Displacements

#### Requirements

In **Stake Track/Check Track**,  page, check **Use pendular displacement** and type in a value for **Pendular length**.

#### Specific values on the page

| Value                               | Description   |
|-------------------------------------|---|
| <b>Pendular length</b>              | The defined pendulum length as entered on  page. |
| <b>Def pendulum displacement</b>    | Resulting horizontal displacement at defined chainage.  |
| <b>Actual pendulum displacement</b> | Resulting horizontal displacement at current chainage.  |
| <b>Def pendulum angle</b>           | Resulting pendulum angle at defined chainage.   |
| <b>Actual pendulum angle</b>        | Resulting pendulum angle at current chainage.   |

## 49.4

## The Toolbox

### 49.4.1

### Overview

#### Access

Press **Fn Tools** on any page of the Stake/Check panel.

#### Description

Additional functions for setting up/staking/checking the track can be accessed through the toolbox. This functionality is additional to those already existing functions which are available via the function keys.

The functionality differs between the stake and check methods. Refer to these subchapters for a detailed description of the functionalities:

- [49.4.2 Use heights from DTM](#)
- [49.4.3 Apply current chainage](#)
- [49.4.4 Stake individual point](#)
- [49.4.5 Second point of super-elevation](#)
- [49.4.6 COGO Rail](#)
- [49.4.7 Chord Setup](#)



Some functionalities can be accessed by a hot key or a favourites keys.

### 49.4.2

### Use heights from DTM

#### Availability

This menu function is available for stake and check.

#### Description

The app offers the possibility to

- switch to a height which is retrieved from an existing height layer, as defined in the selected DTM job. The layer from the DTM is applied and used as a height reference for the staking out or checking of alignments.
- retrieve heights from an existing layer, as defined in the DTM job associated with the project. The DTM used is not considered for the stake values. Three new information lines are added to the **i** page: **DTM height diff**, **DTM height** and **DTM layer**.
- show the DTM triangles in the planar view and in the cross section view in 3D viewer.

Once defined, each layer remains active until it is turned off. DTM heights can be used for both 2D and 3D alignments.

#### Use Heights From DTM

Use Heights From DTM

DTM Soccer DTM

DTM layer Existing

Use DTM height for stake out



Show DTM height difference on Info page tab

DTM layer Existing

OK

| Key | Description  |
|-----|--|
| OK  | To confirm the settings and return to the Stake/Check panel. |

### Description of fields

| Field                                       | Option          | Description   |
|---|-----------------|---|
| DTM   | Display only    | DTM from the selected DTM job.  |
| DTM layer                                   | Selectable list | When selecting a DTM layer the relevant triangle of the DTM is shown in 3D viewer.  |
| Use DTM height for stake out                | Check box       | When this box is checked, a layer of the DTM is used as a height reference. When this box is not checked, no DTM heights are applied for stakeout or check.   |
| Show DTM height difference on Info page tab | Check box       | When this box is checked, a layer of the DTM to be used as a height reference on the  page. When this box is not checked, no additional height information relative to the DTM is shown on the  page. |
| DTM layer                                   | Selectable list | Available when <b>Show DTM height difference on Info page tab</b> is checked. Layer of the DTM to be used as a height reference. When selecting a DTM layer the relevant triangle of the DTM is shown in cross section view in 3D viewer.   |


#### 49.4.3

### Apply current chainage

#### Availability

This menu function is available for stake.

#### Description

To set **Stake chainage** on the  page of the stakeout to the current chainage.

#### 49.4.4

### Stake individual point

#### Availability

This menu function is available for stake.

#### Description

To stake out points with known Easting, Northing and Height. Points can either be selected from the job or manually typed in.

If a design job has been selected, a point from the design job can be selected. When staking out/checking an individual point, the selected point is set in relation to the alignment and all line relevant values are calculated and displayed.

The **Stake chainage** and **Offset** of the Stake panel are calculated based on the coordinates of the selected point.



If the chosen point has no height the design height is used. If the point has a height it is possible to use that one or continue working with the design height.

#### 49.4.5

### Second point of super-elevation

#### Availability

This menu function is only available for check.


#### Description

To determine the current cant of two rails.

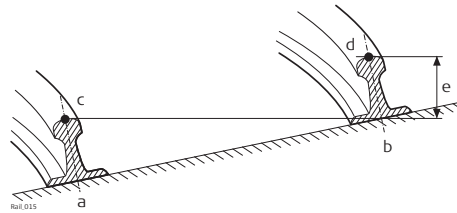
In order to calculate the current cant, it is necessary to measure two points, one on each rail. A mechanical device can be used to measure these points if necessary.

Additionally, the current cant can be calculated by first measuring any two points (example, the track centreline and lower rail) and then using the super-elevation base. The calculation is dependent upon the superelevation base.



When **Second point of super-elevation** is active, the **Current super-elevation** is used for the calculation of the cant difference, not the measured cant value from a cant device as seen in **Check Track**,  page.

## Diagram




- a Left rail
- b Right rail
- c first point
- d Second point of cant
- e Current cant

## Procedure

### Measuring the first point

The first point can be measured directly from the **Check Track** panel.

### Measuring the second point

The second point is measured after accessing the **Second point of super-elevation** in the toolbox. Once the second point has been measured, the value **Current super-elevation** is displayed on the  page.

## 49.4.6

### COGO Rail



The functionality of COGO Rail is identical with COGO Road. Refer to [48.4.6 COGO Road - Alignment info](#).

## 49.4.7

### Chord Setup

## Availability

This menu function is available for stake and check.

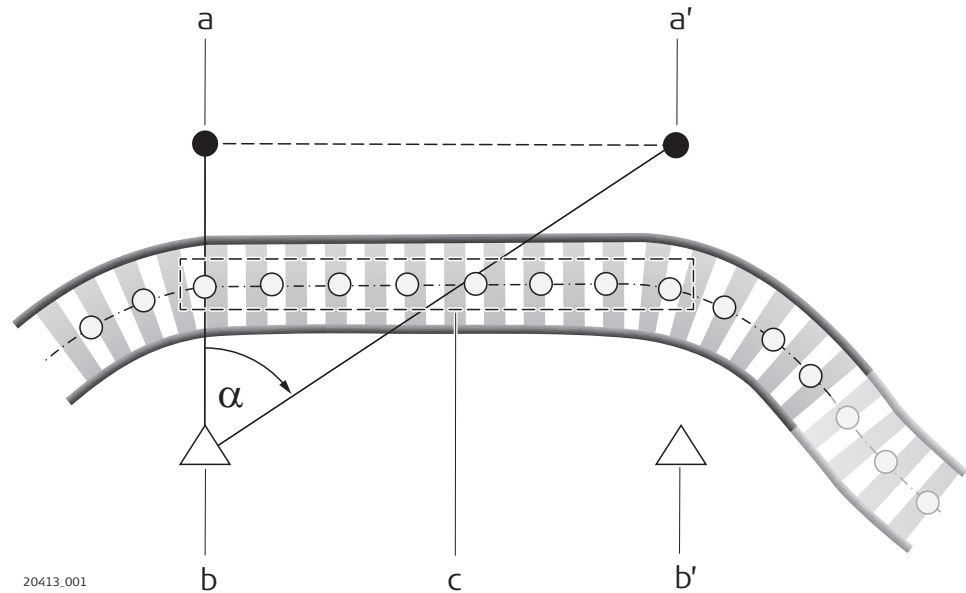
## Description

**Chord Setup** is a method to calculate the setup coordinates for the total station, measuring to only two references.

### Operating conditions


- A gauge device must be used.
- The accuracy for the reference coordinates is poor, approximately 10 cm.

## Diagram



- a First orientation point with known 3D coordinates
- a' Second orientation point with known 3D coordinates = First orientation point for second setup
- b Station point for first setup. Must be opposite of, almost perpendicular to, the first orientation point
- $\alpha$  Measured angle, used for the calculation of the station coordinates
- c Measurements done with the gauge device
- b' Station point, must be opposite of, almost perpendicular to, the orientation point

## Procedure

1. Setup the instrument approximately perpendicular to the first orientation point.
  2. Select **Stake: Track & gauge device** or **Check: Rails & gauge device**.
  3. Make all settings and proceed to the measure panel.
  4. Press **Fn Tools** and select **Chord Setup**.
  5. Take a measurement to the orientation point.
  6. From the same setup point, measure to the second orientation point.
  7. After the setup is done, measure with the gauge device. When measuring M1, M2, ..., the application reduces linearly the measured height according to the delta height error.
-  The measurements done with the gauge device must always be between the chainage values of the first and the second orientation point.

### Calculation of the Easting and Northing of the station point

The measured angle and the distance to the first orientation point are used to calculate the coordinates. The measured distance to the second orientation point is not taken into account.



### Calculation of the height of the station point

Only the measured distance to the first orientation point is used to calculate the height of the station point.

### Calculation of the orientation

Only the angle measurement to the second orientation point (point which is furthest away) is used to calculate the orientation of the instrument.

### Software calculation after the instrument is setup using this method

Measuring to the second orientation point provides the delta height error between both orientation points.

## Setup Details

---

| Key         | Description  |
|-------------|--|
| OK          | To accept changes.   |
| Scale       | To activate scale correction and to type in values for the scale corrections. Refer to <a href="#">New Job,TS scale page</a> . |
| Atmos       | To type in values for the atmospheric corrections. Refer to <a href="#">Atmospheric Corrections,Atmospheric ppm page</a> .     |
| Fn Settings | To configure the Setup app. Refer to <a href="#">53.3 Configuring Setup</a> .  |

### Description of fields

| Field                                     | Option          | Description   |
|---|-----------------|---|
| Point ID                                  | Editable field  | Type in an ID for the setup point.                                |
| Instrument height                         | Editable field  | The height of the instrument.                                     |
| Point code                                | Selectable list | Select a point code for the setup point if desired.               |
| Choose target points from a different job | Check box       | Target points can be selected from the design job.                |
| Choose design data                        | Selectable list | The design job from which the target points can be selected.      |
| Current scale                             | Display only    | The scale according to the scale settings for the selected setup. |

---

### Next setp

Follow the procedure as indicated on the panels. For an explanation of the fields on the **Setup Results** panel refer to [Setup Results](#).

---

## 50

## Roads - Tunnel

### 50.1

### Creating a New Tunnel Job

#### 50.1.1

#### Preparing Design Data

##### Downloads section

The tunnel design data is imported for use onboard the instrument using

- the industry standard LandXML data format
- formats exported from some other design packages using the Design to Field component of the Infinity computer application.

Converters are available for more than 15 different design packages.



The latest version of the Design to Field importers can be found in the downloads section of:

- <https://myworld.leica-geosystems.com>

#### 50.1.2

#### Tunnel Centreline

##### Basics

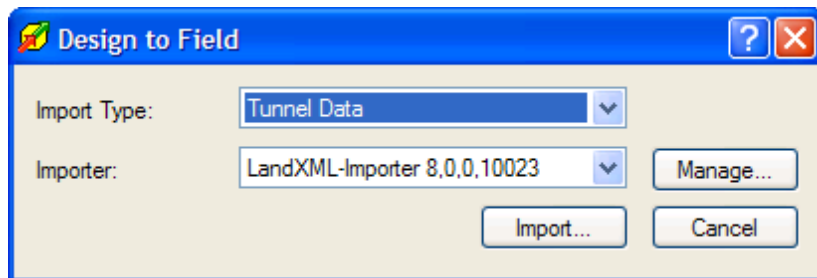
The tunnel centreline is defined in two or three dimensions. If design profiles are to be used, a three-dimensional centreline is required.

##### Design to field

1. To import a centreline using the Design to Field component select the **Tools/Design to Field** option of the Infinity computer application.



- 2.



For general information about Design to Field, please refer to the Infinity manual or Online Help.

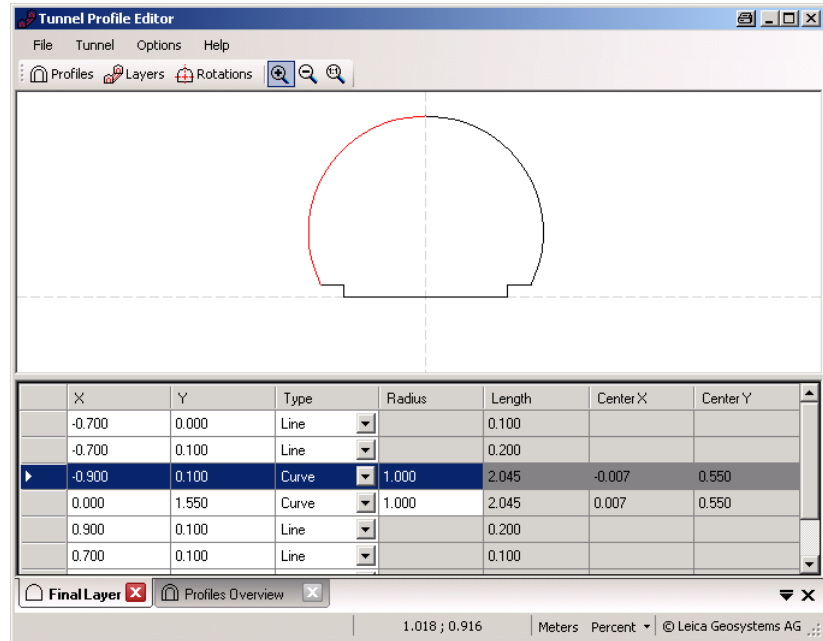
#### 50.1.3

#### Design Profiles

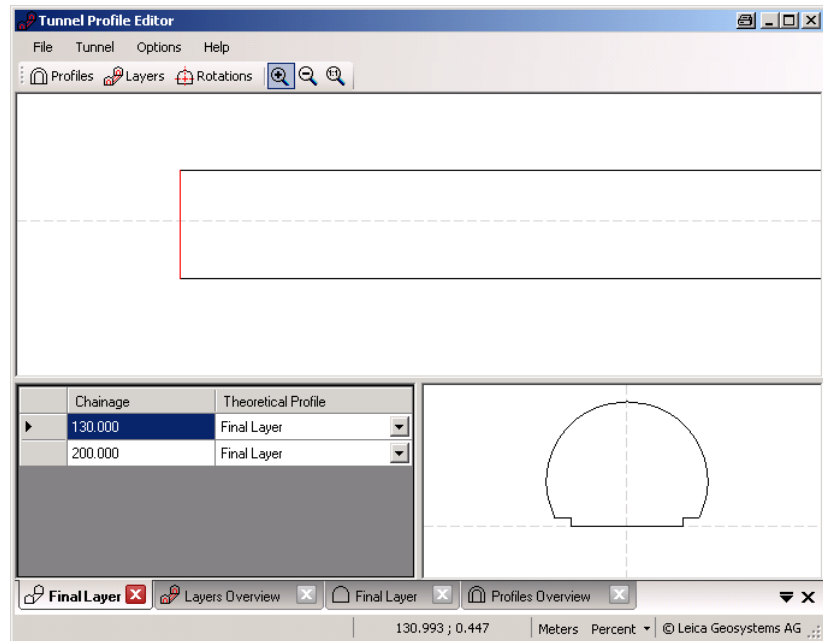
##### Tunnel design profiles

If tunnel design profiles are available, they are created using the Tunnel Profile Editor computer application. This application is integrated in the Design to Field viewer. It allows users to import or create tunnel data like profiles, layers and rotations. Refer to the Tunnel Profile Editor online help for more information.

## Tunnel Profile Editor, Profile details view

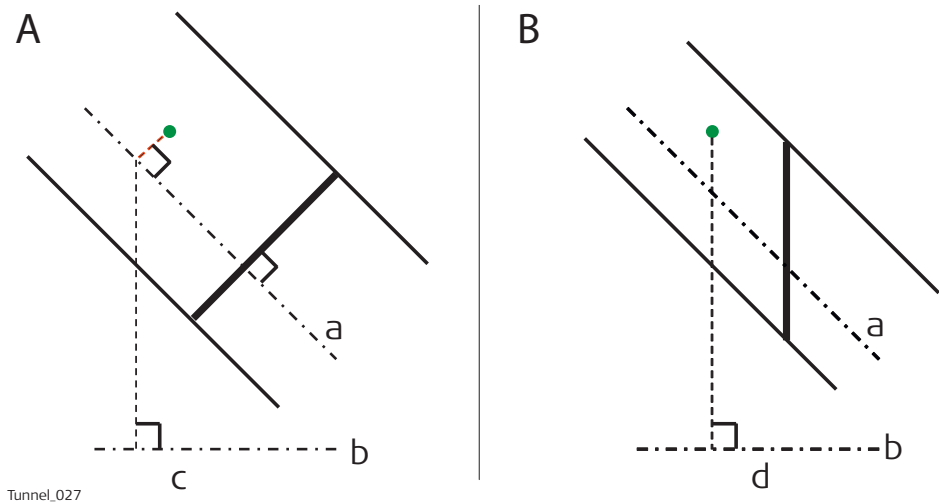


## Tunnel Profile Editor, Layer details view



## Vertical or perpendicular profiles

The Tunnel Profile Editor allows users to define tunnel profiles vertically or perpendicular to the vertical alignment of the tunnel axis. This results in different tunnel sizes for equal profile definitions as shown in the graphic.



Tunnel\_027

- A Perpendicular (tilted) profile
- B Vertical profile
- a Vertical alignment of tunnel axis
- b Horizontal alignment of tunnel axis
- c Chainage for perpendicular profile definition
- d Chainage for vertical profile definition

### 50.1.4

## Data Transfer to Instrument

### Getting data onboard

Once the design data have been converted, copy the database files to the DBX folder of the data storage device that is used on the instrument. The file names are jobname.x\*\*.

### 50.2

## Defining the Work

### Access

Select **Leica Captivate - Home: Stake tunnel** or **Check tunnel**.

### Task

Task

Hz 233.3335 g  
 V 22.2223 g

Stake

**Tunnel face** ▼

Stakeout the tunnel face at a defined chainage. Design information is defined relative to the centreline or the tunnel profile.

Fn
OK
Fn

#### Key

#### Description

OK

To continue to the next panel.

Fn Settings

To configure the app. Refer to [46.3 Configuring Roads Apps](#).

## Description of the methods

| Method                         | Description  |
|--------------------------------|--|
| <b>Tunnel face</b>             | Stakeout the tunnel face at a defined chainage. Design information is defined relative to the centreline or the tunnel profile.  |
| <b>Tunnel profile</b>          | Stakeout tunnel profiles at a defined chainage. Design information is defined relative to the centreline or the tunnel profile.  |
| <b>Profile by measuring</b>    | Check tunnel profiles, by measuring deviations to the design. Design information is defined relative to the centreline or the tunnel profile.  |
| <b>Profile by scanning</b>     | Check tunnel profiles, by automatically scanning at defined chainages to measure deviations to the design. Design information is defined relative to the centreline or the tunnel profile.   |
| <b>Profile generator</b>       | Extract as-built tunnel profiles from scanned point clouds and check deviations to the tunnel design.  |
| <b>Tunnel axis</b>             | Compare the tunnel design centreline against the calculated centre point of a measured profile. Method is only valid for tunnels with circular cross-section<br>Refer to <a href="#">50.3.5 Checking the Tunnel Axis</a> .   |
| <b>As-built by MS Scanning</b> | Available for: <ul style="list-style-type: none"><li>• Total stations with scanning capability, for example MS60/MS50</li><li>• Field controllers, for example CS30/CS35 remotely connected to total stations with scanning capability</li></ul> Creates a scan point cloud from a tunnel slice between two given chainages of a Tunnel alignment.<br>Make the settings in the <b>Define</b> panel. Refer to <a href="#">Define</a> .<br>AFTER that, continue with <a href="#">50.3.6 Tunnel Slice Scanning and Analysis</a> . |

## Next step

**OK** accesses the **Define** panel.

## Select Scans To Use

Available for **Check: Profile generator**.

Check the box in front of a scan ID to select a scan to use.

Uncheck the box in front of a scan ID to deselect a scan.

| Key       | Description                    |
|-----------|--------------------------------|
| <b>OK</b> | To continue to the next panel. |

## Define

The panel is an example valid for **Stake: Stake face**.

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To continue to the next panel.  |
| <b>Load</b>         | To load a task. Refer to <a href="#">46.5 Tasks</a> .   |
| <b>Distance</b>     | Available for <b>Check: As-built by MS Scanning</b> when <b>Start chainage</b> or <b>End chainage</b> is highlighted. To measure a distance which is then applied as starting or ending chainage. |
| <b>Fn Settings</b>  | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .  |
| <b>Fn Shifts</b>    | To apply horizontal, vertical and profile shifts to the selected element. Refer to <a href="#">46.4 Working with Shifts</a> .   |
| <b>Fn Save task</b> | To save the settings as task. Refer to <a href="#">46.5 Tasks</a> .   |

### Description of fields

Common to all methods

| Field             | Option                          | Description  |
|-------------------|---------------------------------|--|
| <b>Layer</b>      | Display only or selectable list | Layers contained in the active tunnel job can be selected. |
| <b>Centreline</b> | Display only                    | The name of the layer centreline.                          |

For **Tunnel face**

| Field                           | Option    | Description   |
|---------------------------------|-----------|---|
| <b>Drilling rig orientation</b> | Check box | This functionality helps to orientate the drilling rig when drilling holes parallel to the tunnel axis direction. The entry point at the tunnel face is marked and delta angles to align the drilling rig are provided. |

The following fields are available when **Drilling rig orientation: Parallel to alignment** is selected in **Tunnel Settings, Tunnel design** page:

|                             |                |  |
|-----------------------------|----------------|--|
| <b>Drilling distance</b>    | Editable field | The bore hole length. Available when <b>Drilling rig orientation</b> is checked and used to calculate the direction parallel to the alignment. |
| <b>Check Jumbo position</b> | Check box      | When this box is checked, the jumbo position is checked after measuring to the back of the boom.   |

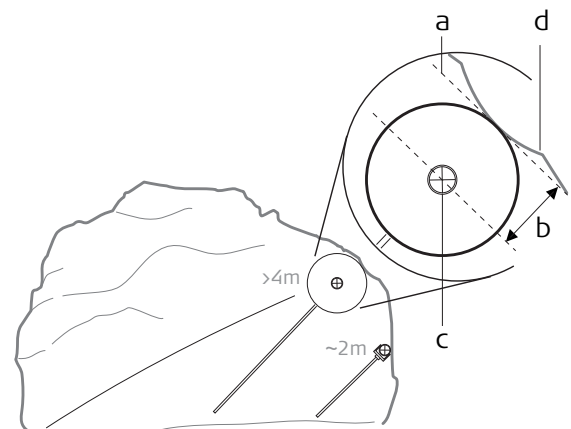
| Field              | Option         | Description   |
|--------------------|----------------|---|
| <b>Boom length</b> | Editable field | The length of the boom is used for calculating and checking the jumbo position when <b>Check Jumbo position</b> is checked.                                       |
| <b>Tolerance</b>   | Editable field | Defines how accurately the boom must be positioned to calculate the delta angles (max 10% of boom length). Available when <b>Check Jumbo position</b> is checked. |

The following fields are available when **Drilling rig orientation: Drill Pattern** is selected in **Tunnel Settings, Tunnel design** page:

|                                 |                         |   |
|---------------------------------|-------------------------|---|
| <b>Apply drill pattern from</b> | <b>Meas chainage</b>    | The drill pattern is directly applied to the measured chainage.<br>To acquire the measured chainage, take a measurement, press <b>Fn Tools</b> and select <b>Apply current chainage</b> . |
|                                 | <b>Defined Chainage</b> | This chainage is typed manually into the <b>Stake chainage</b> editable field. It is used to calculate the corresponding position and drill direction at the measured chainage.           |

For **Profile by measuring**

| Field                      | Option    | Description  |
|----------------------------|-----------|--|
| <b>Apply target radius</b> | Check box | When using a prism to check a design profile, it is important to take the prism radius into account.<br><br>The measured point is projected by a distance equivalent to the radius of the prism in a direction perpendicular to the tangent of the design profile.<br><br>When this box is not checked, the design profile is compared to the coordinates of the centre of the prism at the measured position. |



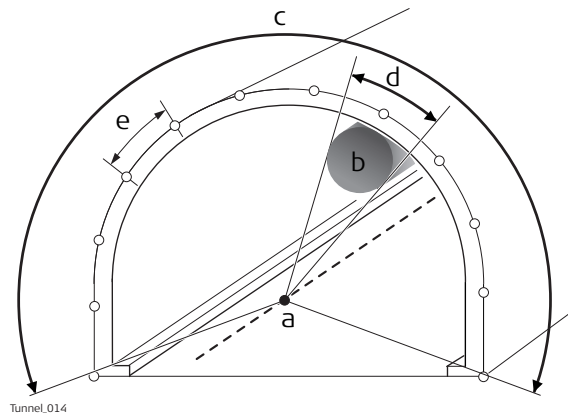
Tunnel\_013

- a Tangent to design profile
- b Prism radius
- c Prism
- d Design profile

| Field                | Option         | Description  |
|----------------------|----------------|--|
|                      |                | If measurements to any surface are used or no design profile has been defined, the prism radius parameter is not used in the calculation.<br><br>In 3D viewer, a plot of the measured point regarding the design profile is displayed. |
| <b>Target radius</b> | Editable field | Available when <b>Apply target radius</b> is checked. The radius of the prism.   |

For **Profile by scanning**



| Field                     | Option                    | Description   |
|---------------------------|---------------------------|---|
| <b>Define a scan task</b> | <b>Scan whole profile</b> | Each profile is scanned 360°/400 gon.   |
|                           | <b>Scan segments</b>      | The tunnel profile can be split into user-defined segments. Each segment can be assigned as a scan segment or non scan segment. |



- a Instrument axis
- b Ventilation shaft
- c Scan segment, included
- d Scan segment, excluded
- e Scan interval

|                      |                           |  |
|----------------------|---------------------------|--|
| <b>Scan interval</b> | Editable fields           | Available for <b>Define a scan task: Scan whole profile</b> . Defines at what interval to measure a point around the profile.                    |
| <b>Scan Mode</b>     | <b>Accuracy optimised</b> | This measurement mode is accuracy and range optimized. It uses single distance measurements to any surface.                                      |
|                      | <b>Speed optimised</b>    | This measurement mode is speed and performance optimized. It uses continuous distance measurements to any surface.                               |
|                      | <b>Quick profiler</b>     | It uses continuous distance measurements to any surface. Stores the measured data once the whole profile has been scanned or the scan is paused. |



| Field                        | Option                                      | Description   |
|------------------------------|---|---|
|                              |   |  The <b>Quick profiler</b> mode does not store TS observations.  |
| <b>Over break limit</b>      | Editable fields                             | Allows to discard scan points that are measured out of the range that is defined. All points scanned out of the tunnel profile, that are further away than that offset value defined, are not stored.   |
| <b>Under break limit</b>     | Editable fields                             | Allows to discard scan points that are measured out of the range that is defined. All points scanned inside the tunnel profile, that are further away than that offset value defined, are not stored.   |
| <b>TS handle is attached</b> | Check box                                   | When this box is checked, scanning a segment above the instrument is excluded automatically. The TS handle would otherwise interfere with measurements.<br><br> If scanning at the station chainage, then the scan does not include the profile segment beneath the total station. |
| <b>Radio handle type</b>     | <b>Normal handle</b><br><b>Radio handle</b> | If this option is selected, then it is not scanned between 386 gon and 7 gon.<br>If this option is selected, then it is not scanned between 380 gon and 25 gon.   |


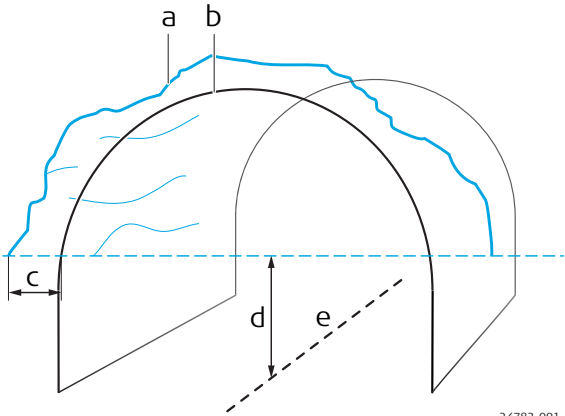
#### For **Profile generator**

| Field                    | Option         | Description  |
|--------------------------|----------------|--|
| <b>Start chainage</b>    | Editable field | Chainage of the first profile to check.                  |
| <b>End chainage</b>      | Editable field | Chainage of the last profile to check.                   |
| <b>Profiles interval</b> | Editable field | Distance between a pair of consecutive checked profiles. |

#### For **As-built by MS Scanning**

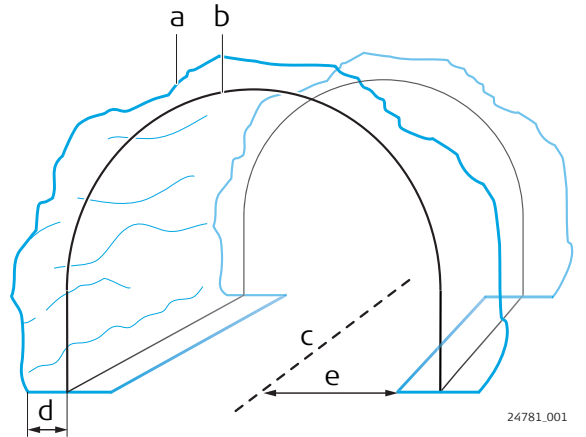
Make the settings, then continue with [50.3.6 Tunnel Slice Scanning and Analysis](#).

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Name of slice</b>  | Editable field | A name for the scanning slice.   |
| <b>Start chainage</b> | Editable field | Chainage of the first profile to check. The value must be between the minimum and the maximum for the given alignment. |
| <b>End chainage</b>   | Editable field | Chainage of the last profile to check. The value must be between the minimum and the maximum for the given alignment.  |

| Field                      | Option           | Description   |
|----------------------------|------------------|---|
| Scan filtering             |                  | <p>Define the limits of the slice to use from the Tunnel design data. Enter the basic data for calculating the polygon.</p> <p>Based on the definition, the software calculates the set of 3D points defining the polygonal area to be scanned.</p> <p> In the 3D viewer, the design data is displayed as grey shaded surface.</p> |
|                            | <None>           | The tunnel design is used to define the area to be scanned.   |
| Exterior / interior offset | Horizontal plane | <p>The polygon is calculated based on estimated offset between design and excavation and a defined horizontal line at a certain height above the centreline. Everything below that height and beyond the shifted design is excluded from the scanning area.</p>   |
|                            |                  |  <p style="text-align: right;">24783_001</p> <ul style="list-style-type: none"> <li>a Excavated profile</li> <li>b Design profile</li> <li>c <b>Exterior offset</b></li> <li>d <b>Centreline height difference</b></li> <li>e Centreline</li> </ul>  |

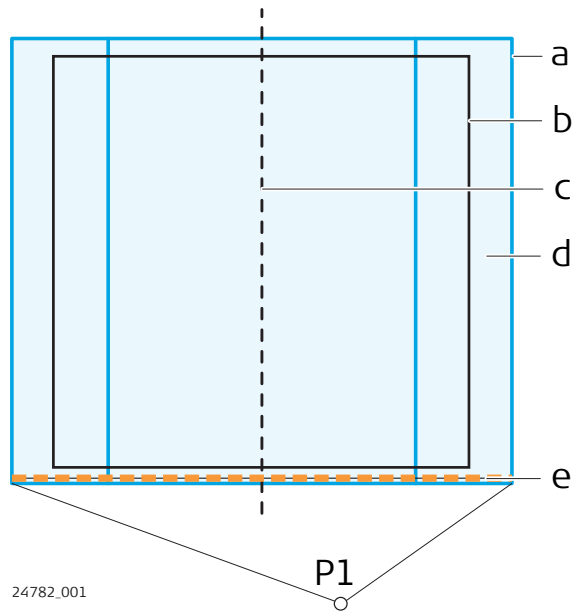
| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

Front view



- a Excavated profile
- b Design profile
- c Centreline
- d **Exterior offset**
- e **Interior offset**

Top view



- a Excavated profile
- b Design profile
- c Centreline
- d Scanned area
- e Scanning window
- P1 Setup of total stations with scanning capability

| Field                               | Option         | Description  |
|-------------------------------------|----------------|--|
| <b>Centreline height difference</b> | Editable field | Available for <b>Scan filtering: Horizontal plane</b> .<br>Height difference from the alignment to the design. <ul style="list-style-type: none"> <li>• Positive<br/>Above the centreline</li> <li>• Negative<br/>Below the centreline</li> </ul>  |
| <b>Scan floor</b>                   | Check box      | Available for <b>Scan filtering: Horizontal plane</b> .<br>When this box is checked the ground is included in the scan.  |
| <b>Exterior offset</b>              | Editable field | Available for <b>Scan filtering: Exterior / interior offset</b> .<br>To cover the difference between design and the natural walls after drilling and further excavations.<br>The difference between the design and an estimation of the current excavation. <ul style="list-style-type: none"> <li>• Positive<br/>Expands the cross section of the tunnel.</li> <li>• Negative<br/>Shrinks the cross section of the tunnel.</li> </ul> |
| <b>Interior offset</b>              | Editable field | Available for <b>Scan filtering: Exterior / interior offset</b> .<br>The surface of a part which will be excluded from the scan. It is limited by the distance to the horizontal alignment. This value is always positive.   |

## 50.3

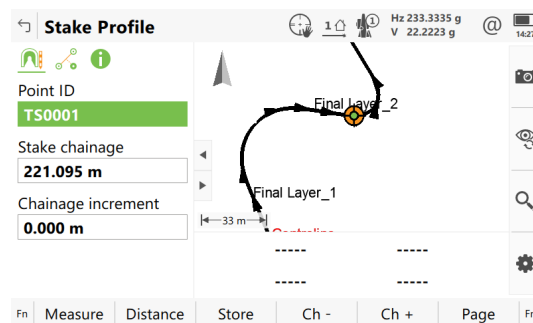
## Staking/Checking the Tunnel

### 50.3.1

### Overview

Stake Face/  
Stake Profile,  
page,  
Check Profile,  
page

This panel is an example valid for **Stake: Stake profile**.



| Key             | Description   |
|-----------------|---|
| <b>Measure</b>  | To measure a distance and store distance and angles.            |
| <b>Distance</b> | To measure a distance.  |
| <b>Store</b>    | To store angles and distance. Distance must be measured before. |

| Key                | Description  |
|--------------------|--|
| <b>Ch -</b>        | Available for <b>Stake tunnel</b> . To decrease the chainage as defined by <b>Chainage increment</b> .   |
| <b>Profile +</b>   | To increase the distance along the profile. Available for <b>Offset method: Profile, dist &amp; offset</b> and <b>Offset method: Dist from top&amp;offset</b> .  |
| <b>Ch +</b>        | Available for <b>Stake tunnel</b> . To increase the chainage as defined by <b>Chainage increment</b> .   |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .   |
| <b>Fn Position</b> | Available for <b>Stake tunnel</b> . To stake the point automatically. The instrument aims toward the point at the given chainage and offsets and measures a distance. If this distance is not within the required tolerance an iterative process is started until: <ul style="list-style-type: none"> <li>the number of iterations set as the parameter <b>Maximum iterations</b> is reached, or</li> <li>the difference between the measured point and the design point is less than the value set as the parameter <b>Position limit</b>.</li> </ul> |
| <b>Fn Tools</b>    | Available for <b>Stake tunnel</b> . To access the toolbox. Refer to <a href="#">50.4 The Toolbox</a> .   |

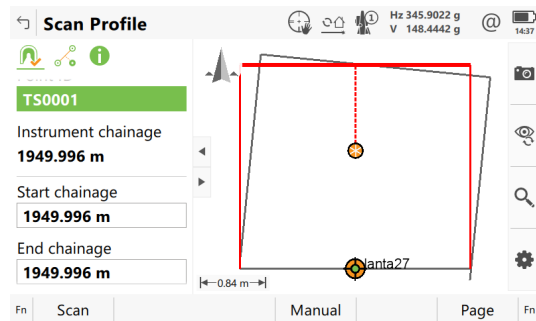
#### Description of fields

| Field                     | Option         | Description   |
|---------------------------|----------------|---|
| <b>Point ID</b>           | Editable field | The point identifier of the point to be staked.   |
| <b>Stake chainage</b>     | Editable field | Available for <b>Stake tunnel</b> . The defined or approximate chainage of the point to be staked out.  |
| <b>Chainage increment</b> | Editable field | Available for <b>Stake: Stake profile</b> . Chainage increment. Value by which the nominal chainage increases/decreases when pressing <b>Ch +/Ch -</b> . Define a chainage increment for points staked at more than one chainage. |
| <b>Target height</b>      | Editable field | Available for <b>Stake: Check profile</b> . The height of the prism. If a prism is used, type in the vertical difference between the point to be measured and the point of the prism pole.  |

#### Next step

**Page** changes to the **Offsets** page.

## Scan Profile, Scan area page

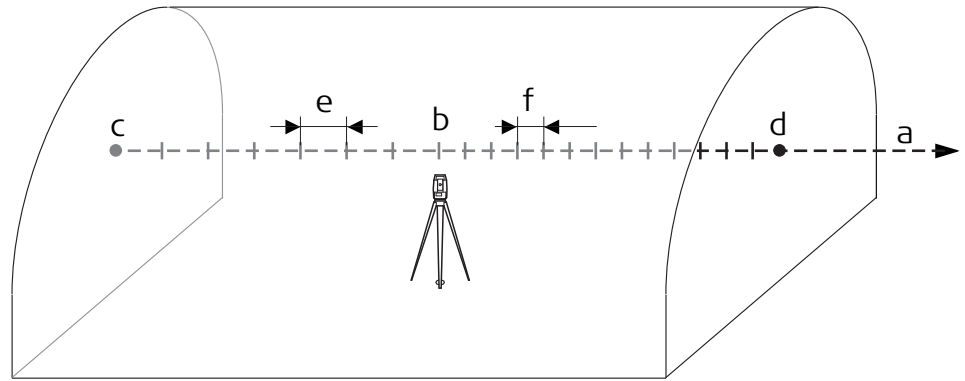


| Key                   | Description   |
|-----------------------|---|
| <b>Scan</b>           | Available for automatic scanning. To start the scanning process. Refer to <a href="#">During a scan</a> .   |
| <b>Stop</b>           | Available for automatic scanning. To stop the scanning process.   |
| <b>Pause</b>          | To pause the scan.  |
| <b>Resume</b>         | To restart scanning.  |
| <b>Get Ch</b>         | Point the telescope to the start or end chainage and press <b>Get Ch</b> to measure to the start/end chainage.  |
| <b>Measure</b>        | Available for manual scanning. To measure a distance and store distance and angles.   |
| <b>Distance</b>       | Available for manual scanning. To measure a distance.   |
| <b>Store</b>          | Available for manual scanning. To store angles and distance. Distance must be measured before.  |
| <b>Next point</b>     | To skip the point being measured and move onto the next profile point.  |
| <b>Profile +</b>      | To stop scanning the current profile and move onto the next profile.  |
| <b>Manual or Auto</b> | To switch between manual and automatic scanning.  |
| <b>Page</b>           | To change to another page on this panel.  |
| <b>Fn Settings</b>    | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .  |
| <b>Fn Temp</b>        | To define a temporary scan interval. Until the temporary scan interval is disabled, all scan segments are scanned at the defined temporary scan interval. |
| <b>Fn Tools</b>       | To access the toolbox. Refer to <a href="#">50.4 The Toolbox</a> .  |

### Description of fields

| Field                      | Option         | Description                                     |
|----------------------------|----------------|---|
| <b>Point ID</b>            | Editable field | The point identifier of the point to be staked. |
| <b>Instrument chainage</b> | Editable field | The chainage of the instrument setup.           |
| <b>Profile chainage</b>    | Display only   | The chainage for the current profile.           |

| Field                                    | Option         | Description  |
|--|----------------|--|
| <b>Start chainage and Start distance</b> | Editable field | Enter/measure a chainage/distance value where scanning starts along the alignment. The start can be before or after the station chainage. If entering a distance value to indicate start scanning before the station chainage use a negative. If entering a distance value to indicate start scanning after the station chainage use positive. |
| <b>End chainage and End distance</b>     | Editable field | Enter/measure a chainage/distance value where scanning ends along the alignment. The end can be before or after the station chainage. If entering a distance value to indicate end scanning before the station chainage use a negative. If entering a distance value to indicate end scanning after the station chainage use positive.         |
| <b>Profiles interval</b>                 | Editable field | Distance between the profiles to measure.  |



Tunnel\_030

- a Alignment
- b **Instrument chainage**
- c **Start chainage** or **Start distance**
- d **End chainage** or **End distance**
- e **Profiles interval**
- f **Profiles interval**

### Next step

Page changes to the [page](#).


Refer to [Stake Face/Stake Profile,page,Check Profile,page](#) for a description of keys.

### Description of fields

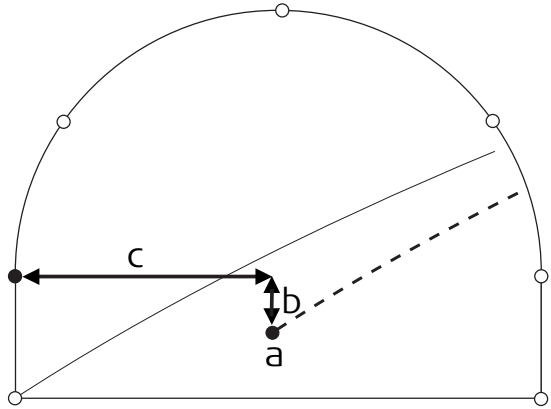
Common for all methods

| Field              | Option    | Description   |
|--------------------|-----------|---|
| <b>Use offsets</b> | Check box | When this box is checked, horizontal and vertical offsets can be applied. |

**Stake Face/  
Stake Profile/  
Check Profile/  
Scan Profile,  
[page](#)**

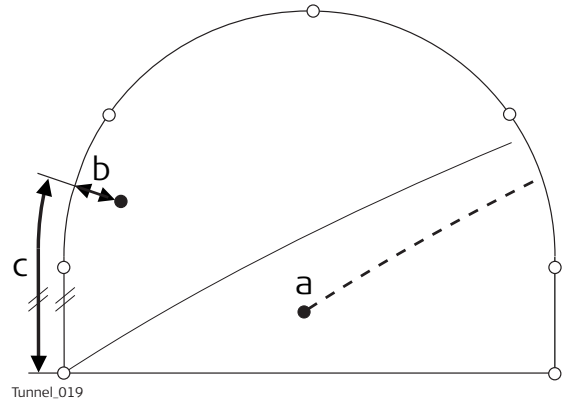
| Field | Option | Description  |
|-------|--------|--|
|       |        |  For <b>Scan Profile</b> , the setting does not offset or expand/shrink the design profile. |

For **Stake tunnel**

| Field                | Option                            | Description  |
|----------------------|-----------------------------------|--|
| <b>Offset method</b> |                                   | To define the position of the point to be staked out.  |
|                      | <b>Offset &amp; height</b>        | The point is staked out with a known perpendicular and vertical offset from the horizontal and vertical alignments respectively.   |
|                      |                                   |  <p>Tunnel_018</p> <ul style="list-style-type: none"> <li>a Centreline</li> <li>b Centreline height difference</li> <li>c Centreline offset</li> </ul> |
|                      | <b>Point from design</b>          | The offsets of the point are stored as coordinates in the <b>Road design</b> . The <b>Offset</b> is stored as the X coordinate and the <b>Height offset</b> is stored as the Y coordinate.   |
|                      | <b>Profile, dist &amp; offset</b> | The point is defined by the distance from the start of the profile and an offset perpendicular to the design profile.  |



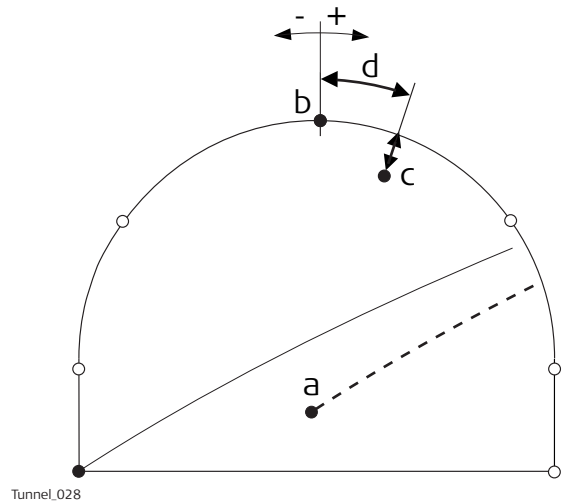
| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



- a Centreline
- b Profile offset
- c Distance from start of design profile

**Dist from top&offset**

The point is defined by the distance from the top of the tunnel and an offset perpendicular to the design profile.



- a Centreline
- b Top of profile
- c Offset perpendicular to the profile segment
- d Distance from the top of the profile

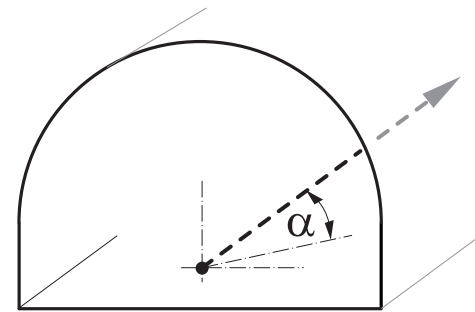
**Element & offset**

The point to stake out is defined by:

1. The number of the element on which the point lies
2. The percentage of the distance along the element of the point to stake out
3. The offset perpendicular to the design profile.

| Field  | Option          | Description  |
|--|-----------------|--|
| <p style="text-align: center; font-size: small;">Tunnel_020</p> <p style="text-align: center;"> a Centreline<br/> b Point defining start of design profile<br/> c Offset perpendicular to profile segment<br/> d Distance from start of start point of segment in %<br/> e Start point of segment </p> |                 |  |
| <b>Offset</b>  | Editable field  | Applies a horizontal offset perpendicular to the centreline. Available for <b>Offset method: Offset &amp; height.</b>  |
| <b>Height off-set</b>  | Editable field  | Applies a vertical offset to the centreline. Available for <b>Offset method: Offset &amp; height.</b>  |
| <b>Point ID</b>  | Selectable list | Available for <b>Offset method: Point from design.</b>   |
| <b>Profile distance</b>  | Editable field  | The distance from start of design profile. Available for <b>Offset method: Profile, dist &amp; offset.</b>   |
| <b>Top distance</b>  | Editable field  | The distance from the top of the tunnel. Available for <b>Offset method: Dist from top&amp;offset.</b>   |
| <b>Profile off-set</b>   | Editable field  | The offset from the design profile. Available for <b>Offset method: Profile, dist &amp; offset, Offset method: Dist from top&amp;offset and Offset method: Element &amp; offset.</b> |
| <b>Profile increment</b>   | Editable field  | To increment the distance for offset definitions as distance and offset. Available for <b>Offset method: Profile, dist &amp; offset and Offset method: Dist from top&amp;offset.</b> |
| <b>Element number</b>  | Editable field  | Element number 1 is the first element of the design profile. Available for <b>Offset method: Element &amp; offset.</b>   |
| <b>% of element</b>  | Editable field  | Distance in percentage terms of the measured point along the design profile element. Available for <b>Offset method: Element &amp; offset.</b>                                       |

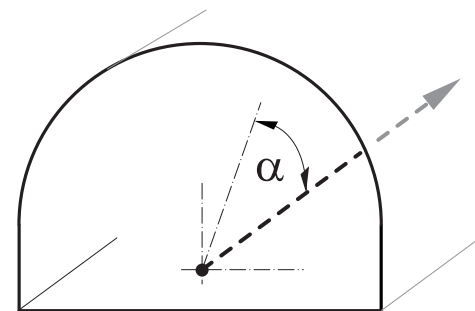
| Field                    | Option         | Description   |
|--------------------------|----------------|---|
| <b>Check offset</b>      | Editable field | Available for <b>Stake: Check profile</b> . Applies a horizontal offset perpendicular to the centreline used for comparing to the measured point. |
| <b>Check height diff</b> | Editable field | Available for <b>Stake: Check profile</b> . Applies a vertical offset to the centreline used for comparing to the measured point.                 |
| <b>Drill hz angle</b>    | Editable field | The horizontal direction 0 is along the centreline of the tunnel alignment.   |



Tunnel\_034

$\alpha$  **Drill hz angle**

|                             |                |   |
|-----------------------------|----------------|---|
| <b>Drill vertical angle</b> | Editable field | The vertical direction 0 is along the centreline of the tunnel alignment. |
|-----------------------------|----------------|---|



Tunnel\_035

$\alpha$  **Drill vertical angle**

For **Check tunnel**

| Field                    | Option         | Description   |
|--------------------------|----------------|---|
| <b>Check offset</b>      | Editable field | Applies a horizontal offset perpendicular to the centreline used for comparing to the measured point. |
| <b>Check height diff</b> | Editable field | Applies a vertical offset to the centreline used for comparing to the measured point.                 |

**Next step**

**Page** changes to the next page.

**Stake Face/  
Stake Profile**



This page is available for Stake tunnel only.

This page displays the differences between the measured point and the defined point. The position of the point to stake is reached when all difference values are close to zero.

Refer to [Stake Face/Stake Profile,page,Check Profile,page](#) for a description of keys.

Refer to [54.4 Staking Out](#) for a description of the elements of the graphical display.

#### Description of fields

| Field                          | Option       | Description   |
|--------------------------------|--------------|---|
| Chainage                       | Display only | The current chainage.   |
| CL offset                      | Display only | Perpendicular horizontal offset from the centreline.          |
| Nearest vertical tangent point | Display only | Distance to the nearest vertical tangent point of the design. |

#### Next step

Page changes to the [i](#) page.

**Stake Face/  
Stake Profile/  
Check Profile/  
Scan Profile,  
[i](#) page**

The [i](#) page displays the differences between the measured and design data. The fields viewed on this page are configurable.

Refer to [46.3.10 Tunnel - Info Page - TS](#) for information on all available items for the [i](#) page and how to select them.

### 50.3.2

#### Stake face

##### Stake face

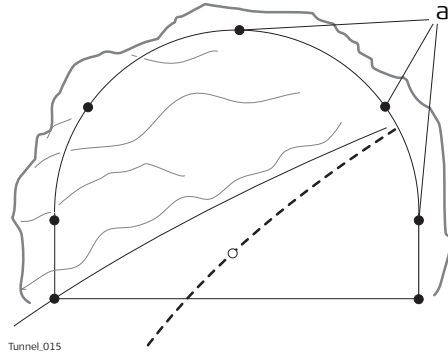
##### Overview

When excavating a tunnel, it is required to stake out the tunnel portal before excavation can begin. For excavation methods other than those involving tunnel boring machines (TBMs), it is required to stake out the tunnel face at given intervals during the excavation.

The tunnel face can be staked out at any time within the Tunnel app using **Stake face**.

This function allows the staking out of a series of points perpendicular to the horizontal alignment. The horizontal alignment indicates the position of the design profile at the chainage of the tunnel face.

### Cross section view



a Points to stake out

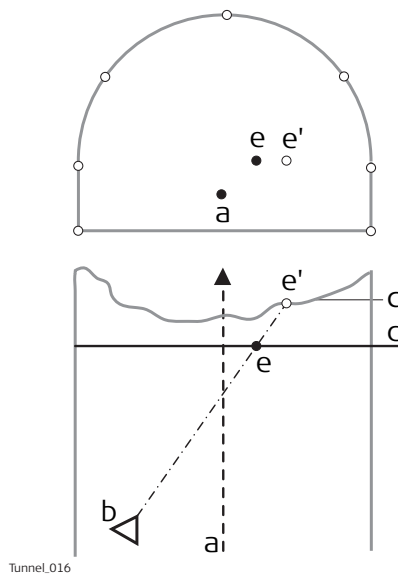
Given that it is likely that a degree of rock debris is present at the tunnel face or that inexact excavation techniques such as blasting are used, it cannot be assumed that the tunnel face at any stage of the excavation is perpendicular to the horizontal alignment.

This situation in turn implies that we cannot stake out a point on the tunnel face at a given chainage as the chainage of the tunnel face at any particular point is unknown. Iterative techniques are necessary to enable any defined point on the tunnel face to be staked out accurately.

The **Stake face** function involves setting out a point on the tunnel face at this unknown chainage. First of all the point to stake out on the tunnel face is staked out at an approximate chainage (e).

The point is defined by offsets regarding the centreline or by its position along the design profile and its offset from the profile. Given that the excavated tunnel face does not intersect the defined chainage, another point (e') is measured.

### First iteration

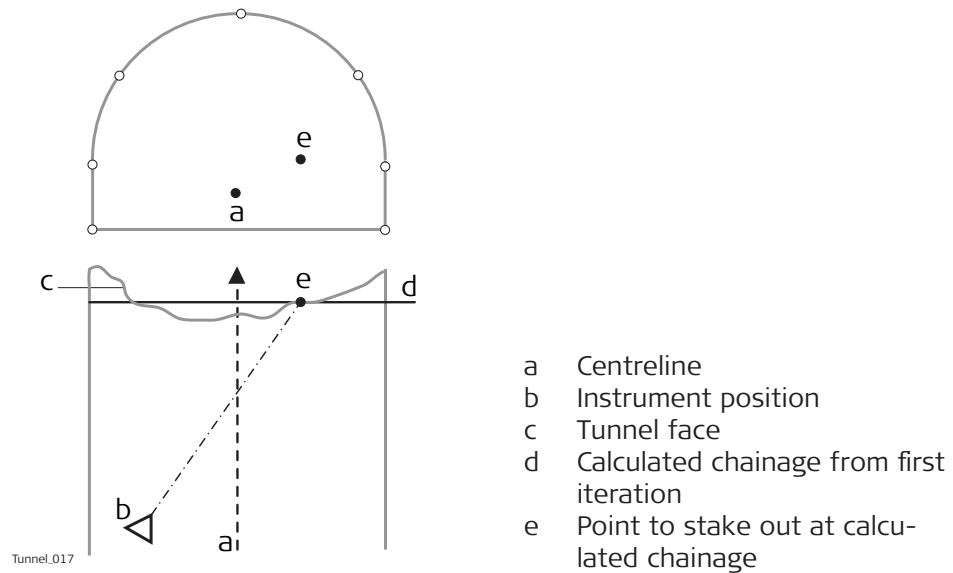


- a Centreline
- b Instrument position
- c Tunnel face
- d Approximate chainage to stake out
- e Point to stake out at approximate chainage
- e') Point to stake out on tunnel face

The true chainage of the measured point of the first iteration (e') is then calculated. The defined point (e) is staked out at the calculated chainage (d).

## Second iteration

This process is repeated until the differences between staked point and the defined point are within a defined tolerance.



## Drilling rig orientation

### Description

This functionality helps to orientate the drilling rig when drilling holes parallel to the tunnel axis or using a drilling pattern, that is manual entry of drill direction.

### Drilling rig orientation step-by-step with Drilling rig orientation: Parallel to alignment

1. Make sure that **Stake tunnel** and **Stake: Stake face** is selected.
2. In **Tunnel Settings, Tunnel design** page, set **Drilling rig orientation: Parallel to alignment**. Refer to [Road Settings, Tunnel design page](#).
3. In the **Define** panel check **Check Jumbo position** and type in the values. Refer to [Defining the Work](#).
4. If **Drilling rig orientation: Parallel to alignment** was selected in **Tunnel Settings, Tunnel design** page and **Check Jumbo position** was checked in the **Define** panel, then proceed to define the drill entry position on the tunnel face by entering the respective centreline offset in **Stake Face**, [📍](#) page.
5. In **Stake Face, General** page, enter the approximate tunnel face chainage. To position the laser pointer to the drill entry point press **FnPosition** to find the point.
6. Position the drill bit to the laser point on the tunnel face.
7. Now the jumbo boom moves onto line between the laser point on wall and the telescope so that the laser now points at the back of the boom. Press **Fn Tools**. Select **Check Jumbo position** to get the delta angles which are used by the drilling rig to move the boom parallel to the alignment.

- $\alpha$  Horizontal angle
- $\beta$  Vertical angle

### Drilling rig orientation step-by-step with Drilling rig orientation: Drill Pattern

1. Make sure that **Stake tunnel** and **Stake: Stake face** is selected.


---

2. In **Tunnel Settings, Tunnel design** page, set **Drilling rig orientation: Drill Pattern**. Refer to [Road Settings, Tunnel design page](#).


---


3. In the **Define** panel, check **Drilling rig orientation** and select the app of the drill pattern. Refer to [Defining the Work](#).

---

4. If **Apply drill pattern from: Defined Chainage** was selected, then proceed to define the drill entry position for the measured chainage by entering the defined chainage centreline offsets in the **Stake Face**,  page and the drill angles according to the defined chainage.

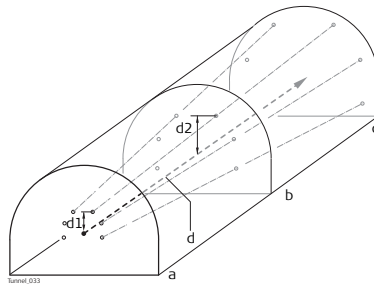
---

5. In the **Stake Face**,  page, enter the defined chainage value in the **Stake chainage** editable field. To position the laser pointer correctly on the measured tunnel face press **Fn Position**.


 The delta chainage value after using **Fn Position** is the difference between the defined and measured chainage. It is normal if the delta is large. The delta position and delta height values after this step should equal zero.

6. Position the drill bit to the laser point on the tunnel face.

#### Example:



- a Chainage 10
- b Chainage 15
- c Chainage 20
- d Centreline
- d1 **Height offset** at defined chainage 10
- d2 **Height offset** at defined chainage 15

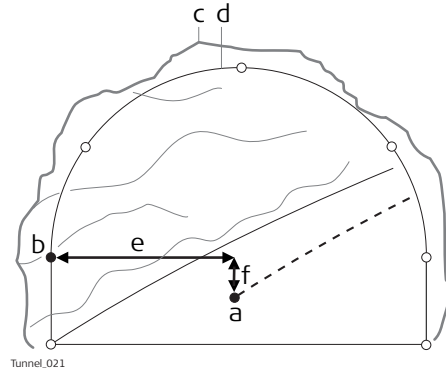
 Stake face point 1 at chainage 10 (point1). Stake face point 1 at chainage 15 as defined at chainage 10. Position and direction at chainage 15 are a result of the **Offset, Height offset** and drilling angles as defined for chainage 10.

7. Now the jumbo boom moves onto line between the laser point on wall and the telescope so that the laser now points at the back of the boom. Press **Fn Tools**. Select **Check Jumbo position** to get the delta values which are used by the drilling rig to move the boom for the correct drilling direction.

### 50.3.3

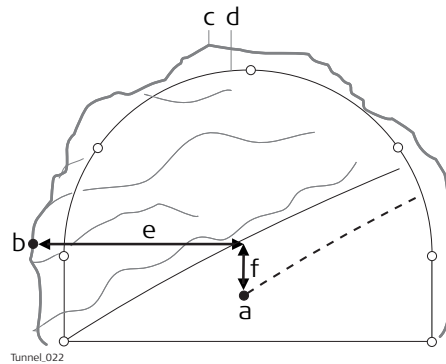
### Stake profile and Check profile

#### Stake/Check point on surface



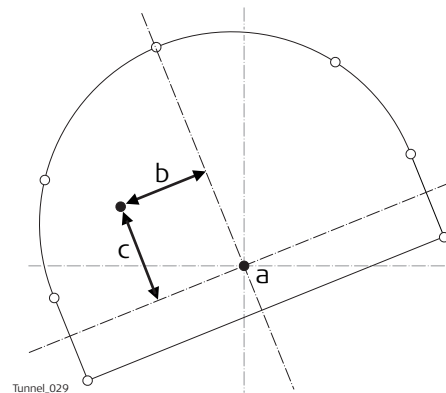
- a Centreline
- b Design point to stake out
- c Excavated profile
- d Design profile
- e Centreline offset
- f Centreline height difference

If it is not possible to stake out the defined point between successive iterations, the instrument will maintain the chainage and height difference from the vertical alignment fixed. The horizontal offset from the centreline to calculate the new position of the point are modified. The point that will be staked out will thus maintain the defined chainage and height difference but will have a modified offset value from the centreline.



- a Centreline
- b Point to stake out on excavated profile
- c Excavated profile
- d Design profile
- e Centreline offset
- f Centreline height difference

#### Rotated profile



- a Centreline
- b Rotated centreline offset
- c Rotated centre height difference

### 50.3.4

### Scan profile

#### Overview

A tunnel surface is scanned in detail during construction and/or at the completion of construction to detect overbreak, underbreak and/or to create an 'as built plan' of the finished tunnel surface.



**Scan profile** allows measuring a user-defined number of tunnel profiles along an existing tunnel alignment.

It can be defined:

- Whether to scan the whole tunnel profile or just a segment of it.
- The interval between measurements around the profile.

It does not matter if a design profile exists in the job or not.



If the job does not contain a design profile, then before scanning the defined scan area the instrument will first scan a profile at the instrument chainage.



For a description of the **Scan Profile, Scan area** page, refer to [50.3.1 Overview](#).

### During a scan

#### During a scan

- **Next point:** To skip the point being measured and move onto the next profile point.
- **Profile +:** To stop scanning the current profile and move onto the next profile.
- **Temp:** To enter a temporary scan interval.

### Pause and options before continuing

It is possible to end the scan once started using **Stop**. To pause the scan, for example to allow passing site traffic through, use **Pause**.

Once the scan has been paused, several options are available before continuing:

- **Stop:** To end the scan.
- **Resume:** To continue the scan at the next position.
- **Manual:** To interrupt the current scan so aiming can be done manually and points added.
- **Auto:** After measuring points manually, press **Auto** to continue scanning where you finished before pressing **Manual**.

### Define Temp Scan Interval

By pausing the current scan and pressing **Fn Temp**, a temporary scan interval can be entered. All scan segments being scanned at the defined temporary scan interval until the **Define Temp Scan Interval** panel is reentered and **Use a temporary scan interval** is unchecked.

#### Description of fields

| Field                                | Option         | Description   |
|--------------------------------------|----------------|---|
| <b>Use a temporary scan interval</b> | Check box      | If this box is checked, then scanning stops and any defined scan interval is ignored and replaced by the temporary scan interval. |
| <b>Temporary scan interval</b>       | Editable field | How often a point is measured around a profile.   |

### Invalid measurements

This process is repeated until the measured point is within the chainage limit or the maximum number of iterations has been reached.

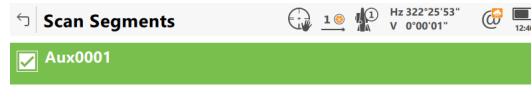
Invalid measurement situations could occur, for example:

- in irregular tunnel surfaces, where the horizontal alignment is formed by a curve with a small radius.
- if the end distance or start distance defined in **Scan Profile, Scan area** page were too large.

## Scan Segments

If **Define a scan task: Scan segments** was selected in the **Define** panel, then the **Scan Segments** panel allows creating, editing or deleting scan segments.

Check one or multiple segments for scanning.



| Key    | Description  |
|--------|--|
| OK     | To continue to <b>Scan Profile</b> after defining the scan segments. |
| New    | To create a scan segment.  |
| Edit   | To edit a defined scan segment.                                      |
| Delete | To delete a defined scan segment.                                    |

### Description of metadata

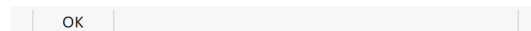
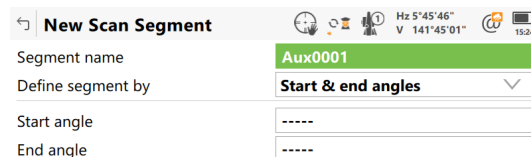
| Metadata | Description               |
|----------|---------------------------|
| -        | Name of the scan segment. |

### Next step

**New** to access **New Scan Segment**.

### New Scan Segment

This panel allows the definition of one or multiple segments of the scan profile as opposed to scanning the whole profile.





When defining the scan segment, define the start and end angles in the station profile. The vertical circle values are used not the horizontal circle values so transit the telescope between face 1 and 2 as needed.

| Key             | Description  |
|-----------------|--|
| <b>OK</b>       | To store the defined scan segment and return to <b>Scan Segments</b> .   |
| <b>Distance</b> | To measure the distance to points at the starting angle and the end angle of a segment. When <b>Start angle</b> or <b>End angle</b> is highlighted, set the vertical circle values by aiming the telescope at the relevant point and press <b>Distance</b> . |
| <b>Position</b> | To review the position of the segment once it has been defined. The instrument turns to the corresponding angle. Available when <b>Start angle</b> or <b>End angle</b> is highlighted.   |

#### Description of fields

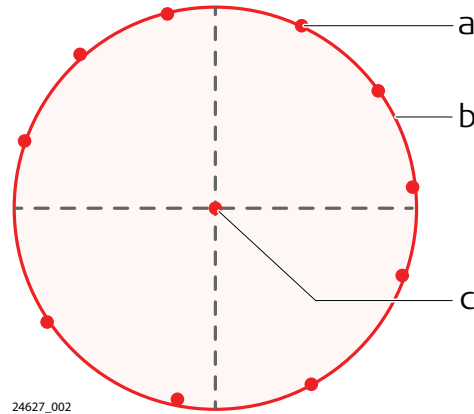
| Field  | Option                              | Description   |
|--|-------------------------------------|---|
| <b>Segment name</b>                              | Editable field                      | The name of the scan segment.   |
| <b>Define segment by</b>                         | <b>Start &amp; end angles</b>       | To define the segment to be scanned by a start and an end angle.  |
|  | <b>Element n° &amp; element (%)</b> | To scan the same location on multiple layers of the tunnel. Define the segment to be scanned based on the element number and the element in percent.  |
| <b>Start angle</b>                               | Editable field                      | Available for <b>Define segment by: Start &amp; end angles</b> .<br>The angle measured to the point at the beginning of the segment.<br>Highlight this field, aim at the start of the segment and press <b>Distance</b> to see the angle value in this field. |
| <b>End angle</b>                                 | Editable field                      | Available for <b>Define segment by: Start &amp; end angles</b> .<br>The angle measured to the point at the end of the segment.<br>Highlight this field, aim at the end of the segment and press <b>Distance</b> to see the angle value in this field.         |
| <b>Starting element n° and Ending element n°</b> | Editable field                      | Element number of the design profile elements where the scanning begins and stops.  |
| <b>Starting element % and Ending element %</b>   | Editable field                      | Distance in percentage terms of the measured point along the design profile element.  |

Overview

The method calculates the displacements between the tunnel design centreline and the calculated centre point of a measured profile.

Measurement and calculation

When the points are measured along the profile the application calculates the centre point using least square method.



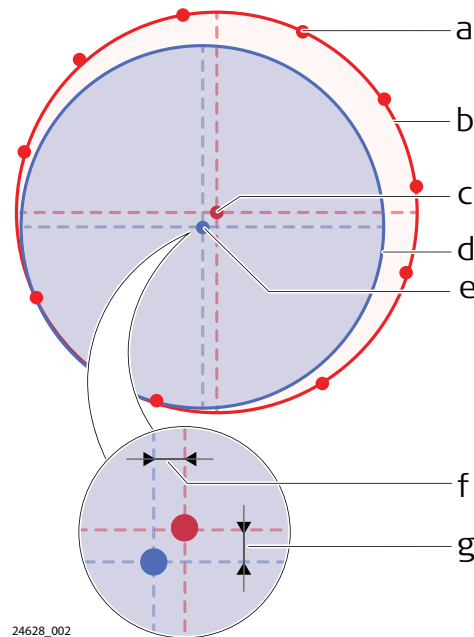
- a Measured point
- b Tunnel profile calculated from the measured points
- c Tunnel centreline calculated from the measured points

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Comparison to design

After the centre point is calculated, the displacements between the tunnel design centreline and the calculated point are shown.

The calculated points are stored in the database. HeXML schema 2.0 is updated with the new point results.



- a Measured point
- b Tunnel profile calculated from the measured points
- c Tunnel centreline calculated from the measured points
- d Design tunnel profile
- e Design tunnel centreline
- f **CL offset:** Centreline offset between measurement and design
- g **CL height difference:** Centreline height difference between measurement and design

24628\_002

Number of point to measure, page

| Key      | Description  |
|----------|--|
| Measure  | To measure a distance and store distance and angles. |
| Distance | To measure a distance.                               |

| Key                | Description  |
|--------------------|--|
| <b>Store</b>       | To store angles and distance. Distance must be measured before.                              |
| <b>Calculate</b>   | Available after measuring three or more target points. The calculated results are displayed. |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .                 |
| <b>Fn Display</b>  | To configure what is displayed in the 3D viewer.   |
| <b>Fn Filter</b>   | To define sort and filter settings. Refer to <a href="#">7.6 Point Sorting and Filters</a> . |
| <b>Fn Tools</b>    | To access the toolbox. Refer to <a href="#">48.4 The Toolbox</a> .                           |

#### Description of fields

| Field                | Option         | Description                                       |
|----------------------|----------------|---|
| <b>Point ID</b>      | Editable field | The point identifier of the point to be measured. |
| <b>Target height</b> | Editable field |   |

#### Next step

**Page** changes to the **Offsets** page.

#### Tunnel Axis Results, Results page

#### Description of fields

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Point ID</b>             | Editable field | The point identifier of the point for the centreline calculated from the measurements.   |
| <b>Chainage</b>             | Display only   | The chainage of the point for the centreline.  |
| <b>CL offset</b>            | Display only   | The horizontal offset to the centreline for the calculated point. <ul style="list-style-type: none"> <li>Negative<br/>Calculated point is to the left of the horizontal alignment.</li> <li>Positive<br/>Calculated point is to the right of the horizontal alignment.</li> </ul>      |
| <b>CL height difference</b> | Display only   | The height difference between the calculated point for the centreline and the design. <ul style="list-style-type: none"> <li>Negative<br/>The calculated point is below the vertical alignment.</li> <li>Positive<br/>The calculated point is above the vertical alignment.</li> </ul> |
| <b>Radius</b>               | Display only   | Radius of the tunnel profile calculated from the measurements.   |
| <b>Easting and Northing</b> | Display only   | Coordinates of the point for the centreline calculated from the measurements.  |

### Next step

Page changes to the **Quality** page.

## Tunnel Axis Results, Quality page

### Description of fields

| Field  | Option       | Description   |
|--|--------------|---|
| <b>Used points</b>                             | Display only | The number of points used in the calculation.<br>On the <b>Targets</b> page, measured point can be included or excluded from the calculation. |
| <b>Quality CL offset (<math>\sigma</math>)</b> | Display only | Standard deviation of the horizontal offset of the calculated point for the centreline from the design.                                       |
| <b>Quality height (<math>\sigma</math>)</b>    | Display only | Standard deviation of the height difference between the calculated point for the centreline and the design.                                   |
| <b>Quality radius (<math>\sigma</math>)</b>    | Display only | Standard deviation of the radius of the tunnel profile calculated from the measurements.  |
| <b>Quality plane (<math>\sigma</math>)</b>     | Display only | Standard deviation of the coordinates of the point for the centreline calculated from the measurements.                                       |

### Next step

Page changes to the **Targets** page.

## Tunnel Axis Results, Targets page

| Key                      | Description   |
|--------------------------|---|
| <b>Use</b>               | To set <b>Yes</b> or <b>No</b> in the metadata for excluding/including the highlighted point. |
| <b>Page</b>              | To change to another page on this panel.  |
| <b>FnSettings</b>        | To configure the app. Refer to <a href="#">46.3 Configuring Roads Apps</a> .                  |
| <b>Fn All or Fn None</b> | To change the setting for the metadata for all points at once.                                |

### Description of metadata

| Metadata           | Description  |
|--------------------|--|
| -                  | Displays the name of the measured points.  |
| <b>Use</b>         | For <b>Yes</b> : The selected point is used in the calculation.<br>For <b>No</b> : The selected point is not used in the calculation.  |
| <b>Plane diff</b>  | Perpendicular distance from the current point to the calculated plane from the square adjustment.  |
| <b>Radius diff</b> | How much the calculated radius differs at that position. <ul style="list-style-type: none"><li><b>Radius diff</b><br/>= [radius in current point] minus [calculated radius from the square adjustment]</li></ul> |

### Next step

Page changes to the **3D viewer** page.

Displayed is:

- Cross section
- 3D and planar view showing the measured points included in the calculation
- Calculated centre point
- Calculated profile
- Points included in the calculation. Other points are not shown.

## 50.3.6

### Tunnel Slice Scanning and Analysis

#### Overview

#### Application

Get accurate information on-site of the current status of the tunnel construction for a tunnel slice between two chainages of an alignment.

The scanned point cloud can be compared with one of these:

- Tunnel design
- Previously scanned version of the same area of the tunnel

#### Workflow

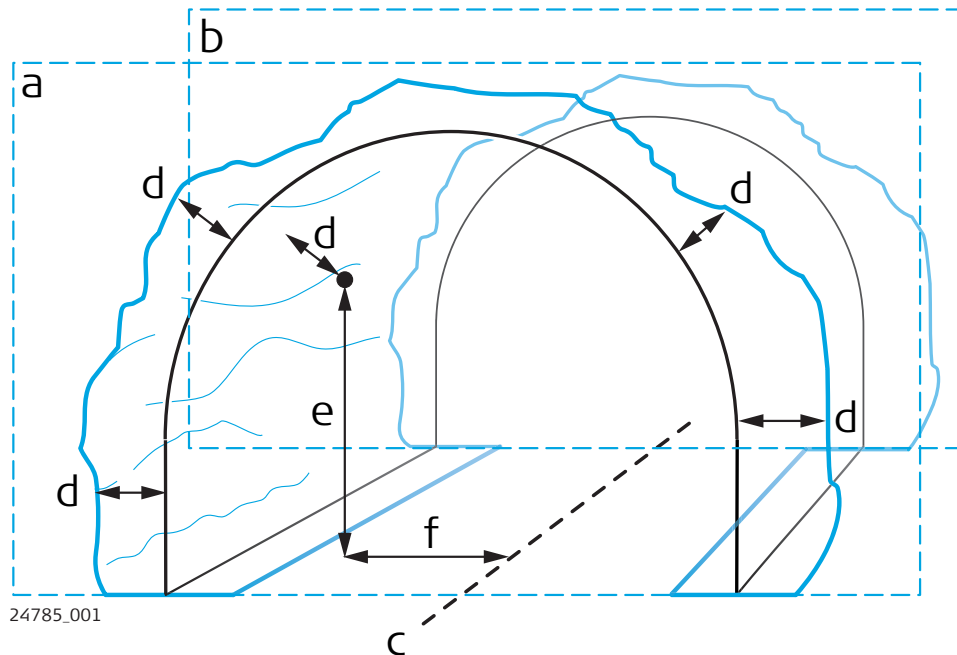
The workflow comprises two parts.

| Part | Task   | App to use                                   | Description   |
|------|--|--|---|
| 1.   | Scanning of the tunnel slice   | <b>Check tunnel</b><br>OR<br><b>Scanning</b> | Based on two chainages of the tunnel alignment selected, the software calculates the limits of the area or polygon defining the tunnel slice to be scanned.<br>For <b>Check tunnel</b> : Refer to the following paragraphs.<br>For <b>Scanning</b> : Refer to <a href="#">When using the Scanning app</a> . |
| 2.   | Comparing the on-site scanned point cloud with either the tunnel design or with an older as-built surface obtained for the same tunnel slice | <b>Inspect surfaces</b>                      | Add the alignment data. This design data is used as reference surface. Additional information regarding every consulted point from the 3D point cloud is calculated. For example chainage and offsets to the alignment. Refer to <a href="#">When using the Scanning app</a> .                              |



All scans to be surfaced and compared must be within the same job.

## Results - Calculated values



- a Starting chainage
- b Ending chainage
- c Exact chainage value on the alignment which corresponds to the selected point
- d Perpendicular distance between the measured point and the triangulated reference surface  
When comparing to a tunnel design: The difference between the current excavation and the designed tunnel surface  
When comparing to a scanned version of the same area of the tunnel: The thickness of the shotcrete  
Positive: The point is outside of the tunnel.  
Negative: The point is inside of the tunnel.
- e Vertical offsets from the selected point to the alignment  
Positive: Above the centreline  
Negative: Below the centreline
- f Horizontal offsets from the selected point to the alignment  
Positive: The point is to the right of the horizontal alignment.  
Negative: The point is to the left of the horizontal alignment.

### Access

1. **Leica Captivate - Home: Check tunnel.**
2. Follow the instructions in [50.2 Defining the Work](#).
3. After defining the settings in the **Define** screen, continue in this chapter.

### Scan Resolution

The resolution has a direct influence on the file size.

| Key         | Description  |
|-------------|--|
| <b>Next</b> | To accept changes and to continue with the subsequent panel within the wizard. |



| Key             | Description   |
|-----------------|---|
| <b>Distance</b> | Available when <b>Define spacing by: Distances</b> is selected. To take a distance measurement to any surface. The measured value is displayed in the <b>Slope distance</b> . |
| <b>Back</b>     | To return to the previous panel.  |

#### Description of fields

| Field  | Option           | Description  |
|--|------------------|--|
| <b>Define spacing by</b>                       | <b>Angles</b>    | Horizontal and vertical angle values define the scan resolution.   |
|  | <b>Distances</b> | Horizontal and vertical spacings at a certain range define the scan resolution.  |
| <b>H<sub>z</sub> and V</b>                     | Editable field   | Available for <b>Define spacing by: Angles</b> . The horizontal and vertical angle values defining the scan resolution.                    |
| <b>Slope distance</b>                          | Editable field   | Available for <b>Define spacing by: Distances</b> . The range for which the horizontal and vertical spacings are valid.                    |
| <b>Horizontal spacing and Vertical spacing</b> | Editable field   | Available for <b>Define spacing by: Distances</b> . The horizontal and vertical spacing defining the scan resolution at the defined range. |
| <b>Estimated points</b>                        | Display only     | The estimated number of points to be scanned according to the defined scan resolution.   |


#### Next step

**Next** changes to the next panel.

#### Advice

- The scan speed and range are fixed to 1000 pts/s and up to 300 m.
- Distance filters for the scan are unavailable since the defined polygon will not include point elements beyond or closer to the ending and starting chainages.

#### Scan Status, Progress page

| Key                   | Description   |
|-----------------------|---|
| <b>Start</b>          | To start scanning.  |
| <b>Stop</b>           | To end scanning. The already scanned points are stored in a file. The scan gets the status <b>Scan completed</b> . After stopping, the status is <b>In progress</b> . To continue a scan, use <b>Start scan</b> in the <b>Scanning</b> panel. Select the scan to re-start from the list.<br> In order to continue a scan, the setup must be identical. |
| <b>Pause and Scan</b> | To pause/re-start scanning. While pausing, the status of the scan is displayed as in progress.  |
| <b>Page</b>           | To change to another page on this panel.  |

### Description of fields

| Field                  | Option          | Description  |
|------------------------|-----------------|--|
| <b>Scan name</b>       | Selectable list | Then name of the first or current scan. Opening the listbox accesses <b>Select Scan</b> . Refer to <a href="#">Select Scan</a> . |
| <b>Points scanned</b>  | Display only    | The total number of scanned points.  |
| <b>% completed</b>     | Display only    | In percent, the number of scans taken against the total number of scans which must be taken.                                     |
| <b>Time remaining</b>  | Display only    | Estimated time remaining until the scan is finished.   |
| <b>Scans completed</b> | Display only    | Number of scans being measured / Number of total scans   |

### Select Scan

All scans which are defined or in progress are listed.

Check a box to include a scan.

Uncheck a box to exclude a scan.

The scans are measured in the same order as listed.

| Key         | Description                                     |
|-------------|---|
| <b>OK</b>   | To accept and store changes.                    |
| <b>Up</b>   | To move the highlighted scan one position up.   |
| <b>Down</b> | To move the highlighted scan one position down. |

### Description of metadata

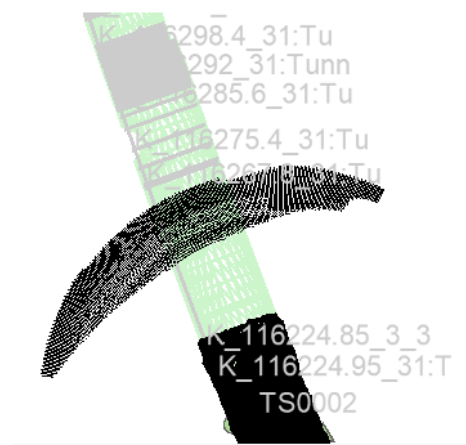
| Field                | Option             | Description   |
|----------------------|--------------------|---|
| -                    | Display only       | The name of the scan.   |
| <b>Status</b>        | <b>Defined</b>     | A scan definition is defined and the scanning has not been started. |
|                      | <b>In progress</b> | The scanning has been started and is ongoing.                       |
|                      | <b>Scanned</b>     | The scanning has been finished.                                     |
| <b>Time and Date</b> | Display only       | The time and the date of when the profile was stored.               |
| <b>No. points</b>    | Display only       | The number of points in the scan.                                   |

### Results

- The scanning result is stored as a normal scan as \*.sdb data file. Find it on the defined memory device in the folder DBX/Name of Job/Scans.
- The scan is later used in **Inspect surfaces** app to complete the comparison and get the desired values.



All scans to be surfaced and compared must be within the same job.



In **Scan Viewer, 3D viewer** page:

Grey:  
The content of the working job

Black:  
Scanning result

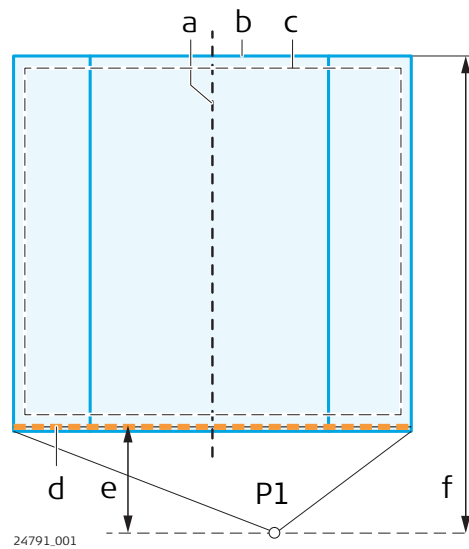
## When using the Scanning app

**Scanning** app can be used to create a scan of the tunnel slice.

- ☞ Setup and orientate the instrument properly since the measured slice is later compared to either with the design data or to another slice which was automatically extracted from the design data.

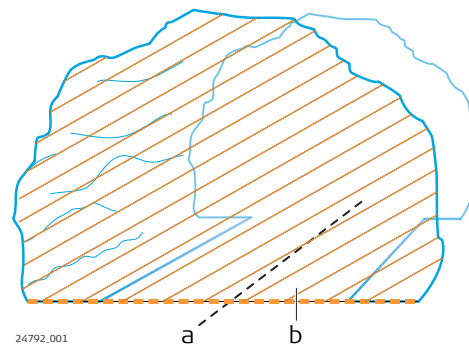
1. **Leica Captivate - Home: Scanning.**
2. Create a scan definition:  
In **Scanning**, select **Create scan definition**.
3. In **Choose Scanning Method**, select a scanning method.
4. For **Method: Polygonal area**:  
Define a window matching with the desired starting chainage. Regard the alignment as unknown. Since the window manually defined, no design data is needed.
5. In **Scan Resolution, Settings** page:  
In case the spacing for the scanning is done based on distances, an average distance is required in order to estimate the number of points included in the scan as well as the time it will take to complete it.  
Enter an averaged slope distance between the starting and ending chainages.
6. In **Scan Mode, Settings** page:  
Select **Scan speed: 1000 pts/s, up to 300 m**. Based on the task to carry out, the scanned points will not be further away than 300 m.
7. In **Scan Distance Filter, Settings** page:  
This part is crucial to avoid extra data. The distance filter is used to define a starting chainage and an ending chainage and therefore limit the tunnel slice. Every point outside of these limits is excluded from the scan.  
**Minimum distance** is equivalent to the starting chainage.  
**Maximum distance** is equivalent to the ending chainage.  
Enter the values manually or use **Distance** to measure.
8. **Finish** to complete the scan definition.
9. In **Scanning**, start scan.
10. Validate the scan once completed.
11. The scanned slice is usable in **Inspect surfaces** for the comparison.

### Top view



- a Centreline
- b Tunnel slice
- c Scanned area
- d Scanning window
- e Minimum distance = starting chainage
- f Maximum distance = ending chainage
- P1 Setup of total stations with scanning capability

### Front view



- a Centreline
- b Scanning window

### Next step

Start **Inspect surfaces** app to complete the comparison and get the comparison. Refer to [64 Inspect Surfaces](#).

## 50.4

### The Toolbox

### 50.4.1

### Profile Viewer

#### Availability

This menu function is available for the check method **Scan profile**.

This menu option is always available. The data that can be viewed depends on those data available in the job. It is independent of the currently measured **Scan Profile** points.



The measured profiles to be viewed must be saved in the job.

#### Access

1. Press **Fn Tools** in **Stake Face**.
2. Select **Profile Viewer** in **Stake Face Tools**.

## View at - Layer Name

| Time         | Date       | No. points |
|--------------|------------|------------|
| <b>1.437</b> | 25.02.2010 | 27         |
| 07:04:13     |            |            |
| <b>1.937</b> | 25.02.2010 | 26         |
| 06:46:29     |            |            |
| <b>2.437</b> | 25.02.2010 | 27         |
| 06:43:42     |            |            |
| <b>2.737</b> | 25.02.2010 | 28         |
| 07:08:19     |            |            |
| <b>3.037</b> | 25.02.2010 | 27         |
| 07:11:40     |            |            |
| <b>3.337</b> | 25.02.2010 | 28         |
| 07:16:56     |            |            |

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To confirm the settings and return to the <b>Scan Profile</b> panel.               |
| <b>Delete</b> | To delete the highlighted profile.   |
| <b>More</b>   | To display information about the time and the date of when the profile was stored. |
| <b>Page</b>   | To change to another page on this panel.   |

### Description of metadata

| Metadata             | Description   |
|----------------------|---|
| -                    | The chainage of the profile.                          |
| <b>No. points</b>    | The number of points in the profile.                  |
| <b>Time and Date</b> | The time and the date of when the profile was stored. |

## View at - Layer Name, 3D viewer page

Tap on the relevant point for selection. The information displayed shows the centreline offset, the delta height and delta profile of the point.

| Metadata            | Description       |
|---------------------|-------------------|
| <b>Diff to prof</b> | <b>0.7327 m</b>   |
| <b>CL offset</b>    | <b>-0.6301 m</b>  |
| <b>CL ht diff</b>   | <b>-0.8673 m</b>  |
| <b>Height</b>       | <b>417.7933 m</b> |

| Key                 | Description   |
|---------------------|---|
| <b>OK</b>           | To accept the settings and return to the <b>Scan Profile</b> panel.                 |
| <b>Ch - or Ch +</b> | To decrease/increase the chainage.  |
| <b>Page</b>         | To change to another page on this panel.  |
| <b>Fn Settings</b>  | To access 3D viewer settings. Refer to <a href="#">37.3 Configuring 3D viewer</a> . |
| <b>Fn Position</b>  | To position the TS to the defined point, including defined offsets.                 |

**Description**

To stakeout tunnel face points automatically. The surveyor configures and selects the points to use in the stakeout. The person driving the drilling machine can see the stakeout points looking to the current position of the laser.

**Availability**

This menu function is available for the stake method **Stake face**.  
This menu option is available if the defined chainage has a valid value.  
**Measure distance: Continuously** is supported.

**Access**

1. Press **Fn Tools** in **Stake Face**.
2. Select **Stake Face Auto** in **Stake Face Tools**.

**Stake Face Auto, General page**

| Key  | Description                                 |
|------|---|
| OK   | To access the <b>Stake Face Auto</b> panel. |
| Page | To change to another page on this panel.    |

**Description of fields**

| Field                               | Option          | Description   |
|-------------------------------------|-----------------|---|
| <b>Store staked points</b>          | Check box       | When this box is checked, the staked points are stored.   |
| <b>Wait time after staked point</b> | Check box       | When this box is checked, a time delay is active after staking a point and before staking the next point starts.  |
| <b>Delay</b>                        | Editable field  | The time delay after staking a point and before staking the next point starts. Available when <b>Wait time after staked point</b> is checked.   |
| <b>Verify orientation</b>           | Check box       | When this box is checked, the system checks orientation automatically in a defined interval. If the orientation error is greater than the defined <b>H<sub>z</sub> tolerance</b> , then the auto mode is stopped. |
| <b>Orientation job</b>              | Selectable list | A point for the orientation check can be selected from a job on a data storage device. Available when <b>Verify orientation</b> is checked.   |
| <b>Orientation point</b>            | Selectable list | The point ID of the point for the orientation check. Available when <b>Verify orientation</b> is checked.   |
| <b>H<sub>z</sub> tolerance</b>      | Editable field  | Tolerance for horizontal directions. If the orientation error is greater than the defined angle, then the auto mode is stopped. Available when <b>Verify orientation</b> is checked.                              |

**Stake Face Auto,  
Points page**

**Next step**

Page changes to the **Points** page.

Select the points to include in the stakeout.


| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To access the <b>Stake Face Auto</b> panel.   |
| <b>Use</b>  | To set <b>Yes</b> or <b>No</b> in the metadata for excluding/including the highlighted point. |
| <b>Page</b> | To change to another page on this panel.  |

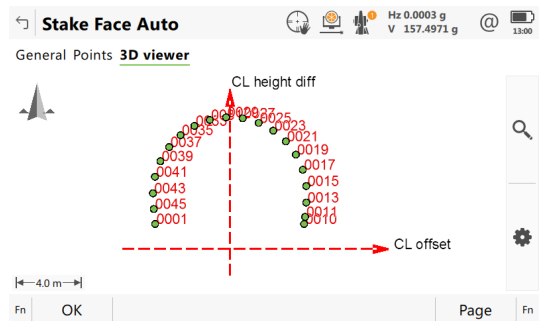
**Description of metadata**

| Metadata                    | Description   |
|-----------------------------|---|
| -                           | Displays the name of all points in the selected <b>Tunnel job</b> .   |
| <b>Use</b>                  | For <b>Yes</b> : The selected point is used for stake.<br>For <b>No</b> : The selected point is not used for stake. |
| <b>CL offset</b>            | The horizontal offset of the point from the layer centreline.   |
| <b>CL height difference</b> | The height difference of the point to the layer centreline.   |

**Next step**

3D viewer shows a cross section, profile and planar view of the design data at the selected chainage.

| IF  | THEN   |
|---|--|
| a single point is to be selected/deselected | tap on the point.  |
| multiple points are to be selected          | click the  icon, drag the stylus in a diagonal line to make a rectangular area. |



**Stake Face Auto**

When **Stake face auto** is activated, the measurement panel opens. In a loop, all selected points are automatically staked indefinitely until the measurement is stopped, or the orientation check is out of tolerance.

| Key           | Description                        |
|---------------|------------------------------------|
| <b>Stop</b>   | To stop the automatic stakeout.    |
| <b>Pause</b>  | To pause the automatic stakeout.   |
| <b>Resume</b> | To restart the automatic stakeout. |

| Key         | Description   |
|-------------|---|
| Back        | To select the previous point.   |
| Forward     | To select the next point.   |
| Page        | To change to another page on this panel.                                  |
| Fn Settings | To access settings. Refer to <a href="#">46.3 Configuring Roads Apps.</a> |
| Fn Display  | To configure what is displayed in 3D viewer.                              |

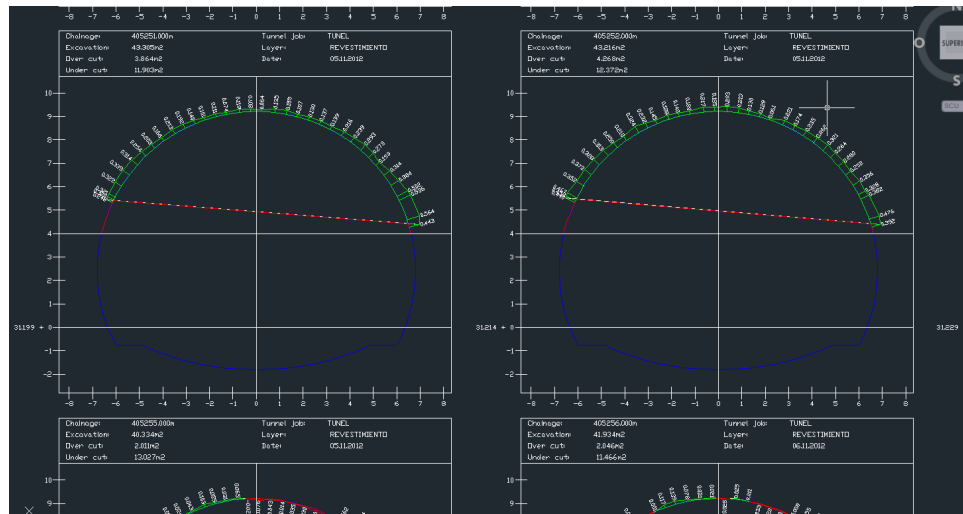
### 50.4.3

### Export DXF Profiles

#### Description

To export the measured profiles against the selected tunnel section in a DXF file.

Example of a result:



#### Availability

This menu function is available for the check method **Scan profile**.

#### Access

1. Press **Fn Tools** in **Scan Profile**.
2. Select **Export Dxf Profiles** in **Scan Profile Toolbox**.

#### Export Dxf Profiles

| Key         | Description                 |
|-------------|-----------------------------|
| OK          | To accept the settings.     |
| Fn Settings | To define what is exported. |

#### Description of fields

| Field     | Option          | Description   |
|-----------|-----------------|---|
| To folder | Selectable list | Defines if the data is exported to the \DATA directory or to the folder where the selected job is located.  |
| To device | Selectable list | Available for <b>To folder: Data</b> . Defines which data storage device the data is exported to.           |
|           | Display only    | Available for <b>To folder: Same as job</b> . Displays the data storage device of the selected <b>Job</b> . |



| Field                                    | Option         | Description   |
|--|----------------|---|
| <b>Working job</b>                       | Display only   | Data is stored to this job.   |
| <b>Tunnel job</b>                        | Display only   | Contains all the information about the tunnel design including the geometry of the centreline and the tunnel profile. The files are stored in the \DBX folder or a subfolder of \DBX.<br><br>The tunnel job is a read-only source of information. |
| <b>Layer</b>                             | Display only   | The layer from the active tunnel job, selected in the <b>Define</b> panel.  |
| <b>Start chain-age and End chain-age</b> | Editable field | Define the range from which DXF profiles are exported.  |
| <b>Report sheet</b>                      | Editable field | The name of the file to which the data is exported.   |

#### Next step

**Fn Settings** goes to **Dxf Export Settings**.

#### Dxf Export Settings

| Key | Description   |
|-----|---|
| OK  | To save the settings and return to <b>Export Dxf Profiles</b> . |

#### Description of fields

| Field                              | Option         | Description  |
|------------------------------------|----------------|--|
| <b>Columns</b>                     | Editable field | The number of columns to organise the DXF. Example: With <b>4</b> selected, four profiles are exported per line.   |
| <b>Export excavation areas</b>     | Check box      | When this box is checked, the excavation areas of the tunnel are exported.   |
| <b>Close the measured profiles</b> | Check box      | When this box is checked, the exported profiles are closed for display purposes.   |
| <b>Use a comparison plane</b>      | Check box      | When this box is checked, a plane is added to the export file for comparison purposes. The plane is added in the defined difference from the centreline. |
| <b>CL height diff</b>              | Editable field | Height difference from the centreline.   |
| <b>Use a profile offset filter</b> | Check box      | When this box is checked, only the profiles for which the perpendicular offset to the design profile is smaller than the defined limit are exported.     |
| <b>Offset limit</b>                | Editable field | Maximum horizontal offset from defined profile.  |

# 51

## Scanning

### 51.1

#### Accessing Scanning

##### Availability

Available for MS60 R2000 and on CS when connected to MS60 R2000.

##### Access

Select **Leica Captivate - Home: Scanning**.

##### Scanning

Depending on the status of the job and the instrument setup, the icons are active or not. If a new job and a new setup have been created, then only **Create scan definition** and **Scan settings** are active.

##### When using the Scanning app for tunnel slicing

Refer to [50.3.6 Tunnel Slice Scanning and Analysis](#) for a description and required settings.

### 51.2

#### Defining a Scan

##### Access


Select **Create scan definition** in **Scanning**.  
The wizard starts.


##### Create Scan Definition

A unique name for the new scan definition. The name can be up to 16 characters long and include spaces. Input required.  
**Next** changes to the next panel.

##### Choose Scanning Method

##### Description of fields

| Field  | Option                  | Description  |
|--------|-------------------------|--|
| Method | <b>Rectangular area</b> | <p>Select one of the following options to define a scan area.</p> <p>Area defined by upper left and lower right corner. Either turn the telescope manually. Or use the automatic tap and turn functionality. Refer to <a href="#">37.6 Context Menu</a>.</p> <p>If the first point is the top left corner, then the second point is then to the bottom right corner point.</p> <p>Or the first corner is the bottom left corner point and the second point is then the top right corner point.</p> |
|        | <b>Polygonal area</b>   | <p>Area defined by three or more corners in clockwise direction. Either point the telescope to the corners (current position of the crosshair). Or draw the polygonal scan area on the <b>Camera</b> page.</p> <p> The scan can be done including or excluding the zenith. Without zenith, the horizon area is scanned.</p>   |

| Field | Option                     | Description  |
|-------|----------------------------|--|
|       | <b>Manually entered</b>    | To define a scan area manually by typing in the horizontal and vertical value of two diagonal corners of a rectangle.<br><br> If scan definitions have already been defined from the current instrument setup, the scan areas are displayed on the <b>Camera</b> page in <b>Manually Entered Extents</b> . A new scan area can be defined in addition to the existing scan areas. |
|       | <b>Band scan area</b>      | A band scan is a 360° scan between two elevation angles. Define the two elevation angles by an upper and lower limit. A dome cap scan is a special form of a band scan. The upper limit is 0°, defined when pressing <b>Zenith</b> in first definition panel . Define the lower limit by pointing.   |
|       | <b>Full dome scan area</b> | The scan area is the full field of view of the instrument.   |
|       | <b>Re-use definition</b>   | To scan an area with the same or different scan settings a second time.<br>Benefits: <ul style="list-style-type: none"> <li>• Fast scan area definition</li> <li>• Easy comparison of the derived point clouds</li> </ul>  |

#### Next step

| IF  | THEN  |
|---|---|
| <b>Rectangular area, Polygonal area or Band scan area</b> is selected | a camera view panel opens. Refer to <a href="#">Camera view</a> .   |
| <b>Manually entered</b> is selected                                   | type in the horizontal and vertical value of two diagonal corners of a rectangle.                                 |
| <b>Full dome scan area</b> is selected                                | <b>Next</b> changes to the <b>Scan Resolution</b> panel. Refer to <a href="#">Scan Resolution</a> .               |
| <b>Re-use definition</b> is selected                                  | <b>Next</b> changes to the <b>Choose Scan Definition</b> panel. Refer to <a href="#">Choose Scan Definition</a> . |

#### Camera view

The scan area can be defined on the camera view of the telescope camera and overview camera. Switching between both cameras is possible.







#### Description of keys










| Key         | Description  |
|-------------|--|
| <b>Next</b> | Available when defining rectangular areas or when using band scan. To accept the selected point and to continue with the subsequent panel within the wizard. |






| Key               | Description   |
|-------------------|---|
|                   | Available when defining a scan area manually. To accept the defined extension of the scan area and to continue with the subsequent panel within the wizard. |
| <b>Add</b>        | Available when defining polygonal areas. To add the current crosshair position as a next point to the polygonal area.                                       |
| <b>Distance</b>   | To correct the parallax by taking a distance measurement to any surface. The crosshair style changes from the coarse style to the fine style.               |
| <b>Zenith</b>     | Available for <b>Method: Band scan area</b> .<br>To define the dome cap scan and set the upper limit to 0.  |
| <b>Done</b>       | Available when defining polygonal areas. To confirm the defined scan area and to proceed to the subsequent panel. At least three points must be defined.    |
| <b>Back</b>       | To return to the previous panel where the definition mode can be selected.  |
| <b>Fn Display</b> | To configure the camera view. Refer to <a href="#">Configuring Scanning</a> .   |

### Description of icons

Icons are available in a toolbar on the right side of the panel.

| Icon  | Hardware keys   | Description   |
|---|---|---|
|   |   | Camera view<br>To switch to the telescope camera. The style of the crosshairs changes with the camera in use.   |
|  |   | Camera view<br>To switch to the overview camera. The style of the crosshairs changes with the camera in use.  |
|  | <b>NAVIGATE</b>   | For plan and orbital view, the viewing volume is stored with the job. When another app is opened, the same viewing volume is used.  |
|  |   | Single autofocus<br>To activate a single autofocus. Single autofocus deactivates continuous autofocus. Same functionality as pressing the autofocus button on the side cover of the instrument. |
|   |  | While continuous autofocus is active, any manually measured distance updates the focus position.  |
|  |   | Continuous focus on<br>To switch on continuous autofocus.   |

| Icon  | Hardware keys     | Description   |
|---|-------------------|---|
|    | 2                 | Zoom +<br>To zoom into the image.   |
|    | 3                 | Zoom -<br>To zoom out of the image.   |
|    | <b>SETTINGS</b>   |   |
|    |                   | CAD layers<br>To turn layers of background maps (CAD files) on and off. Refer to <a href="#">6.2 Creating a New Job</a> for information on CAD files.   |
|    |                   | Settings<br>To define the display settings. Change the crosshair colour, what is displayed in the 3D viewer, separately to the plan or orbital views.   |
|   |                   | Data range<br>To define a range from the eye point by a minimum and maximum distance. Only data within the range is displayed.<br><br>Top slider<br>The maximum distance from the eyepoint, for example set to 400.<br>Bottom slider<br>The minimum distance from the eyepoint, for example set to 10.<br>Result<br>Points between 10 m and 400 m from the eyepoint are displayed on the image.<br><br> To move the slider, tap on the slider, hold and drag it. |
| <b>CAMERA</b>   |                   |   |
|  |                   | Capture image<br>To take an image with the active camera.   |
|  | <b>BRIGHTNESS</b> |   |

| Icon  | Hardware keys | Description   |
|---|---------------|---|
|  |               | Auto Bright<br>To turn on automatic brightness.   |
|  |               | Bright +<br>To increase the brightness from the current value.  |
|  |               | Bright -<br>To decrease the brightness from the current value.  |
|  |               | Remove last point<br>To delete the last selected point of the polygonal area.   |
|  |               | Remove all points<br>To delete the whole boundary of the polygonal area and to restart the definition of the polygonal scan area. |

## Choose Scan Definition

| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.   |
| <b>More</b> | To change between the date, the time, the status, the source and the number points of the scans.   |
| <b>Next</b> | To confirm the selection and to continue to the next panel. The scan can be repeated with the same or with different settings.<br>For different settings, the original scan settings are suggested and can be modified according to the new needs. |

### Description of metadata

| Metadata          | Description  |
|-------------------|--|
|                   | The name of the scan.  |
| <b>Time</b>       | The time the measured scan was stored.   |
| <b>Date</b>       | The date the measured scan was stored. The format is as defined in <b>Regional, Time</b> page. |
| <b>No. points</b> | Number of points included in the selected scan.  |
| <b>Status</b>     | Indicates is a scan is only Defined, In progress or Scanned.                                   |

## Scan Resolution

The resolution has a direct influence on the file size.

| Key             | Description   |
|-----------------|---|
| <b>Next</b>     | To accept changes and to continue with the subsequent panel within the wizard.  |
| <b>Distance</b> | Available when <b>Define spacing by: Distances</b> is selected. To take a distance measurement to any surface. The measured value is displayed in the <b>Slope distance</b> . |
| <b>Back</b>     | To return to the previous panel.  |

#### Description of fields

| Field  | Option           | Description  |
|--|------------------|--|
| <b>Define spacing by</b>                       | <b>Angles</b>    | Horizontal and vertical angle values define the scan resolution.   |
|  | <b>Distances</b> | Horizontal and vertical spacings at a certain range define the scan resolution.  |
| <b>Hz and V</b>                                | Editable field   | Available for <b>Define spacing by: Angles</b> . The horizontal and vertical angle values defining the scan resolution.                    |
| <b>Slope distance</b>                          | Editable field   | Available for <b>Define spacing by: Distances</b> . The range for which the horizontal and vertical spacings are valid.                    |
| <b>Horizontal spacing and Vertical spacing</b> | Editable field   | Available for <b>Define spacing by: Distances</b> . The horizontal and vertical spacing defining the scan resolution at the defined range. |
| <b>Estimated points</b>                        | Display only     | The estimated number of points to be scanned according to the defined scan resolution.   |

#### Next step

**Next** changes to the next panel.

#### Scan Mode

| Key             | Description                         |
|-----------------|-------------------------------------|
| <b>Next</b>     | To accept and record the scan mode. |
| <b>Distance</b> | To measure and display distances.   |
| <b>Back</b>     | To return to the previous panel.    |

#### Description of fields

| Field             | Option                                    | Description   |
|-------------------|---|---|
| <b>Scan speed</b> | <b>Approximately 1 pt/s, up to 1000 m</b> | <ul style="list-style-type: none"> <li>• 1 Hz long range mode</li> <li>• Range up to 1000 m</li> <li>• Optimal for long range applications</li> </ul>                 |
|                   | <b>62 pts/s, up to 500 m</b>              | <ul style="list-style-type: none"> <li>• 62 Hz scanning mode</li> <li>• Range up to 500 m</li> <li>• Optimal for use when accuracy and range are critical.</li> </ul> |

| Field                                   | Option                                 | Description   |
|---|--|---|
|   | <b>250 pts/s,<br/>up to 400 m</b>      | <ul style="list-style-type: none"> <li>• 250 Hz scanning mode</li> <li>• Range up to 400 m</li> <li>• Optimal for use when time and accuracy are critical</li> </ul>  |
|   | <b>1000 pts/s,<br/>up to 300 m</b>     | <ul style="list-style-type: none"> <li>• 1000 Hz scanning mode</li> <li>• Range up to 300 m</li> </ul>  |
|   | <b>4000 pts/s,<br/>up to 200 m</b>     | <ul style="list-style-type: none"> <li>• 4000 Hz scanning mode</li> <li>• Range up to 200 m</li> </ul>  |
|   | <b>8000 pts/s,<br/>up to 150 m</b>     | <ul style="list-style-type: none"> <li>• 8000 Hz scanning mode</li> <li>• Range up to 150 m</li> </ul>  |
|   | <b>30000<br/>pts/s, up to<br/>60 m</b> | <ul style="list-style-type: none"> <li>• 30000 Hz scanning mode</li> <li>• Range up to 60 m</li> </ul>  |
| <b>Scan axis</b>                        | Display only                           | The scan axis defines the primary scanning axis of the instrument.<br>For <b>Method: Manually entered, Method: Rectangular area</b> and <b>Method: Polygonal area</b> , the scan axis is vertical.<br>For <b>Method: Band scan area</b> and <b>Method: Full dome scan area</b> , the scan axis is horizontal. |
| <b>Time required</b>                    | Display only                           | The time needed for the scan.   |
| <b>Average scan distance (optional)</b> | Editable field                         | Slope distance to the scanning object. This distance is optional. By knowing the distance to the object, the system optimises the scanning speed.   |

#### Next step

**Next** changes to the next panel.

#### Scan Distance Filter

| Key           | Description                      |
|---------------|----------------------------------|
| <b>Finish</b> | To exit the wizard.              |
| <b>Back</b>   | To return to the previous panel. |

#### Description of fields

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Only scan objects within a distance range</b> | Check box      | When this box is checked, only objects within the defined distance range are scanned. |
| <b>Minimum distance</b>                          | Editable field | Minimum distance of the scan distance.  |
| <b>When distance changed by</b>                  | Editable field | Maximum distance of the scan distance.  |



### Next step

**Finish** to exit the wizard.

## 51.3

### Configuring Scanning

#### Access

Select **Scan settings** in **Scanning**.

#### Scan Settings

| Key | Description                    |
|-----|--------------------------------|
| OK  | To return to <b>Scanning</b> . |

#### Description of fields

| Field  | Option    | Description  |
|--|-----------|--|
| <b>Store signal to noise ratio (SNR) values with scan points</b>           | Check box | When this box is checked, the value of the <b>Signal to Noise Ratio</b> of the returned signal is stored as additional information to the scan area. |
| <b>Store scan area on panoramic image (if panoramic image is captured)</b> | Check box | When this box is checked, the scan area is laid over the image and stored with the image when a panoramic image is captured.                         |
| <b>Pause scanning when a message is shown</b>                              | Check box | When this box is checked, a scan is paused when a message is shown.  |
| <b>Apply filter to minimise mixed pixels</b>                               | Check box | When this box is checked, an algorithm to reduce mixed pixels is applied to the scan.  |
| <b>Apply filter to optimise the point cloud</b>                            | Check box | When this box is checked, the filter creates an optimum of the point cloud regarding data quality.   |

## 51.4


### Starting a Scan

#### Access

Select **Start scan** in **Scanning**.

#### Scan Status, Progress page

| Key          | Description        |
|--------------|--------------------|
| <b>Start</b> | To start scanning. |

| Key                   | Description  |
|-----------------------|--|
| <b>Stop</b>           | To end scanning. The already scanned points are stored in a file. The scan gets the status <b>Scan completed</b> .<br>After stopping, the status is <b>In progress</b> .<br>To continue a scan, use <b>Start scan</b> in the <b>Scanning</b> panel.<br>Select the scan to re-start from the list.<br> In order to continue a scan, the setup must be identical. |
| <b>Pause and Scan</b> | To pause/re-start scanning.<br>While pausing, the status of the scan is displayed as in progress.  |
| <b>Page</b>           | To change to another page on this panel.   |

#### Description of fields

| Field                  | Option          | Description  |
|------------------------|-----------------|--|
| <b>Scan name</b>       | Selectable list | Then name of the first or current scan.<br>Opening the listbox accesses <b>Select Scan</b> .<br>Refer to <a href="#">Select Scan</a> . |
| <b>Points scanned</b>  | Display only    | The total number of scanned points.  |
| <b>% completed</b>     | Display only    | In percent, the number of scans taken against the total number of scans which must be taken.   |
| <b>Time remaining</b>  | Display only    | Estimated time remaining until the scan is finished.   |
| <b>Scans completed</b> | Display only    | Number of scans being measured / Number of total scans   |

## Select Scan

All scans which are defined or in progress are listed.

Check a box to include a scan.

Uncheck a box to exclude a scan.

The scans are measured in the same order as listed.

| Key         | Description                                     |
|-------------|---|
| <b>OK</b>   | To accept and store changes.                    |
| <b>Up</b>   | To move the highlighted scan one position up.   |
| <b>Down</b> | To move the highlighted scan one position down. |

#### Description of metadata

| Field         | Option             | Description   |
|---------------|--------------------|---|
| -             | Display only       | The name of the scan.   |
| <b>Status</b> | <b>Defined</b>     | A scan definition is defined and the scanning has not been started. |
|               | <b>In progress</b> | The scanning has been started and is ongoing.                       |
|               | <b>Scanned</b>     | The scanning has been finished.                                     |

| Field                | Option       | Description   |
|----------------------|--------------|---|
| <b>Time and Date</b> | Display only | The time and the date of when the profile was stored. |
| <b>No. points</b>    | Display only | The number of points in the scan.                     |

## Description

Sets of Angles:

- This app is used to measure multiple sets of directions and distances (optional) to pre-defined target points in one or two faces.
- The mean direction and mean distance (optional) to each target point, within a set is calculated. The residual for each direction and distance (optional) within a set is also calculated.
- The reduced average direction and average distance (optional) to each target point, for all active sets is calculated.
- Coordinates to each target point are calculated using the reduced average direction and average distance (optional).

Monitoring:

- This module is integrated within the Sets of Angles program.
- With this module, it is possible to use a timer to enable repeated and automated angle and distances measurements to pre-defined target points at defined intervals.

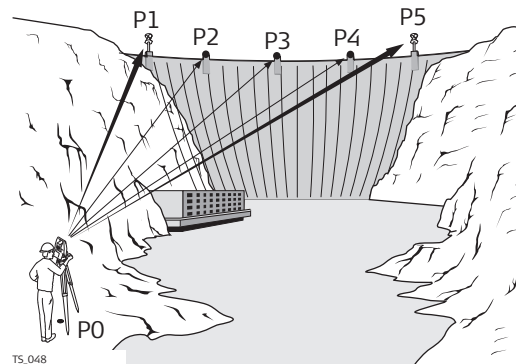


If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).



**AP tilt compensation** cannot be used.

## Diagram

**Known:**

- P1 Pre-defined target point - E,N,Height (optional)
- P2 Pre-defined target point - E,N,Height (optional)
- P3 Pre-defined target point - E,N,Height (optional)
- P4 Pre-defined target point - E,N,Height (optional)
- P5 Pre-defined target point - E,N,Height (optional)

**Unknown:**

- a Mean direction and mean distance (optional) to each target point, within a set
- b Mean coordinates (optional) for each target point, for all active sets
- c Residual for each direction and distance (optional), within a set
- d Reduced average direction and average distance (optional) to each target point, for all active sets

## Automatic aiming

Automatic aiming (search and measurements) can be performed to a prism. After completing the first measurements to each target point, the measurements to the target points in subsequent sets are automated.

## Setup and orientation

To record oriented grid coordinates, setup and orientation are required before starting the Measure sets app.

## Point averaging

Sets of Angles points are never calculated as an average, even if a measured point of class **Measured** already exists with the same point ID.

## 52.2

### Sets of Angles

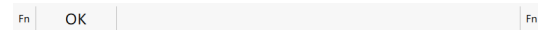
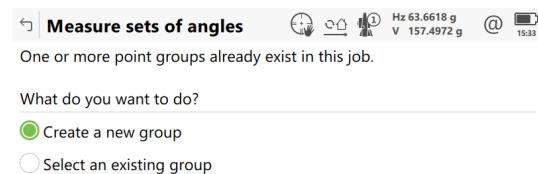
### 52.2.1

### Accessing Sets of Angles

#### Access

Select **Leica Captivate - Home: Measure sets.**

#### Measure sets of angles



| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To select the highlighted option and to continue with the next panel.                             |
| <b>Fn Settings</b> | To configure the Sets of Angles app. Refer to <a href="#">52.2.2 Configuring Sets of Angles</a> . |

#### Description of options

| Options                         | Description   |
|---------------------------------|---|
| <b>Create a new group</b>       | To define the target points. Refer to <a href="#">52.2.3 Creating New Point Groups</a> .  |
| <b>Select an existing group</b> | To select, edit and manage a points group of the target points for the survey. Refer to <a href="#">52.2.4 Managing Existing Point Groups</a> . |

### 52.2.2

### Configuring Sets of Angles

#### Access

Select **Leica Captivate - Home: Measure sets.** Press **Fn Settings**.

#### Settings, Parameters page

The explanations for the softkeys given here are valid for all pages, unless otherwise stated.

Settings Hz 63.6619 g  
V 157.4972 g 15:34

Parameters Tolerances Defaults Report sheet

Page to show **Measure** ▾

Stop for messages **All messages** ▾

Time out **No time out** ▾

Re-measure points **Never** ▾

Sort points by Hz angle


Define time when sets should be measured (timer monitoring)

OK Edit Page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Edit</b> | To edit the page currently being displayed. Available when a list item in <b>Page to show</b> is highlighted. Refer to <a href="#">27.2 User defined pages</a> . |
| <b>Page</b> | To change to another page on this panel.   |

### Description of fields

| Field                    | Option                   | Description  |
|--------------------------|--------------------------|--|
| <b>Page to show</b>      | Selectable list          | The names of the available pages.  |
| <b>Stop for messages</b> | <b>All messages</b>      | To define what action is taken when a message panel appears during a measurement set.<br>All message panels are displayed as per normal and are closed as defined by the settings in <b>Time out</b> .   |
|                          | <b>Tol exceeded only</b> | Only the message panel relating to the exceeding of tolerances is displayed and is closed as defined by the settings in <b>Time out</b> .  |
|                          | <b>Never stop</b>        | No message panels are displayed except for specific warnings.<br>Specific warnings which affect the instrument and its ability to continue with the monitoring process is displayed and remains on the panel. These warnings include the overheating of the instrument, low battery levels, or unavailable space on the data storage device. |
| <b>Time out</b>          | <b>No time out</b>       | To define the time delay for the automatic closing of message panels during a measurement set. This selectable list is not available when <b>Stop for messages:Never stop</b> .<br>There is no automatic closure, only by user interaction in a message panel. When a message panel appears, press <b>Yes</b> to close.                      |
|                          | <b>1sec to 60sec</b>     | All message panels are automatically closed as defined by these individual time settings.  |

| Field  | Option               | Description   |
|--|----------------------|---|
| <b>Re-measure points</b>   |                      | To define the action if a target point cannot be measured.  |
|  | <b>Never</b>         | The target point is skipped and the next target point in the list is measured.  |
|  | <b>Automatically</b> | The measurement to the target point is repeated automatically.<br> The option for <b>Measure distance</b> in <b>Measure &amp; Target</b> is also changed for the repeated measurement. If the option is changed, then it is applied to all following sets. |
|  | <b>Manually</b>      | The measurement to the target point can be repeated manually or the target point can be skipped.  |
| <b>Sort points by Hz angle</b>                                     | Check box            | Check this box to sort the target points automatically. The instrument works in a clockwise direction and finds the shortest path to move between the target points.  |
| <b>Define time when sets should be measured (timer monitoring)</b> | Check box            | When this box is checked, automatic monitoring of target points is activated.   |
|  |                      | When this box is not checked, automatic monitoring of target points is not activated. The Sets of Angles app applies.   |

#### Next step

**Page** changes to the **Tolerances** page.

#### Settings, Tolerances page

#### Description of fields


| Field                     | Option         | Description  |
|---------------------------|----------------|--|
| <b>Use tolerances</b>     | Check box      | If checked, the entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements. |
| <b>Hz tolerance</b>       | Editable field | Tolerance for horizontal directions.   |
| <b>V tolerance</b>        | Editable field | Tolerance for vertical directions  |
| <b>Distance tolerance</b> | Editable field | Tolerance for distances.   |

#### Next step

**Page** changes to the **Defaults** page.

Define the default target properties for points that are added to the point group by importing.

**Description of fields**

| Field   | Option                | Description  |
|---|-----------------------|--|
| <b>Target height</b>  | Editable field        | The default prism height.  |
| <b>Target</b>   | Selectable list       | Target names as configured in the <b>Targets</b> panel.  |
| <b>Leica constant</b>                                       | Display only          | The additive constant as stored for the selected prism in the Leica Captivate software.  |
| <b>Aim at target</b>  | <b>Manually</b>       | Measurements are done without any automation. ATRplus search and/or ATRplus measurement are not performed.   |
|   | <b>Automatic</b>      | Positioning to static prisms. The ATRplus sensor is used for measurements to static prisms. If needed, an ATRplus measurement or ATRplus search is performed after pressing <b>Measure</b> or <b>Distance</b> .  |
|   | <b>With lock</b>      | The instrument locks onto and follows the moving prism. The ATRplus sensor is used to follow moving prisms and to find prisms after loss of lock. Depending on the setting for <b>Measure distance</b> , single or continuous measurements are performed. Unavailable for SmartStation.  |
| <b>Enhance target recognition for misty rain conditions</b> | Check box             | Available on TS16, TS60, MS60 and TM60 with <b>Aim at target: Automatic</b> or <b>Aim at target: With lock</b> .<br>When this box is checked, the instrument measuring ability in misty rain conditions is increased. This setting is automatically deactivated when the instrument is turned off. If weather conditions are normal, then uncheck the box. |
|   |                       |  Configure a hot key or favourites menu to <b>TS - Toggle enhanced target recognition on/off to activate/deactivate the setting..</b>   |
| <b>Visibility</b>   |                       | Available when a CS20 is connected to a TS15/TS50/TM50/MS50.<br>TS13/TS16/TS60/MS60/TM60 automatically adjust the settings for optimal performance.  |
|   | <b>Good</b>           | If weather conditions are normal, then select this mode.   |
|   | <b>Rain &amp; fog</b> | To increase the instrument measuring ability during suboptimal weather conditions. This mode is automatically deactivated when the instrument is turned off.   |



| Field                               | Option                       | Description  |
|-------------------------------------|------------------------------|--|
|                                     | <b>Sun &amp; reflections</b> | To increase the instrument measuring ability during incident solar radiation and reflections, for example safety vests. This mode has a considerable influence on the range (restriction 100 - 150 m). This mode is automatically deactivated when the instrument is turned off. |
| <b>Use ultra fine aiming</b>        | Check box                    | Reduces the field of view of the ATRplus. The setting is only applied for <b>Aim at target: Automatic</b> .  |
| <b>Automatically measure points</b> | Check box                    | Check this box to survey the target points automatically. The instrument turns automatically and measures the target point. For instruments with automatic aiming.   |

#### Next step

**Page** changes to the **Report sheet** page. Refer to [38 Apps - General](#).

### 52.2.3

### Creating New Point Groups

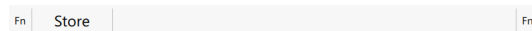
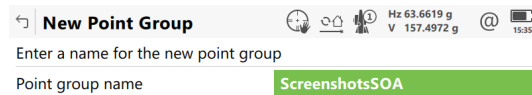
#### Description

The points to be used for Sets of Angles can be selected and the first set measured. The measurement settings of the first measurement to each point are used for all further sets.

#### Access

Highlight **Create a new group** in **Measure sets of angles** and **OK**.

#### New Point Group



| Key                | Description                          |
|--------------------|--------------------------------------|
| <b>Store</b>       | To store the new points group.       |
| <b>Fn Settings</b> | To configure the Sets of Angles app. |

#### Description of fields

| Field                   | Option         | Description                   |
|-------------------------|----------------|-------------------------------|
| <b>Point group name</b> | Editable field | The name of the points group. |

#### Add Points To Group

| Key       | Description   |
|-----------|---|
| <b>OK</b> | To select the checked option and to continue with the next panel. |

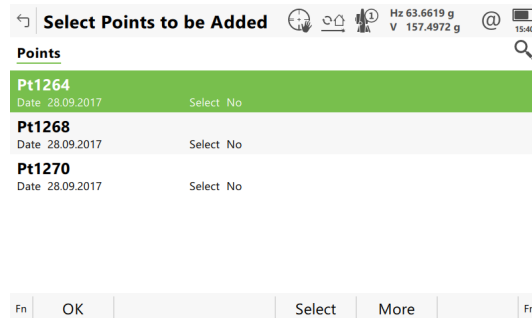
## Description of options

| Option                                  | Description  |
|---|--|
| <b>Measure points</b>                   | When this box is checked, the points to be used for Sets of Angles can be measured.  |
| <b>Use within a set of measurements</b> | Available when <b>Measure points</b> is checked. To select the measuring sequence.   |
| <b>Add individual points from a job</b> | When this box is checked, a design job can be selected. Individual points can be selected from this job. Refer to <a href="#">Select Points - Measure, Sets page</a> . |
| <b>Add all points from a job</b>        | When this box is checked, a design job can be selected. All points from the design job are added to the point group by pressing <b>OK</b> .                            |

## Select Points to be Added, Points page



The points are sorted in alphabetical order. To sort points by horizontal angle, check **Sort points by Hz angle** in **SettingsParameters**, page.



| Key                      | Description   |
|--------------------------|---|
| <b>OK</b>                | To store the points to the group.   |
| <b>Select</b>            | To change the setting for the <b>Select</b> metadata for the highlighted point.   |
| <b>More</b>              | To display information about the 3D coordinate quality, the class, Easting, Northing and Elevation, the time and the date of when the point was stored, |
| <b>Page</b>              | To change to another page on this panel.  |
| <b>Fn All or Fn None</b> | To change the setting for the <b>Select</b> metadata for all scans at once.   |

## Next step

In **3D viewer**, the points from the list are displayed in black. The other points from the job are displayed in grey.

## Define Points for Set

Define Points for Set

Points measured: 0

Point ID: TS0001

Target height: 1.500 m

Target: Leica round prism

Leica constant: 0.0 mm

Measure distance: Once

Aim at target: Manually


Automatically measure points:

Fn OK Done Fn

| Key         | Description   |
|-------------|---|
| OK          | To measure the entered point and to access <b>Select Points - Measure</b> .               |
| Done        | To finish selection of points and access <b>Measure sets of angles</b> for further steps. |
| Fn Settings | To configure the Sets of Angles app.  |
| Fn Get Pt   | To select points from the design job.   |

### Description of fields

| Field            | Option               | Description  |
|------------------|----------------------|--|
| Measure distance | Once                 | When a single measurement with high precision is required.   |
|                  | Once & fast          | When a single measurement is required but the time to survey must be minimised. The highest accuracy is of less importance. Use this setting for example when performing, "typical" topographical surveys.   |
|                  | Continuously         | When continuous distance measurements are required. Performs a linear interpolation between the previous and following angle measurement, based on the timestamp of the EDM measurement. Using this interpolation procedure, a higher accuracy for all dynamic applications is possible.   |
|                  | Repeatedly & average | When an average of several measurements is required. Repeats measurements in standard measuring mode. The average distance of <b>Number of distances</b> and the standard deviation for the averaged distance are calculated. Use this setting for example when performing cadastral survey where rigid guidelines must be followed. |
|                  | Greater than 4km     | When long distances to prisms are needed. Use this setting for example for triangulation measurements.   |

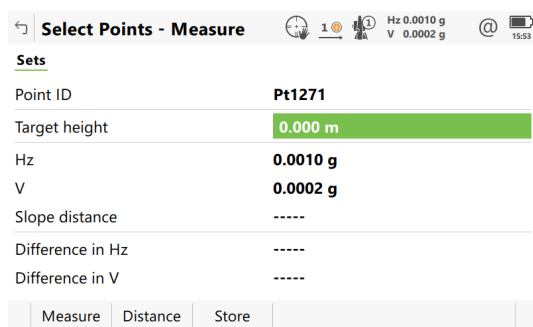
| Field   | Option                            | Description  |
|---|-----------------------------------|--|
|   | <b>Greater than 4km &amp; avg</b> | Whenever long distances to prisms are needed but in addition, average values and standard deviations for multiple precise distance measurements are required.<br><br>Use this setting for example when performing triangulation measurements within a cadastral survey where rigid guidelines must be followed.  |
|   | <b>With highest precision</b>     | Available on TS60/TM60. Fine measuring for highest precision measurements with prisms.   |
| <b>Aim at target</b>  | <b>Manually</b>                   | Measurements are done without any automation. ATRplus search and/or ATRplus measurement are not performed.   |
|   | <b>Automatic</b>                  | Positioning to static prisms. The ATRplus sensor is used for measurements to static prisms. If needed, an ATRplus measurement or ATRplus search is performed after pressing <b>Measure</b> or <b>Distance</b> .  |
|   | <b>With lock</b>                  | The instrument locks onto and follows the moving prism. The ATRplus sensor is used to follow moving prisms and to find prisms after loss of lock. Depending on the setting for <b>Measure distance</b> , single or continuous measurements are performed. Unavailable for SmartStation.  |
| <b>Enhance target recognition for misty rain conditions</b> | Check box                         | Available on TS16, TS60, MS60 and TM60 with <b>Aim at target: Automatic</b> or <b>Aim at target: With lock</b> .<br>When this box is checked, the instrument measuring ability in misty rain conditions is increased. This setting is automatically deactivated when the instrument is turned off. If weather conditions are normal, then uncheck the box.<br><br> Configure a hot key or favourites menu to <b>TS - Toggle enhanced target recognition on/off to activate/deactive the setting..</b> |
| <b>Use precise target aiming</b>                            | Check box                         | Available for the 0.5" instruments of TS60/TM60. When this box is checked, four ATRplus measurements are performed and the mean value out the measurements is considered for the angle value.  |
| <b>Use ultra fine aiming</b>                                | Check box                         | Reduces the field of view of the ATRplus. The setting is only applied for <b>Aim at target: Automatic</b> in <b>Measure &amp; Target</b> .   |

| Field                               | Option    | Description   |
|-------------------------------------|-----------|---|
| <b>Automatic-ly meas-ure points</b> | Check box | Available for instruments with automatic aiming and <b>Aim at target:Automatic</b> . If checked, search and measurements are done to specified targets in sets. |

### Next step

| IF   | THEN  |
|--|---|
| new or selected points are to be measured          | <b>OK</b> to access <b>Select Points - Measure</b> .    |
| existing points are to be selected                 | <b>Fn Get Pt</b> to select a point from the design job. |
| all desired points have been selected and measured | <b>Done</b> to return to the previous panel.            |

### Select Points - Measure, Sets page



| Key             | Description   |
|-----------------|---|
| <b>Measure</b>  | To measure and store the angles and distance, and to return to <b>Define Points for Set</b> . |
| <b>Distance</b> | To measure a distance.  |
| <b>Store</b>    | To store data and to return to <b>Define Points for Set</b> .                                 |
| <b>Page</b>     | To change to another page on this panel.  |

### Description of fields

| Field                   | Option       | Description  |
|-------------------------|--------------|--|
| <b>Difference in Hz</b> | Display only | Difference between the current horizontal angle and the horizontal angle to this target when selected.   |
| <b>AR diff</b>          | Display only | Available when <b>Hz angle display: Angle right</b> is configured in <b>Regional, Angle</b> page. Difference between the current angle right and the angle right to this target when selected. |
| <b>Difference in V</b>  | Display only | Difference between the current vertical angle and the vertical angle to this target when selected.   |

| Field                           | Option       | Description  |
|---------------------------------|--------------|--|
| <b>Difference in slope dist</b> | Display only | Difference between the current slope distance to the target and the slope distance to this target when selected. |

## 52.2.4

### Managing Existing Point Groups

#### Description

A point group of the target points for the survey can be selected.

#### Access

Highlight **Select an existing group** in **Measure sets of angles** and **OK**.

#### Existing Point Groups

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To continue with the next panel.  |
| <b>Fn Settings</b> | To configure the Sets of Angles app. Refer to <a href="#">52.2.2 Configuring Sets of Angles</a> . |

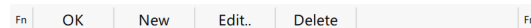
#### Description of fields

| Field                   | Option          | Description                                   |
|-------------------------|-----------------|---|
| <b>Point Groups</b>     | Selectable list | The name of the points group.                 |
| <b>Number of points</b> | Display only    | The number of points in the group.            |
| <b>Creation date</b>    | Display only    | The date of when the point group was created. |
| <b>Creation time</b>    | Display only    | The time of when the point group was created. |

#### Next step



**OK** to access **Point Groups**.

#### Point Groups



| Key           | Description                          |
|---------------|--------------------------------------|
| <b>OK</b>     | To continue with the next panel.     |
| <b>New</b>    | To create a point group.             |
| <b>Edit..</b> | To edit the highlighted point group. |
| <b>Delete</b> | To delete an existing points group.  |

## Edit Point Group, Points page

| Key   | Description  |
|---|--|
| <b>Store</b>  | To store the points to the group.  |
| <b>Add points</b>   | To add points to the group.  |
| <b>Edit</b>   | To view or change the settings for a point.  |
|  | <b>Previous</b> to display the previous point of the point group. Available unless the beginning of the list is reached. |
|  | <b>Next</b> to display the next point in the list of points. Available unless the end of the list is reached.            |
| <b>More</b>   | To display information about the date, the 3D coordinate quality, the point code, the target height and fine aiming.     |
| <b>Page</b>   | To change to another page on this panel.   |
| <b>Fn Remove 1</b>  | To remove all points from the group.   |
| <b>Fn Remove all</b>  | To remove the highlighted point from the group. The point itself is not deleted.   |

### 52.2.5

### Measuring the Sets

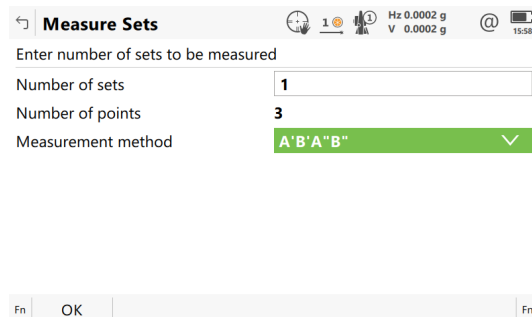
#### Description

The points defined in the point group are measured with the defined measurement method and for the defined number of sets.

#### Access

Highlight **Measure Sets** in **Measure sets of angles** and **OK**.

#### Measure Sets



| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | Opens a panel to measure the points. When auto survey is activated, measurements are done automatically. |
| <b>Fn Settings</b> | To configure the Sets of Angles app. Refer to <a href="#">52.2.2 Configuring Sets of Angles</a> .        |

#### Description of fields

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| <b>Number of sets</b>   | Editable field | The number of sets to measure with the target points. The maximum of sets allowed is 200. |
| <b>Number of points</b> | Display only   | The number of target points.  |

| Field                     | Option             | Description   |
|---------------------------|--------------------|---|
| <b>Measurement method</b> |                    | Determines the order in which the target points are measured.   |
|                           | <b>A'A''B''B'</b>  | The target points are measured in face I and face II.<br>point A I - point A II - point B II - point B I ...  |
|                           | <b>A'A''B''B''</b> | The target points are measured in face I and face II.<br>point A I - point A II - point B I - point B II ...  |
|                           | <b>A'B'A''B''</b>  | The target points are measured in face I and face II.<br>point A I - point B I... point A II - point B II ... |
|                           | <b>A'B''B''A''</b> | The target points are measured in face I and face II.<br>point A I - point B I... point B II - point A II...  |
|                           | <b>A'B'C'D'</b>    | The target points are only measured in face I.<br>point A I - point B I - point C I - point D I ...           |

### Next step

**OK** to measure further sets of the defined points.

### Set n of n, Pt n of n, Sets page

| Sets                                    |            |
|---|------------|
| Point ID                                | 1010       |
| Target height                           | 0.000 m    |
| Hz                                      | 262.6291 g |
| V                                       | 100.9850 g |
| Slope distance                          | -----      |
| Difference in Hz                        | -----      |
| Difference in V                         | -----      |
| Fn Measure Distance Store Skip Pause Fn |            |

| Key                    | Description  |
|------------------------|--|
| <b>Measure</b>         | To measure and store the angles and distances, and to increment to the next point. |
| <b>Distance</b>        | To measure a distance.   |
| <b>Store</b>           | To store data and to increment to the next point.                                  |
| <b>Skip</b>            | To skip measuring the displayed point and continue with the next point.            |
| <b>Pause or Resume</b> | To pause/re-start the set measurement.   |
| <b>Page</b>            | To change to another page on this panel.   |
| <b>FnDone</b>          | To end the measurements and to return to <b>Measure sets of angles</b> .           |



## Description of fields

| Field                            | Option                       | Description   |
|----------------------------------|------------------------------|---|
| <b>Difference in Hz</b>          | Display only                 | Difference between the current horizontal angle and the horizontal angle to this target when selected.  |
| <b>Difference in V</b>           | Display only                 | Difference between the current vertical angle and the vertical angle to this target when selected.  |
| <b>Difference in slope dist</b>  | Display only                 | Difference between the current slope distance to the target and the slope distance to this target when selected.  |
| <b>Aim at target</b>             | <b>Manually</b>              | Measurements are done without any automation. ATRplus search and/or ATRplus measurement are not performed.  |
|                                  | <b>Automatic</b>             | Positioning to static prisms. The ATRplus sensor is used for measurements to static prisms. If needed, an ATRplus measurement or ATRplus search is performed after pressing <b>Measure</b> or <b>Distance</b> .   |
|                                  | <b>With lock</b>             | The instrument locks onto and follows the moving prism. The ATRplus sensor is used to follow moving prisms and to find prisms after loss of lock. Depending on the setting for <b>Measure distance</b> , single or continuous measurements are performed. Unavailable for SmartStation. |
| <b>Visibility</b>                |                              | Available when a CS20 is connected to a TS15/TS50/TM50/MS50.<br>TS13/TS16/TS60/MS60/TM60 automatically adjust the settings for optimal performance.   |
|                                  | <b>Good</b>                  | If weather conditions are normal, then select this setting.   |
|                                  | <b>Rain &amp; fog</b>        | To increase the instrument measuring ability during suboptimal weather conditions. This setting is automatically deactivated when the instrument is turned off.   |
|                                  | <b>Sun &amp; reflections</b> | To increase the instrument measuring ability during incident solar radiation and reflections, for example safety vests. This setting has a considerable influence on the range (restriction 100 - 150 m). This setting is automatically deactivated when the instrument is turned off.  |
| <b>Use precise target aiming</b> | Check box                    | Available for instruments other than TS60/TM60/TM50/TS50/TS30. When this box is checked, four ATRplus measurements are performed and the mean value out the measurements is considered for the angle value.   |

| Field                                | Option    | Description   |
|--------------------------------------|-----------|---|
| <b>Use ultra fine aiming</b>         | Check box | Reduces the field of view of the ATRplus. The setting is only applied for <b>Aim at target: Automatic</b> .   |
| <b>Automatic-ally measure points</b> | Check box | Available for instruments with automatic aiming and <b>Aim at target:Automatic</b> . If checked, search and measurements are done to specified targets in sets. |

### Next step

**Measure** to measure further sets of the selected points.



- Motorised instruments point automatically in the direction of the targets.
- Instruments with automatic aiming and auto survey activated, measure the targets automatically.

### Measurement Summary

This panel is displayed automatically at the end of the sets measurement.

| Key       | Description                      |
|-----------|----------------------------------|
| <b>OK</b> | To continue with the next panel. |

### Description of metadata

| Metadata            | Description   |
|---------------------|---|
| -                   | Points of the point group in the same order as in the point group.  |
| <b>Compl meas</b>   | How many times the point was successfully measured.<br>Example: 4/6 - The point was measured four times, six sets were measured.                                  |
| <b>In tolerance</b> | How many times the tolerance configured was met.<br>Example: 4/6 - The point falls within the defined tolerance four times, six sets were measured.               |
| <b>Compl sets</b>   | How many sets are completed. The value is the same for all points.<br>Example: 4/6 - The point was measured in a complete set four times, six sets were measured. |

### After measuring sets

Depending on points skipped or not, select how to continue.

| Key       | Description   |
|-----------|---|
| <b>OK</b> | To select the highlighted option and to continue with the next panel. |

### Description of options

| Options                        | Description            |
|--------------------------------|------------------------|
| Always available:              |                        |
| <b>Measure more sets</b>       | To measure extra sets. |
| Available for sets incomplete: |                        |

| Options                            | Description  |
|------------------------------------|--|
| <b>Re-measure incomplete sets</b>  | To remeasure the skipped points in the face that was skipped. To fill in the missing measurements in the sets.                 |
| <b>Remove incomplete points</b>    | To calculate results. The skipped points are discarded. Only points measured in all sets are used for the calculation.         |
| <b>Remove incomplete sets</b>      | To calculate results. The sets that contain skipped points are discarded. Only the complete sets are used for the calculation. |
| Available for sets complete:       |  |
| <b>View &amp; manage results</b>   | Available when no points are skipped. Refer to <a href="#">52.2.6 Managing Results</a> .                                       |
| <b>Compute points from results</b> | Available when no points are skipped. To compute points from set results.  |
| <b>Exit app</b>                    | To end the Sets of Angles program.   |

## 52.2.6

### Managing Results

#### Description

For two and more sets measured with angles and distances in two faces, calculations for angles and distances can be done.

For sets measured in one face, the standard deviation and average values can be viewed.

If only one set or point is measured, only some of the values are displayed.

#### Manage Results

If points are measured with method **A'B'C'D'**, the points results are limited and only standard deviation and average values are shown.

| Manage Results          |                 |
|-------------------------|-----------------|
| <b>Angles</b> Distances |                 |
| Number of points active | <b>3</b>        |
| Number of sets active   | <b>3</b>        |
| Hz $\sigma$ single dir. | <b>0.0001 g</b> |
| Hz $\sigma$ avg dir.    | <b>0.0000 g</b> |
| V $\sigma$ single dir.  | <b>0.0000 g</b> |
| V $\sigma$ avg dir.     | <b>0.0000 g</b> |

Navigation bar: OK | Sets | Page

| Key         | Description                              |
|-------------|--|
| <b>OK</b>   | To return to the previous panel.         |
| <b>Sets</b> | To view angle/distance results.          |
| <b>Use</b>  | To activate/deactivate sets.             |
| <b>Page</b> | To change to another page on this panel. |

## Description of fields

| Field   | Option       | Description  |
|---|--------------|--|
| <b>Number of points active</b>                                  | Display only | Number of active points which are set to <b>Yes</b> for the <b>Select</b> metadata in the <b>Select Points to be Added</b> panel.    |
| <b>Number of sets active</b>                                    | Display only | Number of active sets which are set to <b>Yes</b> for the <b>Select</b> metadata in the <b>Angle Results/Distance Results</b> panel. |
| <b>Hz <math>\sigma</math> single dir.</b>                       | Display only | Standard deviation of the single horizontal direction.   |
| <b>Hz <math>\sigma</math> avg dir.</b>                          | Display only | Standard deviation of the average horizontal direction.  |
| <b>V <math>\sigma</math> single dir.</b>                        | Display only | Standard deviation of a single vertical direction.   |
| <b>V <math>\sigma</math> avg dir.</b>                           | Display only | Standard deviation of the average vertical direction.  |
| <b>Standard deviation (<math>\sigma</math>) single distance</b> | Display only | Standard deviation of a single distance.   |
| <b>Std deviation (<math>\sigma</math>) of avg distance</b>      | Display only | Standard deviation of the average distance.  |

## Next step

**Sets** accesses the **Angle Results/Distance Results** panel.

## Angle Results/ Distance Results

| Angle Results |                        |                       |
|---------------|------------------------|-----------------------|
| 1             | Hz Zr Residl 0.0002 g  | V Zr Residl 0.0000 g  |
| 2             | Hz Zr Residl -0.0003 g | V Zr Residl 0.0000 g  |
| 3             | Hz Zr Residl 0.0001 g  | V Zr Residl -0.0000 g |

| Fn | OK | Points | Use | Fn |
|----|----|--------|-----|----|
|----|----|--------|-----|----|

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To return to the previous panel.   |
| <b>Points</b> | To access <b>Residuals in Set n</b> .  |
| <b>Use</b>    | To set <b>Yes</b> or <b>No</b> in the <b>Use</b> metadata for the highlighted set. |

## Description of metadata

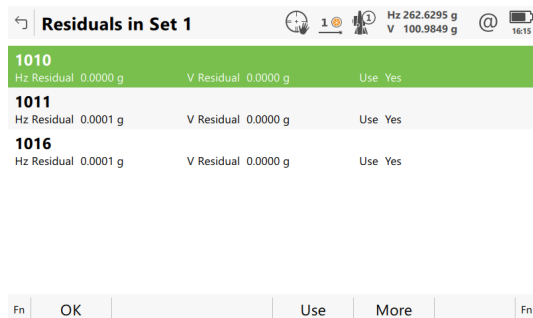
| Metadata | Description                      |
|----------|----------------------------------|
| -        | Displays the number of the sets. |

| Metadata             | Description   |
|----------------------|---|
| <b>Hz Σr Residl</b>  | Shows the calculated absolute sum of residuals in Hz of the selected set. The sum of residuals is the sum of the difference between the reduced average direction and each sets directions. For sets not used in the calculation, ----- is shown.   |
| <b>V Σr Residl</b>   | Shows the calculated absolute sum of residuals in V of the selected set. The sum of residuals is the sum of the difference between the average vertical angles and each sets vertical angles. For sets not used in the calculation, ----- is shown. |
| <b>Max Residl SD</b> | Shows the calculated maximum residuals in slope distance of the selected set. The sum of residuals is the sum of the difference between the average distance and each sets distance. For sets not used in the calculation, ----- is shown.          |
| <b>Use</b>           | For <b>Yes</b> :<br>The selected set is used for calculations.<br><br>For <b>No</b> :<br>The selected set is not used for calculations.   |

### Next step

Points to access **Residuals in Set n**.

## Residuals in Set n



| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To return to the previous panel.  |
| <b>Use</b>  | To set <b>Yes</b> or <b>No</b> for the <b>Use</b> metadata for the highlighted point. |
| <b>More</b> | To view additional information.   |

### Description of metadata

| Metadata           | Description  |
|--------------------|--|
| -                  | Point ID of the measured points in the order they were defined and measured. |
| <b>Hz Residual</b> | Residual in the Hz value of the selected point within the single set.        |
| <b>V Residual</b>  | Residual in the V value of the selected point within the single set.         |
| <b>Avg Hz</b>      | Reduced Average Hz value of the point in all active sets.                    |

| Metadata           | Description  |
|--------------------|--|
| <b>Avg V</b>       | Average V value of the point in all active sets.   |
| <b>Mean Hz</b>     | Mean Hz value of the point within the single set.  |
| <b>Mean V</b>      | Mean V value of the point within the single set.   |
| <b>SD Residual</b> | Residual in the distance value of the point within the single set.   |
| <b>Avg SD</b>      | Average distance value of the point in all active sets.  |
| <b>Mean SD</b>     | Mean distance value of the point within the single set.  |
| <b>Use</b>         | For <b>Yes</b> :<br>The selected point is used for calculations in all sets.<br>For <b>No</b> :<br>The selected point is not used for calculations in any set. |

Compute Points,  
General page

| Key          | Description   |
|--------------|---|
| <b>Store</b> | To store the point with class <b>CTRL</b> in the database.<br>The averaged angles and distances are stored as point results to the point. |
| <b>Page</b>  | To change to another page on this panel.  |

Description of fields

| Field                           | Option         | Description   |
|---------------------------------|----------------|---|
| <b>Number of points active</b>  | Display only   | The number of selected points having been measured.   |
| <b>Number of sets active</b>    | Display only   | The number of sets having been measured.  |
| <b>Store point ID with</b>      | <b>Prefix</b>  | Adds the setting for <b>Prefix / suffix</b> in front of the original point IDs.   |
|                                 | <b>Suffix</b>  | Adds the setting for <b>Prefix / suffix</b> at the end of the original point IDs.   |
| <b>Prefix / suffix</b>          | Editable field | The identifier with up to four characters is added in front of or at the end of the ID of the calculated points.  |
| <b>Use a point as reference</b> | Check box      | When this box is checked, the point selected is considered fixed: known coordinates and therefore <b>Easting diff</b> and <b>Northing diff</b> are made equal to zero.<br>The values shown on the <b>Points</b> page are updated accordingly. |

Compute Points,  
Points page

| Key           | Description  |
|---------------|--|
| <b>Store</b>  | To store the calculated points which are set to <b>Yes</b> for the <b>Accept</b> metadata. |
| <b>Accept</b> | To set <b>Yes</b> or <b>No</b> for the <b>Accept</b> metadata for the highlighted point.   |

## Description of metadata

| Metadata             | Description  |
|----------------------|--|
| -                    | Point ID of the measured points in the order they were defined and measured.   |
| <b>Easting diff</b>  | The difference in Easting between the original and the calculated points.  |
| <b>Northing diff</b> | The difference in Northing between the original and the calculated points.   |
| <b>Accept</b>        | For <b>Yes</b> :<br>The selected point is used for calculations in all sets.<br><br>For <b>No</b> :<br>The selected point is not used for calculations in any set. |

## 52.3

## Monitoring

### Description

Monitoring is a module integrated within the Sets of Angles app.

Monitoring uses a timer to enable repeated and automated angle and distances measurements to pre-defined target points at defined intervals. The ability to configure the handling of message panels during measurement sets is also enabled.

### Important aspects

For monitoring, instruments must be motorised.

### Monitoring preparation

This step-by-step description is an example on preparing a set for monitoring.

1. Select the control job and the job.
2. Set setup coordinates and setup orientation.
3. Select **Leica Captivate - Home: Measure sets**.
4. In **Measure sets of angles** press **Fn Settings** to configure Sets of Angles for monitoring.  
For the **Parameters** page set:
  - **Stop for messages: All messages** (for example purposes only).
  - **Time out: 10 secs** (for example purposes only).
  - **Define time when sets should be measured (timer monitoring)** Select this option for monitoring. This setting enables access to the **Define Monitoring Timer** panel.
5. Press **OK** to access the **Measure sets of angles** panel.
6. Select **Create a new group**.
7. Press **OK** to access the **Define Points for Set** panel.
8. Enter details of the target point as required.  
For each target point, ensure that auto survey is activated. This setting enables the automated measurement and recording of the target point in the other face. The setting also enables the automated measurement and recording of all target points during monitoring.
9. Press **OK** to access the **Select Points - Measure** panel.
10. Measure and record the measurement to the target point as required.

11. Continue with steps 8. to 10. until all target points for the first measurement set have been measured and recorded.
12. Press **Done** to complete the selection of the target points for the first measurement set in one face. This action then begins the measurement of the target points in the other face. On completion, the **Measure sets of angles** panel is accessed.
13. Select **Measure Sets**.
14. Press **OK** to access the **Define Monitoring Timer** panel.

## Define Monitoring Timer

### Description of fields

| Field                     | Option          | Description   |
|---------------------------|-----------------|---|
| <b>Begin date</b>         | Editable field  | Start date for monitoring.  |
| <b>Begin time</b>         | Editable field  | Start time for monitoring.  |
| <b>End date</b>           | Editable field  | End date for monitoring.  |
| <b>End time</b>           | Editable field  | End time for monitoring.  |
| <b>Interval</b>           | Editable field  | The time between the start of each scheduled measurement set.   |
| <b>Measurement method</b> |                 | Determines the order in which the target points are measured.   |
|                           | <b>A'A"B'B'</b> | The target points are measured in face I and face II.<br>point A I - point A II - point B II - point B I ...  |
|                           | <b>A'A"B'B"</b> | The target points are measured in face I and face II.<br>point A I - point A II - point B I - point B II ...  |
|                           | <b>A'B'A"B"</b> | The target points are measured in face I and face II.<br>point A I - point B I... point A II - point B II ... |
|                           | <b>A'B'B"A"</b> | The target points are measured in face I and face II.<br>point A I - point B I... point B II - point A II...  |
|                           | <b>A'B'C'D'</b> | The target points are only measured in face I.<br>point A I - point B I - point C I - point D I ...           |

### Next step

When all required information is entered press **OK** to begin the monitoring process.

A panel displays a notice that monitoring is in progress. If necessary, press **Cancel** to stop the monitoring process and return to **Measure sets of angles**.

Refer to [52.2 Sets of Angles](#) for information about calculations and the viewing of results.



## Monitoring interval

### Description

The dates and times entered define the timeframe for when the monitoring will take place.

The time interval defines the time between the start of each measurement set during the monitoring period. The interval time begins at the start of a measurement set and ends at the start of the next measurement set.

### Example

Data;

- 3 target points
- Begin Date: 03.11.2010
- End Date: 06.11.2010
- Interval: 30 min
- 4 measure sets
- Begin Time: 14:00:00
- End Time: 14:00:00

Results;

- The time taken to measure 4 sets of 3 target points in both faces is 10 minutes.
  - The measurements will start at 14:00:00 on 03.11.2010.
  - At 14:10:00, the first measurement set is complete.
  - The instrument will wait until 14:30:00 for the next scheduled measurement set.
-

**Description**

The Setup app is only available for use with TS instruments. Setup determines the coordinates and the instrument orientation using TS measurements and/or GS measurements.

**Setup with GS using SmartPole**

SmartPole allows target points to be determined using GS measurements. The new points are then used as control points for the TS setup.

**Setup with GS using SmartStation**

SmartStation allows TS setup coordinates (position and height) to be determined from GS measurements.



**AP tilt compensation** cannot be used.

**Setup methods**

| Setup Method        | "Standard" setup type | "On-the-Fly" setup type | Methods for TS | Methods for SmartPole | Methods for SmartStation |
|---------------------|-----------------------|-------------------------|----------------|-----------------------|--------------------------|
| Set orientation     | ✓                     | -                       | ✓              | -                     | ✓                        |
| Known backsight     | ✓                     | -                       | ✓              | ✓                     | ✓                        |
| Multiple backsights | ✓                     | ✓                       | ✓              | ✓                     | ✓                        |
| Transfer height     | ✓                     | -                       | ✓              | ✓                     | -                        |
| Resection           | ✓                     | ✓                       | ✓              | ✓                     | -                        |
| Orientate to line   | ✓                     | -                       | ✓              | -                     | ✓                        |
| Orientate to object | ✓                     | -                       | ✓              | -                     | -                        |

- Each setup method requires different input data and a different number of target points.
- All setup methods are described in [53.6 Setup Methods](#).

**Setup types****"Standard" setup**

This type of setup is the traditional type. The user must always measure all setup points consecutively to complete the setup. The TS setup coordinates and TS orientation must be set before measuring survey points.

**"On-the-Fly" setup**

This setup type allows the user to move between setup and survey before completing the setup (working "on the fly"). When leaving, the TPS setup coordinates and orientation do not have to be final, they can be set at anytime during the survey.

## "Standard" setup

## "On-the-Fly" setup

This setup can only be used when measuring survey points. When staking out points, the TS setup coordinates and TS orientation must be set first.

### Incomplete setups

- For a "Standard" setup, the user must always measure all setup points consecutively to complete the setup. This type of setup is always regarded as a complete setup.
- For "On-the-Fly" setups, the setup points can be measured together with the survey points. It is not necessary to complete the setup before measuring survey points. Until the user selects **Set** in **Setup Results**, this type of setup is regarded as incomplete.

### An incomplete setup, or a setup where more targets can be added, can be accessed in the following ways:

1. In the Measure app, Setup can be accessed by selecting the **Setup** softkey.
2. When entering any panel where measurements are possible, a message is displayed to notify that the setup is incomplete. It is then possible to:
  - a) continue with the existing app, or **OK**
  - b) start Setup and create a setup, or **New**
  - c) start Setup and continue to measure more fix-points. **Setup**
3. Assigning the function **TS - Continue open setup** to the favourites or a hot key.

### Linked jobs and global data

Linked jobs will overwrite the points and lines from the global design job selected in **Design Data**.

## 53.2

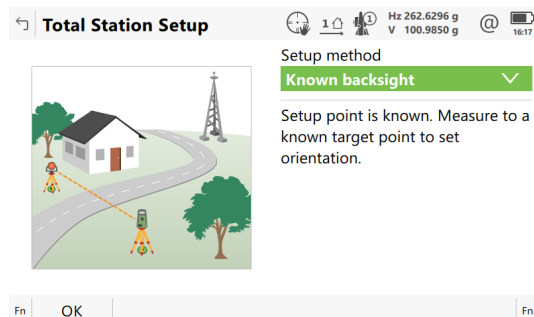
### Accessing Setup

#### Access

Select **Leica Captivate - Home: Setup**.

#### Total Station Setup

An illustration and a description is shown for each **Setup method**.



#### Key

#### Description

**OK**

To accept changes and access the subsequent panel. The chosen settings become active.

| Key                | Description   |
|--------------------|---|
| <b>Fn Settings</b> | To configure the Setup app. Refer to <a href="#">53.3 Configuring Setup</a> . |

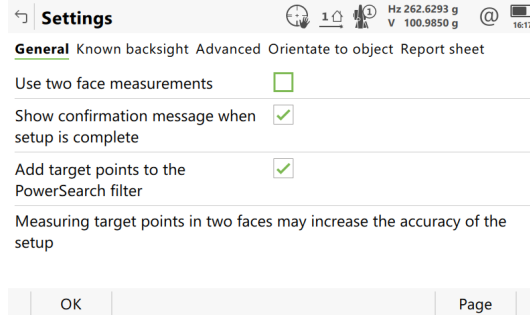
## 53.3

## Configuring Setup

### Access


Press **Fn Settings** in **Total Station Setup**.

### Settings, General page




| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.                                      |

### Description of fields

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Use two face measurements</b>                        | Check box | <p>Defines if the instrument measures the second face automatically after storing the first.</p> <p>When this box is checked, after storing a measurement with <b>All</b> or <b>Store</b> motorised instruments change face automatically, non-motorised instruments access <b>Telescope Positioning</b>. The measurements of facel and facell are averaged. The averaged value is stored.</p> <p>When this box is not checked, no automatic measurement in two faces.</p> <p> When using two face measurements, then the angle right value is averaged between both two face measurements.</p> |
| <b>Show confirmation message when setup is complete</b> | Check box | When this box is checked, a message informs when the setup is finished.  |

Settings,  
Known backsight  
page

| Field  | Option    | Description  |
|--|-----------|--|
| <b>Add target points to the PowerSearch filter</b> | Check box | When this box is checked, the setup points are included in PowerSearch scans looking for available prisms. Refer to <a href="#">Bubble icons</a> for more information.<br> By unchecking the box, the likelihood to only find the correct prisms on the robotic pole is increased and the time to find the prisms is significantly decreased. |

**Next step**

**Page** changes to the **Known backsight** page.

For **Setup method: Known backsight**, the settings on this page apply.

**Description of fields**

| Field   | Option         | Description  |
|---|----------------|--|
| <b>Check measurement to backsight (2D position)</b> | Check box      | Allows a check to be made on the horizontal coordinate difference between the existing and the measured known backsight point. If the defined <b>Position limit</b> is exceeded, the setup can be repeated, skipped or stored. |
| <b>Position limit</b>                               | Editable field | Available when <b>Check measurement to backsight (2D position)</b> is checked. Sets the maximum horizontal coordinate difference accepted in the position check.   |
| <b>Check measurement to backsight (1D height)</b>   | Check box      | Allows a check to be made on the vertical difference between the existing and the measured known backsight point. If the <b>Height limit</b> is exceeded, the setup can be repeated, skipped or stored.                        |
| <b>Height limit</b>                                 | Editable field | Available when <b>Check measurement to backsight (1D height)</b> is checked. Sets the maximum vertical difference accepted in the height check.  |

**Next step**

**Page** changes to the **Advanced** page.

Settings,  
Advanced page

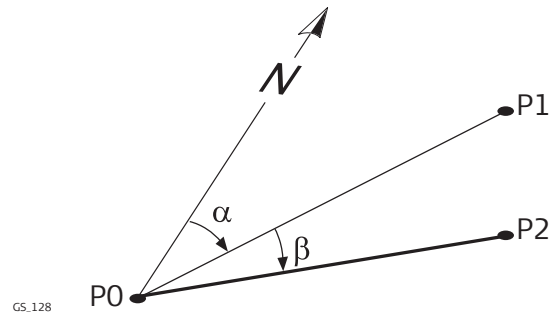
For **Setup method: Resection** and **Setup method: Multiple backsights**, the settings on this page apply.

**Description of fields**

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Automatically turn TS to next target point</b> | Check box | When this box is checked, the instrument positions horizontally and vertically to the point. |

| Field   | Option   | Description  |
|---|--|--|
| <b>Measure target points while measuring other points (on-the-fly)</b>  | Check box  | When this box is checked, the setup points can be measured together with the survey points. It is not necessary to complete the setup before measuring survey points. Until you select <b>Set</b> in <b>Setup Results</b> , this type of setup is regarded as incomplete.  |
| <b>Calculate &amp; show scale from the measurements made to targets</b> | Check box  | Only available if <b>Scale TS measurements</b> is unchecked in the job properties <b>TS scale</b> page.<br>If checked, a setup scale is calculated from the target observations. You can apply this new scale (calculated ppm + current ppm = new ppm) to all survey observations, including the setup observations, from that setup. If not checked, then the calculated ppm is not displayed and therefore not applied to any survey observations. |
| <b>For resections use Helmert method for calculations</b>               | Check box  | Helmert calculation is used.   |
| <b>Height weighting</b>   | <b>1/distance</b> or <b>1/distance<sup>2</sup></b> | Available when <b>For resections use Helmert method for calculations</b> is checked. To change the distance weighting that is used in the calculation of the setup height in the resection.  |
| <b>Edit the default setup limits</b>                                    | Check box  | Check to type in values for standard deviation, position and height accuracy. If the limits are exceeded, a message is shown when <b>Calculate</b> is selected.  |
| <b>Orientation limit</b>  | Editable field                                     | Available when <b>Edit the default setup limits</b> is checked. Define a limit for the standard deviation of the orientation.  |
| <b>Position limit</b>   | Editable field                                     | Available when <b>Edit the default setup limits</b> is checked. Define a position accuracy of the target point.  |
| <b>Height limit</b>   | Editable field                                     | Available when <b>Edit the default setup limits</b> is checked. Define a height accuracy of the target point.  |
| <b>The first resection point will be used to set AR to 0.</b>           | Check box  | Applicable for <b>Setup method: Resection</b> .<br>When this box is checked, the angle right direction is set to 0 in the direction of the first measured resection point. The values displayed for angle right during the following measurements always relate to the first measured point in the resection.<br><br>The angle right displays the horizontal angle difference between the backsight point and the current telescope position.        |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



- P0 Instrument setup
- P1 Backsight point
- P2 Point in direction of current telescope position
- $\alpha$  Azimuth
- $\beta$  Angle right

### Next step

**Orientate to object:** Page changes to the **Orientate to object** page.

### Settings, Orientate to object page

For **Setup method: Orientate to object**, the settings on this page apply.

### Description of fields

| Field                  | Option         | Description  |
|------------------------|----------------|--|
| <b>Position limit</b>  | Editable field | Defines a position accuracy of the target point.   |
| <b>Height limit</b>    | Editable field | Defines a height accuracy of the target point.   |
| <b>Rotations limit</b> | Editable field | Defines a rotation accuracy for the calculation.   |
| <b>Shifts limit</b>    | Editable field | Defines a shift accuracy for the calculation.  |
| <b>Scale limit</b>     | Editable field | Defines a scale accuracy for the calculation.  |
| <b>Scale mode</b>      | <b>Free</b>    | The scale factor is calculated throughout the Helmert transformation calculation. The calculated scale factor is applied to all subsequent transformations and measured coordinates. |
|                        | <b>Fixed</b>   | A user-entered scale factor can be typed in. This fixed scale factor is used for all subsequent transformations and coordinate calculations.   |
| <b>Scale factor</b>    | Editable field | The user-entered scale factor. Available for <b>Scale mode: Fixed</b> .  |

### Next step

Page changes to the **Report sheet** page. Refer to [.38 Apps - General](#)

The setup method **Orientate to object** does not support a report sheet.

## 53.4

### Choose Setup Point

#### Access

A station point must be selected for **Setup method: Set orientation**, **Setup method: Known backsight**, **Setup method: Multiple backsights** and **Setup method: Transfer height**. **Choose Setup Point** is then accessed automatically from **Setup**.




#### Choose Setup Point

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To accept changes and return to the panel from where this panel was accessed.  |
| <b>Meas H</b>      | To measure the instrument height using the integrated AutoHeight laser plummet. Refer to <a href="#">Measure Instr. Height</a> . |
| <b>Fn Settings</b> | To configure the Setup app. Refer to <a href="#">53.3 Configuring Setup</a> .  |
| <b>Fn Coord</b>    | To view other coordinate properties.   |
| <b>Fn Scale</b>    | To activate scale correction and to type in values for the scale corrections. Refer to <a href="#">New Job,TS scale page</a> .   |
| <b>Fn Atmos</b>    | To type in values for the atmospheric corrections. Refer to <a href="#">Atmospheric Corrections,Atmospheric ppm page</a> .       |

#### Description of fields

| Field                   | Option                 | Description  |
|-------------------------|------------------------|--|
| <b>Setup point from</b> | <b>Job</b>             | The selection made here determines the availability of the other fields on this panel.<br>A setup point can be selected from a job on a data storage device.   |
|                         | <b>Dataset</b>         | When the working job has at least one available linked job, the data for the setup can be selected from the data set.<br>The option is available when all linked jobs are set to hidden or if all points in the data set are filtered out.<br>The option is unavailable when the jobs in the data set are unavailable on the data storage devcies. |
|                         | <b>Enter new point</b> | Pressing <b>OK</b> opens a panel where a new point can be typed in. After pressing <b>Store</b> there, the Setup app continues.  |



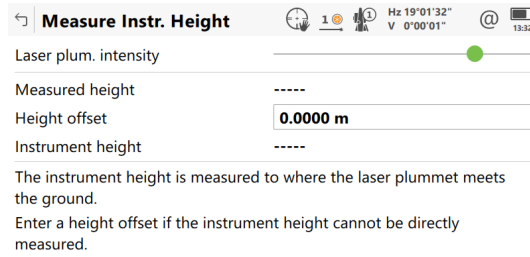
| Field                               | Option                   | Description   |
|-------------------------------------|--------------------------|---|
|                                     | <b>GS - SmartStation</b> | <p>Available when TS and GS are used. Press <b>OK</b> to open the GSMeasure app. After measuring a point with <b>Measure, Stop, Store</b> there, the Setup app continues. Refer to <a href="#">57.1.2 Real-Time Rover Operations</a>.</p> <p> In order to use GS, a coordinate system for the setup is required and must be attached to the job. If not, then a coordinate system must be selected, or local coordinates for the setup must be typed in, during the setup process.</p> <p> To obtain the correct elevation of the setup point, measure the instrument height as usual and ensure that the antenna type is set to the relevant SmartStation antenna.</p> <p> If SmartPole is used in the setup or later in Measure, remember to update the antenna type after finishing the SmartStation measurement.</p> |
|                                     | <b>Last used setup</b>   | The setup used last in the Setup app is displayed.  |
| <b>Job</b>                          | Selectable list          | The job from which the setup is selected. Refer to <a href="#">6.3 Choosing a Job</a> .   |
| <b>Point ID</b>                     | Display only             | The point ID of the setup point.  |
| <b>Instrument height</b>            | Editable field           | The height of the instrument.   |
| <b>Easting, Northing and Height</b> | Display only             | The coordinates of the setup point.   |
| <b>Current scale</b>                | Display only             | Available when <b>Scale TS measurements</b> is checked in <b>Scale Corrections</b> . The scale according to the scale settings ( <b>Fn Scale</b> ) for the selected setup.  |



Refer to [25 Antenna Heights](#) for further information regarding height values used in a SmartStation.

### Measure Instr. Height

Available for TS10/TS13/TS16/TS60/MS60/TM60.



Measure

| Key     | Description  |
|---------|--|
| OK      | The measured instrument height is displayed and used in the setup app. |
| Measure | To measure the instrument height.                                      |

### Description of fields

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| Laser plum. intensity | Slider         | External influences and the surface conditions may require the adjustment of the intensity of the plummet. Adjust the intensity of the plummet using the navigation key. The laser can be adjusted in 20% steps as required. |
| Measured height       | Display only   | The height measured by the laser plummet.  |
| Height offset         | Editable field | The entered value is added to the measured vertical distance.  |
| Instrument height     | Display only   | The sum of <b>Measured height</b> and <b>Height offset</b> .   |

## 53.5

### Setup Details

#### Access

Setup information must be typed in for **Setup method: Resection**, **Setup method: Orientate to line** and **Setup method: Orientate to object**. **Setup Details** is accessed after selecting **OK** in **Total Station Setup** with one of these setup methods selected.

#### Setup Details

| Key       | Description  |
|-----------|--|
| OK        | To accept changes and return to the panel from where this panel was accessed.  |
| Date time | To fill the <b>Point ID</b> field with a point name based on the current date and time. The format depends on the system setting.<br>Example:<br>01072021_161858, where 01072021 is the date and 161858 is the time.<br>Available for <b>Setup method: Resection</b> , <b>Setup method: Orientate to line</b> and <b>Setup method: Orientate to object</b> . |

| Key                | Description  |
|--------------------|--|
| <b>Meas H</b>      | To measure the instrument height using the integrated AutoHeight laser plummet. Refer to <a href="#">Measure Instr. Height</a> . |
| <b>Fn Settings</b> | To configure the Setup app. Refer to <a href="#">53.4 Choose Setup Point</a> .   |
| <b>Fn Coord</b>    | To view other coordinate properties.   |
| <b>Fn Scale</b>    | To activate scale correction and to type in values for the scale corrections. Refer to <a href="#">New Job,TS scale page</a> .   |
| <b>Fn Atmos</b>    | To type in values for the atmospheric corrections. Refer to <a href="#">23.3 Atmospheric corrections</a> .                       |

For a description of the setup details of **Chord Setup** in Roads Rail refer to [Setup Details](#).

#### Description of fields

| Field  | Option            | Description  |
|--|-------------------|--|
| <b>Point ID</b>                                  | Editable field    | Type in an ID for the setup point.   |
| <b>Instrument height</b>                         | Editable field    | The height of the instrument.  |
| <b>Point code</b>                                | Selectable list   | Select a point code for the setup point if desired.  |
| <b>Choose target points from a different job</b> | Check box         | Available for setup method <b>Resection</b> and <b>Orientate to object</b> . Target points can be selected from the design job.  |
| <b>Job</b>                                       | Selectable list   | The design job from which the target points can be selected. Refer to <a href="#">6.3 Choosing a Job</a> .   |
| <b>Manually enter the setup height</b>           | Check box         | Available for setup method <b>Orientate to line</b> .<br>When this box is checked, the height value of the setup is entered and used to calculate the height of the measured points.<br>When this box is not checked, the height of the setup is calculated relative to the first measured point. The height can be entered in <b>Measure Target</b> . |
| <b>Setup height</b>                              | Editable field    | Available for setup method <b>Orientate to line</b> with <b>Manually enter the setup height</b> being checked. The elevation of the instrument setup.  |
| <b>Line between target 1 &amp; 2 defines</b>     |                   | Available for setup method <b>Orientate to line</b> .<br>To define the positive North or positive East axis.   |
|  | <b>North axis</b> | The second point measured defines the direction of the positive North axis.  |
|  | <b>East axis</b>  | The second point measured defines the direction of the positive East axis.   |



Refer to [25 Antenna Heights](#) for further information regarding height values used in a SmartStation.

## 53.6

## Setup Methods

### 53.6.1

### Set orientation and Known backsight

#### Requirements

The position coordinates of the setup point are required.

For **Set orientation**: The instrument is set up and oriented to either a known or unknown target point, to which a true or assumed azimuth is set.

For **Known backsight**: The instrument is set up and oriented to a known backsight target.

For SmartStation, the position coordinates of the setup are unknown and are determined with GS. The instrument is set and oriented to either a known or unknown target point, to which a true or assumed azimuth is set.

#### Updating Hz measurements

A setup using the **Set orientation** method, is always automatically flagged with an 'update later' attribute. If the backsight point is measured again, for example from another setup, and found to have different coordinates, then a message appears. You can then select whether to update the original setup or not. The update uses the backsight point coordinates to recalculate the orientation and updates all measured points connected to the setup.



For information on camera and images refer to [34 Camera & Imaging](#).

#### Access

In **Total Station Setup**, select **Setup method: Set orientation** or **Known backsight**. Press **OK**.

In **Choose Setup Point**, select a setup. Press **OK**.

#### Set Orientation, Orientation page

|     |          |      |      |
|-----|----------|------|------|
| Set | Distance | More | Page |
|-----|----------|------|------|

| Key             | Description   |
|-----------------|---|
| <b>Set</b>      | To set the setup and orientation and exit the Setup app.  |
| <b>Distance</b> | To measure a distance to the point being used to set the azimuth.<br>For <b>Set orientation</b> :<br>A distance measurement is <b>NOT</b> required when setting the setup and the orientation with <b>Set</b> . |
| <b>GS</b>       | For <b>Known backsight</b> applicable when using SmartPole. To enter the Measure panel and measure a point with GS. The antenna height is automatically converted from the target height.                       |

| Key                          | Description   |
|------------------------------|---|
| <b>Store</b>                 | To store the measurement with or without a distance. Only available when <b>Use two face measurements</b> is selected in the <b>Setup</b> settings.   |
| <b>More</b>                  | To change between the slope and the horizontal distance.  |
| <b>Page</b>                  | To change to another page on this panel.  |
| <b>Fn Run /<br/>Indiv ID</b> | Available for <b>Setup method: Set orientation</b> only. <b>Run</b> automatically chooses the next available point ID from the list of points already stored.<br><b>Indiv ID</b> to type in any value for <b>Backsight ID</b> . |

#### Description of fields

| Field                                    | Option          | Description  |
|--|-----------------|--|
| <b>Backsight ID</b>                      | Editable field  | Point ID of the backsight point.<br>For <b>Set orientation</b> .   |
|  | Selectable list | For <b>Known backsight</b> . Select a point from the points stored in the design job.  |
| <b>Target height</b>                     | Editable field  | Height of the target above or below the backsight point. The last setup target height is always remembered.  |
| <b>Direction</b>                         | Editable field  | Available for <b>Set orientation</b> . The direction is set to 0 by default. This value can be edited. The value is not set to the system until <b>Set</b> is pressed. |
| <b>Horizontal distance</b>               | Display only    | Available for <b>Set orientation</b> . Press <b>Distance</b> to measure a distance to the target point being used to set the azimuth.                                  |
| <b>Slope distance</b>                    | Display only    | Available for <b>Set orientation</b> . The slope distance measured between the setup point and the backsight point.  |
| <b>Difference in height</b>              | Display only    | Available for <b>Set orientation</b> . The vertical distance between the setup point and the backsight point.  |
| <b>Computed direction</b>                | Display only    | Available for <b>Known backsight</b> . Displays the calculated azimuth from the selected setup to the backsight point.   |
| <b>Computed horizontal distance</b>      | Display only    | Available for <b>Known backsight</b> . Displays the calculated horizontal distance between the selected setup and backsight point.                                     |
| <b>Difference in horizontal distance</b> | Display only    | Available for <b>Known backsight</b> . The difference between the calculated horizontal distance from setup to backsight point and the measured horizontal distance.   |
| <b>Computed slope dist</b>               | Display only    | Available for <b>Known backsight</b> . Displayed after <b>More</b> was pressed. The calculated slope distance to the backsight point.                                  |

| Field                               | Option       | Description  |
|-------------------------------------|--------------|--|
| <b>Difference in slope distance</b> | Display only | Available for <b>Known backsight</b> . Displayed after <b>More</b> was pressed. The difference between the calculated slope distance from setup to backsight point and the measured slope distance.                  |
| <b>Difference in height</b>         | Display only | Available for <b>Known backsight</b> . The difference between the design height of the backsight point and the measured height of the backsight point. If the backsight point is a 2D point, this field shows -----. |
| <b>Angle right</b>                  | Display only | Available when <b>Hz angle display: Angle right</b> is configured in <b>Regional, Angle</b> page. Displays the horizontal angle difference between the backsight point and the current telescope position.           |

### Next step

**Page** changes to the **Backsight point code** page.

## Set Orientation, Backsight point code page

Orientation **Backsight point code** Setup Camera 3D viewer

Backsight ID **TP50001**

Point code **<None>**

Code description -----

| Set | New attrb | Last | Default | Page |
|-----|-----------|------|---------|------|
|-----|-----------|------|---------|------|

| Key              | Description   |
|------------------|---|
| <b>Set</b>       | To set the setup and orientation and exit the Setup app.        |
| <b>New attrb</b> | To create more attributes for this point code.                  |
| <b>Last</b>      | To recall the last used attribute values for the selected code. |
| <b>Default</b>   | To recall the default attribute values for the selected code.   |
| <b>Page</b>      | To change to another page on this panel.                        |

### Description of fields

For attributes for which an attribute name can be typed in: Tap on the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in.

| Field               | Option                         | Description                       |
|---------------------|--------------------------------|-----------------------------------|
| <b>Backsight ID</b> | Editable field or display only | Point ID of the backsight point.  |
| <b>Code</b>         | Selectable list                | The code for the backsight point. |

| Field                   | Option       | Description                      |
|-------------------------|--------------|----------------------------------|
| <b>Code description</b> | Display only | A short description of the code. |

### Next step

Page changes to the **Setup** page.

## Set Orientation, Setup page

Set Orientation

Orientation Backsight point code **Setup** Camera 3D viewer

Point ID **Stn001**

Instrument height **1.500 m**

Point code **<None>**

Current PPM **-354.6**

Fn Set Distance Meas H Page Fn

| Key                     | Description  |
|-------------------------|--|
| <b>Set</b>              | To set the setup and orientation and exit the Setup app.   |
| <b>Distance</b>         | To measure a distance to the point being used to set the azimuth. A distance measurement is <b>NOT</b> required when setting the setup and the orientation with <b>Set</b> .   |
| <b>Store</b>            | Records displayed values temporarily. The target measurements are not stored to the current job until the setup is set. A distance measurement is not necessary before pressing <b>Store</b> . After recording the measurement data, the next point ID in the job is displayed. The instrument positions to the point if enough data is available and the instrument is robotic. |
| <b>Meas H</b>           | To measure the instrument height using the integrated AutoHeight laser plummet. Refer to <a href="#">Measure Instr. Height</a> .   |
| <b>Scale fctr / ppm</b> | To switch between displaying the current scale as a scale factor or ppm value.   |
| <b>Page</b>             | To change to another page on this panel.   |

### Description of fields

| Field                              | Option          | Description  |
|------------------------------------|-----------------|--|
| <b>Point ID</b>                    | Display only    | ID as selected in <b>Choose Setup Point</b> .  |
| <b>Instrument height</b>           | Editable field  | The instrument height.   |
| <b>Point code</b>                  | Selectable list | The code for the backsight point.  |
| <b>Current PPM / Current scale</b> | Display only    | The current job scale. Refer to <a href="#">New Job,TS scale page</a> for more information on scale corrections. |

## Next step

Page changes to the **3D viewer** page.

## 53.6.2

## Multiple backsights

### Requirements

The position coordinates of the setup point are required. The instrument is set up and oriented to one or more known backsight targets.

For SmartStation, the position coordinates of the setup are unknown and are determined with GS. The instrument is set up and oriented to one or more known backsight targets.

For TS and SmartStation, the orientation is determined by sighting to one or more known target points. Ten target points is the maximum. Only angles or both angles and distances can be measured. The height of the setup point can also be derived from the target points.



For information on camera and images refer to [34 Camera & Imaging](#).

### Access

In **Total Station Setup**, select **Setup method: Multiple backsights**. Press **OK**.

In **Choose Setup Point**, select a setup. Press **OK**.

### Measure Target

Unless otherwise stated the following panel and description applies to the setup methods: **Multiple backsights**, **Transfer height**, **Resection**, **Orientate to line** and **Orientate to object**.

**Measure Target 1** Hz 0.0004 g V 0.0002 g 16:29

Target Camera

Point ID **TPS0001**

Target height **0.000 m**

Hz angle **0.0004 g**

V angle **0.0002 g**

Slope distance -----

Difference in azimuth -----

Difference in horizontal distance -----

Measure Distance Store Page

| Key             | Description  |
|-----------------|--|
| <b>Measure</b>  | To measure and store the distances and angles made to the control points. After storing the measurement data, the next point ID in the job is displayed. The instrument positions to the point if enough data is available.  |
| <b>Distance</b> | To measure and display distances.  |
| <b>Store</b>    | Records displayed values temporarily. The target measurements are not stored to the current job until the setup is set. A distance measurement is not necessary before pressing <b>Store</b> . After recording the measurement data, the next point ID in the job is displayed. The instrument positions to the point if enough data is available and the instrument is robotic. |



The setup method **Orientate to object** requires valid distance measurements before using **Store**.



| Key                | Description   |
|--------------------|---|
| <b>GS</b>          | Applicable when using SmartPole. To enter the Measure panel and measure a point with GS. The antenna height is automatically converted from the target height.  |
| <b>Done</b>        | For <b>Resection</b> only. To exit the Setup app temporarily. The setup is incomplete but can be continued later. This softkey changes to <b>Calculate</b> when sufficient data is available.   |
| <b>Calculate</b>   | <p>For <b>Multiple backsights</b>:<br/>Available after the first measurement. You can see the calculated setup orientation and other results.</p> <p>For <b>Resection</b>:<br/>Available after measuring two target points or as soon as a preliminary setup and orientation can be calculated. The calculated setup coordinates and overall "quality" of the results are displayed.</p> <p>For <b>Orientate to object</b>:<br/>Available after measuring three or more target points. The calculated setup coordinates and overall "quality" of the results are displayed.</p> |
| <b>Fn Find</b>     | <p>Stakeout values are provided to guide the prism holder to the selected target point.</p> <p>For <b>Resection</b> and <b>Orientate to object</b>, this key becomes available once sufficient data is available for calculation. Refer to <a href="#">53.8 Finding a Target Point</a>.</p>   |
| <b>Fn Position</b> | <p>To position the instrument to the selected target point.</p> <p>For <b>Resection</b>:<br/>Available once sufficient data is available for calculation.</p>   |

#### Description of fields

| Field                                    | Option          | Description  |
|--|-----------------|--|
| <b>Point ID</b>                          | Selectable list | The point ID of the target point to be measured.   |
| <b>Target height</b>                     | Editable field  | The height of the target above or below the backsight point. The last setup target height is always remembered.  |
| <b>Angle right</b>                       | Display only    | Available when <b>HZ angle display: Angle right</b> is configured in <b>Regional, Angle</b> page. Displays the horizontal angle difference between the backsight point and the current telescope position. |
| <b>V angle</b>                           | Display only    | The current vertical angle.  |
| <b>Slope distance</b>                    | Display only    | The measured slope distance after <b>Distance</b> was pressed.   |
| <b>Difference in horizontal distance</b> | Display only    | The difference between the calculated and the measured horizontal distance.  |
| <b>Difference in height</b>              | Display only    | The difference between the given and the measured height of the target point.  |

| Field                        | Option         | Description   |
|------------------------------|----------------|---|
| <b>Easting and Northing</b>  | Editable field | Available for <b>Orientate to line</b> .<br>The coordinates of the first target point. Editing the coordinates shifts the origin of the coordinate system.  |
| <b>Height</b>                | Editable field | Available for setup method <b>Orientate to line</b> when <b>Manually enter the setup height</b> is not checked in <b>Setup Details</b> .<br>The height of the first measured point. The height of the setup is calculated relative to the first measured point. |
| <b>Difference in azimuth</b> | Display only   | Displays the difference between the calculated azimuth and the current horizontal angle.<br>If <b>Setup method: Resection</b> or <b>Setup method: Orientate to object</b> , displays ----- until at least 3 target points are measured.                         |



A maximum of ten target points can be measured and used for the calculation. When the maximum number of points is exceeded, a message will appear. The user can remove previous points or finish the setup. Points can be removed from the **Setup Results, Targets** page.

### 53.6.3

#### Transfer height

##### Requirements

This method is used to compute a setup height to apply to the selected setup. Only the height is updated, the orientation is not updated.  
The position coordinates of the setup point are required.

##### Access

In **Total Station Setup**, select **Setup method: Transfer height**. Press **OK**.  
In **Choose Setup Point**, select a setup. Press **OK**.



For a description of the **Measure Target** panel, refer to [53.6.2 Multiple backsights](#).

### 53.6.4

#### Resection

##### Requirements

The coordinates of the setup point are unknown. The coordinates and orientation are determined by sighting to at least two or more known target points. 30 target points is the maximum. Only angles or both angles and distances can be measured. For a resection, least squares or robust calculations are used. The resection calculations can be done using the Helmert method, robust method or least squares method, after three measurements to known backsights have been completed.

##### Access

In **Total Station Setup**, select **Setup method: Resection**. Press **OK**.  
In **Setup Details**, type in the required information. Press **OK**.



For a description of the **Measure Target** panel, refer to [53.6.2 Multiple back-sights](#).

---

### 53.6.5

#### **Orientate to line**

---

##### **Description**

This method can be used to calculate the 2D or 3D local coordinates for the instrument setup and the orientation of the horizontal circle. The calculation is done using the distance and angle measurements to two target points.

The first target point defines the origin of the local coordinate system. The first target point can be measured or selected from the job.

The line between the first and the second target point defines, depending on the working style, the local direction of North, East or a User defined direction.

The coordinates of the first target point can be changed in the **Measure Target** screen. Editing the coordinates shifts the origin of the coordinate system.

---

##### **Requirements**

All coordinates calculated are local coordinates.

---

##### **Access**

In **Total Station Setup**, select **Setup method: Orientate to line**. Press **OK**. In **Setup Details** type in the required information. Press **OK**.



For a description of the **Measure Target** panel, refer to [53.6.2 Multiple back-sights](#).

---

### 53.6.6

#### **Orientate to object**

---




##### **Description**

This method is used to set up the instrument referring to an arbitrary object coordinate system.


The object coordinate system is defined by at least three known points having 3D coordinates. The station coordinates are unknown. To set up the instrument, distance and angle measurements to at least three known 3D target points must be performed.


After a successful setup, the station coordinates and all subsequently measured points are referring to the object coordinate system.

The position values Easting and Northing are related to the X/Y plane of the object coordinate system. The height component refers to the Z-axis.

-  In contrast to the coordinates, the observation values do not have to refer to the object coordinate system, as the Z-axis does not have to be parallel to the plumb line.
-  Reflector heights always refer to the plumb line. Since the plumb line does not have to coincide with the Z-axis, changing the reflector height can lead to changes in all three coordinate components (E, N, H).
-  Apps which cannot be used when this setup method was used are:

- Stake road
- Check road
- Stake rail
- Check rail
- Stake tunnel
- Check tunnel
- Meas plane/grid
- Traverse
- Measure sets
- TS hidden point
- COGO Intersection method Two TS observations

 Measure foresight from the toolbox for apps cannot be used when this setup method was used.

 **AP tilt compensation** cannot be used when this setup method was used.

## Requirements

- The measured setup points must have 3D coordinates. 1D (height only) or 2D (position only) coordinates are not allowed.
- Distances must be measured to at least three target points.
- The scale factor of 1 is used. A user defined scale factor is ignored. To check the current scale factor select **Current setup** in the **Instrument**.  
The scale factor is defined on the **TS scale** page when creating or editing a job.

## Access

In **Total Station Setup**, select **Setup method: Orientate to object**. Press **OK**.

In **Setup Details** type in the required information. Press **OK**.



For a description of the **Measure Target** panel, refer to [53.6.2 Multiple backsights](#).

## 53.7

### Setup Results

#### Description

The results panel is displayed after pressing **Calculate** in the **Measure Target** panel. The results panel is part of the **Multiple backsights**, **Transfer height**, **Resection**, **Orientate to line** and **Orientate to object** setup methods.

After three measurements to known targets, the calculations can be done using the robust method or the least squares method. For **Resection**, the calculations can also be done using the Helmert method. For **Orientate to object**, the calculations are always done using the robust method. For **Orientate to line**, no adjustment is applicable.

After the setup is set, all following measurements will be related to this new setup and orientation.



For information on camera and images refer to [34 Camera & Imaging](#).

## Setup Results, Results page

| Setup Results                     |                                     |
|-----------------------------------|-------------------------------------|
| Results                           | Setup Targets 3D viewer Camera      |
| New height                        | <b>99.996 m</b>                     |
| Old height                        | <b>100.000 m</b>                    |
| Difference in height              | <b>0.004 m</b>                      |
| Height quality (1 $\sigma$ )      | <b>0.003 m</b>                      |
| Use the new height for this setup | <input checked="" type="checkbox"/> |

Fn Set Robust Page Fn

| Key                                    | Description   |
|--|---|
| <b>Set</b>                             | To set the orientation, to store all setup data and exit the app.<br>For <b>Transfer height</b> :<br>To store all setup data and exit the app.  |
| <b>Done</b>                            | To exit the setup without setting it, the setup is incomplete.  |
| <b>Robust</b> or <b>Least Sqrs</b>     | To display the results for the robust or the least squares calculation method.<br>Available for setup method <b>Resection</b> .   |
| <b>Page</b>                            | To change to another page on this panel.  |
| <b>Fn 3 param</b> or <b>Fn 4 param</b> | Switches between a 3 parameter and 4 parameter calculation. For 3 parameter, the current scale is not applied to setup observations for a new setup calculation. For 4 parameter, the current scale is applied. The setup coordinates are automatically updated according to the setting used. Defaults to 4 parameter.<br>Available for setup methods <b>Resection</b> . |
| <b>Fn Params</b>                       | To access <b>Parameters</b> .<br>Available for setup method <b>Orientate to object</b> .  |
| <b>Fn Add target</b>                   | To access <b>Measure Target</b> and to measure more target points.  |
| <b>Fn Scale</b>                        | To access <b>Scale Corrections</b> . Refer to <a href="#">New Job,TS scale page</a> .<br>Available for setup method <b>Resection</b> .  |
| <b>Fn Scale fctr</b> or <b>Fn ppm</b>  | To display the scale results by scale factor or as a ppm value.<br>Available for setup method <b>Resection</b> .  |

### Description of fields

| Field                  | Option       | Description  |
|------------------------|--------------|--|
| <b>New orientation</b> | Display only | New oriented azimuth with running angle as telescope moves. Unavailable for setup methods <b>Transfer height</b> and <b>Orientate to object</b> .  |
| <b>Angle right</b>     | Display only | Available when <b>Hz angle display: Angle right</b> is configured in <b>Regional, Angle</b> page. Displays the horizontal angle difference between the backsight point and the current telescope position. |

| Field   | Option       | Description   |
|---|--------------|---|
| <b>Difference in height</b>                     | Display only | The difference between the new calculated height and the old height.<br>Available for setup methods <b>Multiple backsights</b> and <b>Transfer height</b> .   |
| <b>Use the new height</b>                       | Check box    | For setup method <b>Multiple backsights</b> :<br>When this box is checked, both orientation and height are updated. If not checked, only the orientation is updated.<br>For setup method <b>Transfer height</b> :<br>When this box is checked, the setup height is updated. If not checked, the setup height does not change.<br>Not available for any other setup methods. |
| <b>New height</b>                               | Display only | The calculated height is displayed.<br>Available for setup methods <b>Multiple backsights</b> and <b>Transfer height</b> .  |
| <b>Old height</b>                               | Display only | The original height is displayed.<br>Available for setup methods <b>Multiple backsights</b> and <b>Transfer height</b> .  |
| <b>Height quality (1 <math>\sigma</math>)</b>   | Display only | Standard deviation of the calculated setup height.<br>Available for setup methods <b>Transfer height</b> .  |
| <b>Easting</b>                                  | Display only | The calculated Easting is displayed.<br>Available for setup methods <b>Resection, Orientate to line</b> and <b>Orientate to object</b> .  |
| <b>Northing</b>                                 | Display only | The calculated Northing is displayed.<br>Available for setup methods <b>Resection, Orientate to line</b> and <b>Orientate to object</b> .   |
| <b>Height</b>                                   | Display only | The calculated Height is displayed.<br>Available for setup methods <b>Resection, Orientate to line</b> and <b>Orientate to object</b> .   |
| <b>Apply the computed height for this setup</b> | Check box    | When this box is checked, then the height from the solution is set as the setup height. When this box is not checked, then the height is not updated.<br>Available for setup method <b>Resection</b> .  |
| <b>New orientation</b>                          | Display only | The calculated orientation is displayed.<br>Available for setup methods <b>Orientate to line</b> .  |

#### Next step

Page changes to the **Setup** page.

## Setup Results, Setup page

← **Setup Results** Hz 0.0010 g V 0.0002 g 17:04

Results **Setup** Targets 3D viewer Camera

|                   |         |
|-------------------|---------|
| Point ID          | TPS4    |
| Instrument height | 1.500 m |
| Point code        | <None>  |
| Current PPM       | 0.0     |

Fn Set Page Fn

| Key  | Description  |
|--|--|
| <b>Set</b>                                   | To set the orientation, to store all setup data and exit the app.<br>For <b>Transfer height</b> :<br>To store all setup data and exit the app.   |
| <b>Done</b>                                  | To exit the setup without setting it, the setup is incomplete.   |
| <b>Scale</b>                                 | To type in values for the scale corrections. Refer to <a href="#">New Job,TS scale page</a> .<br>Unavailable for setup methods <b>Transfer height</b> and <b>Orientate to object</b> .   |
| <b>ppm/Scale fctr</b>                        | To switch between displaying the setup scale factor and the setup ppm.   |
| <b>Page</b>                                  | To change to another page on this panel.   |
| <b>Fn 3 param</b><br>or<br><b>Fn 4 param</b> | Switches between a 3 parameter and 4 parameter calculation. For 3 parameter, the current scale is not applied to setup observations for a new setup calculation. For 4 parameter, the current scale is applied. The setup coordinates are automatically updated according to the setting used. Defaults to 4 parameter.<br>Available for setup method <b>Resection</b> . |

### Description of fields

| Field                              | Option          | Description  |
|------------------------------------|-----------------|--|
| <b>Point ID</b>                    | Display only    | ID of the current setup.   |
| <b>Instrument height</b>           | Editable field  | The current instrument height.   |
| <b>Point code</b>                  | Selectable list | Select a point code for the setup point if desired.  |
| <b>Current PPM / Current scale</b> | Display only    | The current job scale. Refer to <a href="#">New Job,TS scale page</a> for more information on scale corrections. |

### Next step

**Page** changes to the **Quality** page.

## Setup Results, Quality page

For a description of the softkeys refer to [Setup Results,Setup page](#).

This page is not available for setup methods **Transfer height** or **Orientate to line**.

## Description of fields

| Field  | Option       | Description   |
|--|--------------|---|
| <b>New orientation</b>                                 | Display only | New oriented azimuth with running angle as telescope moves.<br>Available for setup method <b>Multiple backsights</b> .                |
| <b>Difference in height</b>                            | Display only | Delta height, the difference between original and calculated height.<br>Available for setup method <b>Multiple backsights</b> .       |
| <b>Easting quality (1 <math>\sigma</math>)</b>         | Display only | Standard deviation of the calculated setup Easting.<br>Available for setup methods <b>Resection</b> and <b>Orientate to object</b> .  |
| <b>Northing quality (1 <math>\sigma</math>)</b>        | Display only | Standard deviation of the calculated setup Northing.<br>Available for setup methods <b>Resection</b> and <b>Orientate to object</b> . |
| <b>Height quality (1 <math>\sigma</math>)</b>          | Display only | Standard deviation of the calculated setup height.  |
| <b>New orientation quality (1 <math>\sigma</math>)</b> | Display only | Standard deviation of the calculated orientation.   |

## Next step

Page changes to the **Targets** page.

## Setup Results, Targets page

This panel displays information about the accuracy of the measured target points and allows exclusion of measurements from the calculation.

Extra measurements can be made and measurements can be deleted.

This page is not available for setup method **Orientate to line**.

| Target Point | Use | Status         | Height diff m |
|--------------|-----|----------------|---------------|
| TPS1         | Yes | Out of limit ! | 0.005 m       |
| TPS3         | Yes | Out of limit ! | -0.005 m      |

Fn Set Use Remove Page Fn

| Key        | Description  |
|------------|--|
| <b>Set</b> | To set the calculated setup for all setup methods. The setup values are updated automatically if target points are added or removed. |



| Key           | Description   |
|---------------|---|
| <b>Use</b>    | To change between using the selected point as 3D, 2D, 1D or not at all, in the calculation. The change automatically updates any new coordinate or orientation values.<br>For setup method <b>Orientate to object</b> : To set <b>Yes</b> or <b>No</b> in the metadata for excluding/including the highlighted point for the calculation. |
| <b>Remove</b> | To delete a point from the list of measured target points and exclude it from the Setup calculation.  |
| <b>More</b>   | To change the metadata displayed.   |
| <b>Page</b>   | To change to another page on this panel.  |

#### Description of metadata

| Metadata             | Description   |
|----------------------|---|
| -                    | The point ID of the measured target points.   |
| <b>Out of limit</b>  | The <b>Out of limit</b> indicates that the delta value of either measured horizontal angle, distance or height exceeds the calculation limit.<br>Unavailable for <b>Orientate to object</b> .   |
| <b>Use</b>           | Indicates if and how a target point is used in the setup calculation. Choices are <b>3D</b> , <b>2D</b> , <b>1D</b> and <b>No</b> .   |
| <b>Hz diff</b>       | Difference between calculated and measured horizontal angle for the target points. If a target point does not have coordinates, ----- are displayed. Differences exceeding the defined limit are indicated by <b>Out of limit</b> .                     |
| <b>Distance diff</b> | Difference between calculated and measured distance from the setup to the target points. If a target point does not have coordinates, ----- are displayed. Differences exceeding the defined limit are indicated by <b>Out of limit</b> .               |
| <b>Height diff</b>   | Difference between the known control point height and the measured height of the target point. If a target point does not have a height coordinate, ----- are displayed. Differences exceeding the defined limit are indicated by <b>Out of limit</b> . |
| <b>Easting diff</b>  | Difference between control point and measured point, calculated from new setup coordinates.   |
| <b>Northing diff</b> | Difference between control point and measured point, calculated from new setup coordinates.   |

#### Next step

**Page** changes to the **3D viewer** page.

## 53.8

### Finding a Target Point

#### Description

The **Find Target** panel can be accessed, to guide the prism to the selected target point.

The panel is only available if the Stakeout app is available on the instrument.

The functionality of this panel is similar to a stakeout routine and is intended to help find hidden survey bench marks or base points.


---

#### Access

Press **Fn Find** in **Measure Target** once enough data is available to calculate roughly the new orientation.

---

#### Find Target

This panel is similar to the **Stake Points**,  page and is configured through the **Stake Points** settings. Refer to [Stake Points,page](#) for a detailed description of this panel.

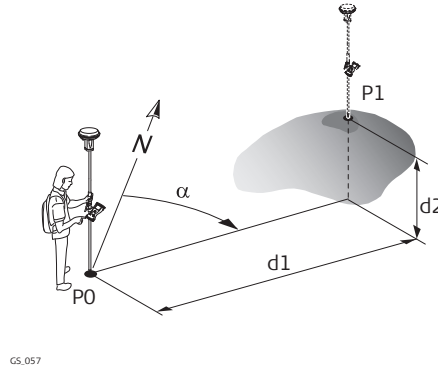
---

## Description

The Stakeout app is used to place marks in the field at predetermined points. These predetermined points are the points to be staked. The points to be staked can

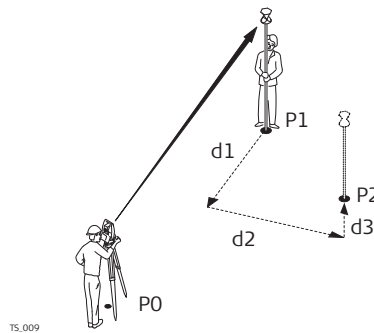
- be uploaded to a job on the instrument using Infinity.
- exist in a job on the instrument.
- be uploaded from an ASCII file to a job on the instrument. Use **Import data\ASCII** from the job menu.

## Diagram



## GS:

- P0 Current position
- P1 Point to be staked
- d1 Stakeout distance
- d2 Height difference between current position and point to be staked
- $\alpha$  Stakeout direction



## TS:

- P0 Setup
- P1 Current position
- P2 Point to be staked
- d1 Stakeout element
- d2 Stakeout element
- d3 Stakeout element

## Stakeout modes

Points can be staked using different modes:

- Polar mode.
- Orthogonal mode.



Staking out is possible for RTK rover and TS.



The points to be staked must exist in a job on the active memory device or can be typed in.

## Linked jobs and global data

Linked jobs will overwrite the points and lines from the global design job selected in **Design Data**.

## Coordinate system

If staking local grid points with GNSS, always ensure that the correct coordinate system is being used. For example, if the points to be staked are stored in WGS 1984, the active coordinate system must also be WGS 1984.

## Point types

It is possible to stake:

- Position only points.
- Height only points.
- Points with full sets of coordinates.

## Height types

Height type of the point to be staked:

Orthometric OR ellipsoidal

Height type computed for current position:

Orthometric OR ellipsoidal depending on the

- configured transformation,
- availability of a geoid model,
- height type of the point to be staked.

If possible, the height type of the point to be staked is computed for the current position.

## Height source

Heights can be taken into account from

- the vertical component of a coordinate triplet.
- a **D**igital **T**errain **M**odel.

The DTM licence key must be loaded. Refer to [30.3 Entitlements & licences](#) for information on how to enter the licence key.

If loaded, the height of the points to be staked can be edited in the field.

## Coding of staked points

Codes can be attached to staked points. The behaviour of the coding functionality depends on the definition of a page with editable fields for coding and attributes.

## Averaging of staked points

The principles for averaging are identical to the averaging principles of the Measure app.

## 54.2

### Accessing Stakeout

#### Access

Select **Leica Captivate - Home: Stake points**.



The points to be staked are stored in the selected design job.

Points which are measured during staking out are stored in the selected job.

## 54.3

### Configuring Stakeout

#### Access

Select **Leica Captivate - Home: Stake points**. Press **Fn Settings**.

## Settings, General page

This panel consists of several pages. The explanations for the softkeys given here are valid for all pages, unless otherwise stated.

| Key  | Description   |
|------|---|
| OK   | To accept changes and return to the panel from where this panel was accessed. |
| Page | To change to another page on this panel.                                      |

### Description of fields

| Field  | Option                              | Description   |
|--|-------------------------------------|---|
| <b>Automatic-ly select next closest point</b>  | Check box                           | The order of the points suggested for staking out.<br>When this box is checked, then the next point suggested for staking out is the point closest to the point which was staked. If there are many points in the job, the search can take a few seconds.<br>When this box is not checked, the next point suggested for staking out is the subsequent one in the job. |
| <b>Store point with</b>                        | <b>Design point ID</b>              | The staked points are stored with the same point IDs as the points to be staked.  |
|  | <b>Design point ID &amp; prefix</b> | Adds the setting for <b>Prefix / suffix</b> in front of the original point IDs.   |
|  | <b>Design point ID &amp; suffix</b> | Adds the setting for <b>Prefix / suffix</b> at the end of the original point IDs.   |
|  | <b>Individual point ID</b>          | The staked points are stored with an alphanumeric point ID entered.   |
| <b>Prefix / suffix</b>                         | Editable field                      | Available for <b>Point ID: Design point ID &amp; prefix</b> and <b>Point ID: Design point ID &amp; suffix</b> . The identifier with up to four characters is added in front of or at the end of the ID of the staked point.   |
| <b>View results page after staking a point</b> | Check box                           | When this box is checked, the stake results are displayed after staking a point.  |

## Next step

Page changes to the **Graphics** page.

## Settings, Graphics page

### Description of fields

| Field                   | Option                            | Description   |
|-------------------------|-----------------------------------|---|
| <b>Help me navigate</b> |                                   | The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Stake app are based on this selection.  |
|                         | <b>From behind instrument</b>     | For TS:<br>The direction of the orientation is from the instrument to the point to be staked.<br><br>When this setting is used in combination with <b>Navigational arrow types: Direction &amp; distance</b> , then the direction and distance to the next Stakeout point is displayed without the need of a measurement.<br>Distance = Horizontal distance from instrument station to stakeout point.<br>Direction = Direction from current telescope position to the point to be staked.<br>When turning the instrument, the direction changes according to the telescope position of the instrument whereas the distance does not change. When a measurement is done, direction and distance are updated according to the measurement results. |
|                         | <b>Facing instrument</b>          | For TS:<br>The direction of the orientation is from the current position relative to the instrument.  |
|                         | <b>Facing last measured point</b> | The direction of the orientation is from the current position relative to the last recorded point. If no points are yet staked, <b>Help me navigate: Facing north</b> is used for the first point to be staked.   |
|                         | <b>Facing point (design data)</b> | The direction of the orientation is from the current position relative to a point from the design job.  |
|                         | <b>Facing point</b>               | The direction of the orientation is from the current position relative to a point from the job.   |
|                         | <b>Using base line (design)</b>   | The direction of the orientation is parallel to a baseline from the design job. Open the drop-down list to create, edit or delete a baseline.   |
|                         | <b>Using base line</b>            | The direction of the orientation is parallel to a baseline from the job. Open the drop-down list to create, edit or delete a baseline.  |
|                         | <b>Facing north</b>               | The direction of the orientation is from the current position relative to North   |

| Field   | Option                          | Description   |
|---|---------------------------------|---|
|   | <b>Following arrow</b>          | The direction of the orientation is from the current moving direction to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked. The current position must have moved at least 0.5 m for the orientation to be calculated.<br>If <b>AP tilt compensation</b> is in use, the direction of the orientation is according to the AP20 heading.  |
|   | <b>Facing sun</b>               | For GS:<br>The position of the sun calculated from the current position, the time and the date.   |
| <b>Point ID or Base line</b>                            | Selectable list                 | Available for <b>Help me navigate: Facing point (design data)</b> , <b>Help me navigate: Facing point</b> , <b>Help me navigate: Using base line</b> and <b>Help me navigate: Using base line (design)</b> . To select the point or line to be used for orientation.  |
| <b>Navigational arrow types</b>                         |                                 | The method of staking out.  |
|   | <b>Direction &amp; distance</b> | The direction from the orientation reference, the horizontal distance and the cut/fill are displayed.<br><br>When this setting is used in combination with <b>Help me navigate: From behind instrument</b> , then the direction and distance to the next Stakeout point is displayed without the need of a measurement.<br>Distance = Horizontal distance from instrument station to stakeout point.<br>Direction = Direction from current telescope position to the point to be staked.<br>When turning the instrument, the direction changes according to the telescope position of the instrument whereas the distance does not change. When a measurement is done, direction and distance are updated according to the measurement results. |
|   | <b>In/out, left/right</b>       | The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed.  |
| <b>Switch to bulls eye when 0.5m (1.5ft) from point</b> | Check box                       | When this box is checked, a bulls eye bubble is shown in the stakeout graphic when less than half a metre from the point being staked.  |

| Field  | Option   | Description  |
|--|--|--|
| <b>Beep faster when getting close to point</b> | Check box  | The instrument beeps when the distance from the current position to the point to be staked is equal to or less than defined in <b>Start within</b> .<br>The closer the instrument is to the point to be staked the faster the beeps are. |
| <b>Distance to use</b>                         | <b>Height, Horizontal distance</b> or <b>Position &amp; height</b> | Available when <b>Beep faster when getting close to point</b> is checked. The type of distance to use for staking.   |
| <b>Start within</b>                            | Editable field   | Available when <b>Beep faster when getting close to point</b> is checked. The horizontal radial distance, from the current position to the point to be staked.   |

#### Next step

Page changes to the **Quality control** page.

#### Settings, Quality control page

#### Description of fields

| Field                                   | Option  | Description   |
|---|---|---|
| <b>Check differences before storing</b> | Check box   | Allows a check to be made on the horizontal and vertical difference between the staked point and the point to be staked. If the defined limit is exceeded, the stake out can be repeated, skipped or stored.          |
| <b>Differences to check</b>             | <b>Position, Height</b> or <b>Position &amp; height</b> | The type of differences to be checked before storing a point.   |
| <b>Position limit</b>                   | Editable field  | Available when <b>Check differences before storing</b> is checked. Sets the maximum horizontal coordinate difference accepted in the position check.  |
| <b>Position limit</b>                   | Editable field  | Available when <b>Check differences before storing</b> is checked. Sets the maximum vertical difference accepted in the height check.   |
| <b>Prompt off-setting annotation</b>    | Check box   | Available for the <b>Seismic stakeout</b> app. When this box is checked, a specific annotation must be entered when the current staked point is out of distance tolerance. This annotation is stored as annotation 1. |


#### Next step

Page changes to the **Heights** page.



Settings,  
Heights page

Description of fields

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Allow editing the height of the selected point</b>    | Check box      | When this box is checked, the value for <b>Design height</b> displayed in <b>Stake Points</b> ,  page, can be changed. The design height is the height of the point to be staked.<br><br>When this box is not checked, the value for <b>Design height</b> cannot be changed. |
| <b>Apply offset to height of all points being staked</b> | Check box      | Allows a constant height offset to be applied to the height of the points being staked.   |
| <b>Height offset</b>                                     | Editable field | The height offset that is applied.  |

Next step




Page changes to the **Info** page.


Settings,  
Info page

| Key               | Description  |
|-------------------|--|
| <b>OK</b>         | To accept changes and to return to previous panel. |
| <b>Clear</b>      | To set all fields to <b>Unused line</b> .          |
| <b>Fn Default</b> | To recall the default settings.                    |

Description of fields

| Field                         | Option                              | Description   |
|-------------------------------|-------------------------------------|---|
| <b>Show user defined page</b> | Check box                           | The user-defined page to be shown in the <b>Stake Points</b> panel. |
| <b>Page to show</b>           | Selectable list                     | The names of the available pages.                                   |
| <b>1st line</b>               | Display only                        | Fixed to <b>Point ID</b> .  |
| <b>2nd line to 16th line</b>  |                                     | For each line, one of the following options can be selected.        |
|                               | <b>Separator and Unused line</b>    | Empty line.   |
|                               | <b>Point ID</b>                     | Editable field for the point ID.                                    |
|                               | <b>Target height</b>                | Editable field for prism height.                                    |
|                               | <b>Code</b>                         | Editable field for codes.   |
|                               | <b>Code description</b>             | Display only field for the description of codes.                    |
|                               | <b>Attribute 01 to Attribute 02</b> | Editable field for attributes for codes.                            |

| Field | Option                     | Description  |
|-------|----------------------------|--|
|       | <b>Height difference</b>   | Display only field for the vertical offset between the defined position and the current position.  |
|       | <b>Direction to point</b>  | Display only field for the direction from the current position to the point to stakeout.   |
|       | <b>Distance to point</b>   | Display only field for the distance from the current position to the point to stakeout.  |
|       | <b>Design East</b>         | Display only field for the Easting of the design point.  |
|       | <b>Design North</b>        | Display only field for the Northing of the design point.   |
|       | <b>Design height</b>       | Display only field for the height of the design point, depending on the defined heights to use.  |
|       | <b>Easting</b>             | Display only field for the Easting coordinate of measured point.   |
|       | <b>Northing</b>            | Display only field for the Northing coordinate of measured point.  |
|       | <b>Height</b>              | Display only field for the height coordinate of the measured point.  |
|       | <b>3D quality</b>          | Display only field for the current 3D coordinate quality of computed position.   |
|       | <b>Cut/fill</b>            | Display only field for the height difference between the design height and the measured height.  |
|       | <b>Go forward/backward</b> | Distance to point. Available for staking. For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
|       | <b>Go left/right</b>       | Distance to point. Available for staking. For <b>Navigational arrow types: In/out, left/right</b> in 3D viewer equivalent to:<br><br>       |
|       | <b>Go</b>                  | Distance to point. Available for staking. For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |

| Field | Option                        | Description   |
|-------|-------------------------------|---|
|       | <b>Turn left/<br/>right</b>   | Direction to point. Available for staking.<br>For <b>Navigational arrow types: Direction &amp; distance</b> in 3D viewer equivalent to:<br><br> |
|       | <b>Difference in easting</b>  | Display only field for the difference in Easting between the current position and the point to stakeout.  |
|       | <b>Difference in northing</b> | Display only field for the difference in Northing between the current position and the point to stakeout.   |

### Next step

Page changes to the **TS specific** page.

Settings,  
TS specific page

### Description of fields

| Field  | Option                       | Description  |
|--|------------------------------|--|
| <b>Do not update stakeout values between distance measurements</b>           | Check box                    | When this box is checked, angles and stakeout values are updated after a distance was measured. Then all values are frozen until the next distance is taken. |
| <b>Automatically aim instrument to point being staked</b>                    | Check box                    | When this box is checked, the instrument positions automatically to the point to be staked.  |
| <b>Automatic behaviour</b>   | <b>Position only</b>         | Available when <b>Automatically aim instrument to point being staked</b> is checked.<br>Instrument positions horizontally to the point to be staked.         |
|  | <b>Position &amp; height</b> | Instrument positions horizontally and vertically to the point to be staked.  |
| <b>Show direction &amp; distance when selecting a new point to be staked</b> |                              | For each point which is selected for staking, angle and distance information is momentarily displayed in the message line.                                   |

| Field                                  | Option                   | Description  |
|--|--------------------------|--|
|  | <b>Instrument</b>        | The delta horizontal angle that the instrument must turn to the point, and the distance from the instrument to the point, is displayed in the message line.  |
|  | <b>Last staked point</b> | The delta horizontal angle that the instrument must turn to the point, and the distance from the last staked point, is displayed in the message line.  |
| <b>Measure all points in two faces</b> | Check box                | To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When an instrument is fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |

### Next step

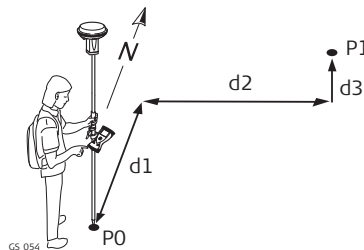
Page changes to the **Report sheet** page. Refer to [38 Apps - General](#).

## 54.4

### Staking Out

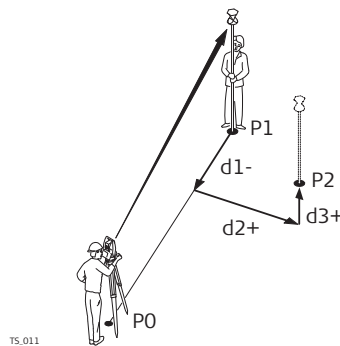
#### Diagram

This diagram shows an example for **Navigational arrow types: In/out, left/right**.



#### For GS:

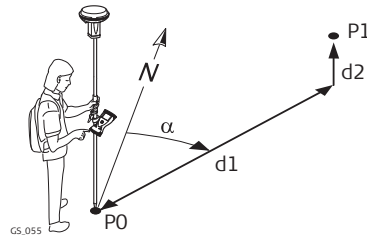
- P0 Current position
- P1 Point to be staked
- d1 Forwards or backwards
- d2 Right or left
- d3 Fill or cut



#### For TS:

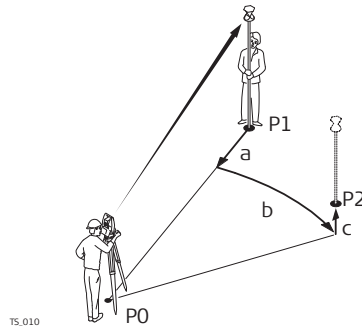
- P0 Setup
- P1 Current position
- P2 Point to be staked
- d1 Forward or backwards
- d2 Right or left
- d3 Cut or fill

This diagram shows an example **Navigational arrow types: Direction & distance**.



**For GS and TS:**

- P0 Current position
- P1 Point to be staked
- d1 Distance
- d2 Cut or fill
- $\alpha$  Direction



**For TS with Help me navigate:  
From behind instrument:**

- P0 Setup
- P1 Current position
- P2 Point to be staked
- a Distance
- b Horizontal angle
- c Cut or fill



For information on camera and images refer to [34 Camera & Imaging](#).

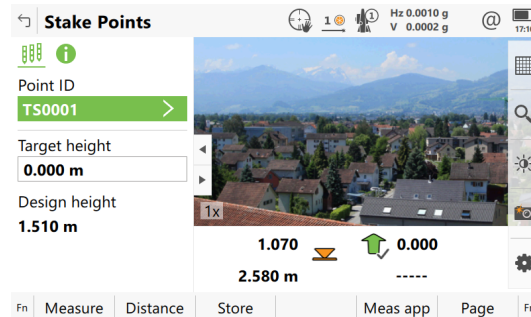
**Stake Points,  
page**

The pages shown are from a typical working style. An extra page is available when a user-defined page is used.

The selected view of the 3D viewer is the one last used,

- when leaving the app and returning to it.
- when turning off and on the instrument.

For an explanation of the graphical symbols refer to [37.4.4 Orientation Information for Stakeout](#).



| Key            | Description  |
|----------------|--|
| <b>Measure</b> | <p>For GS:<br/>To start measuring the point being staked. The key changes to <b>Stop</b>. The difference between the current position and the point being staked is still displayed.</p> <p>For TS:<br/>To measure a distance and store distance and angles.</p> |

| Key  | Description   |
|--|---|
| <b>Stop</b>                                | For GS:<br>To end measuring the point being staked. When <b>Automatically stop point measurement</b> is checked in <b>GS Quality Control, General</b> page recording of positions ends automatically as defined by the stop criteria. The key changes to <b>Store</b> . After ending the measurements, the differences between the measured point and the point to be staked are displayed. |
| <b>Store</b>                               | For GS:<br>To store the measured point. When <b>Automatically store point</b> is checked in <b>GS Quality Control, General</b> page, the measured point is stored automatically. The key changes to <b>Measure</b> .<br><br>For TS:<br>To store angles and distance. Distance must be measured before.  |
| <b>Distance</b>                            | For TS:<br>To measure a distance.   |
| <b>Flip view</b> or <b>Flip view</b>       | To reverse the graphical display top to bottom. A reversed graphical display can be used when the point to be staked lies behind the current position.  |
| <b>Meas app</b>                            | To measure more points which may be needed during staking out.<br>Available when <b>Measure</b> is displayed.   |
| <b>Page</b>                                | To change to another page on this panel.  |
| <b>Fn Settings</b>                         | To configure the Stakeout app. Refer to <a href="#">54.3 Configuring Stakeout</a> .   |
| <b>Fn Display</b>                          | To configure what is displayed in the 3D viewer.  |
| <b>Fn Connect</b> and <b>Fn Disconnect</b> | For GS:<br>To connect/disconnect from the <b>GPS</b> reference data.  |

#### Description of fields

| Field                 | Option          | Description   |
|-----------------------|-----------------|---|
| <b>Point ID</b>       | Selectable list | The point ID of the point to be staked.   |
| <b>Antenna height</b> | Editable field  | For GS:<br>The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style. |
| <b>Target height</b>  | Editable field  | For TS:<br>The prism height.  |
| <b>Design height</b>  | Display only    | Available when <b>Allow editing the height of the selected point</b> is not checked in <b>Settings, Heights</b> page.   |

| Field | Option         | Description   |
|-------|----------------|---|
|       | Editable field | Available when <b>Allow editing the height of the selected point</b> is checked in <b>Settings, Heights</b> .<br><br>The design height, which is the orthometric height of the point to be staked, is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. The value for <b>Height offset</b> configured in <b>Settings, Heights</b> page is not taken into account.<br><br>Changing the value for <b>Design height</b> changes the values displayed for cut and fill. |
| -     | -              | The orthometric height of the current position is displayed with the stake height difference in the stakeout graphics. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. The value for <b>Height offset</b> configured in <b>Settings, Heights</b> page is taken into account.   |

## Stake Results, General page

If **View results page after staking a point** is checked in **Settings, General** page, this panel opens automatically once a point is measured and stored.

| Key  | Description                              |
|------|--|
| OK   | To return to the stake panel.            |
| Page | To change to another page on this panel. |

### Description of fields

| Field                        | Option         | Description   |
|------------------------------|----------------|---|
| <b>Design point ID</b>       | Display only   | The point ID of the design point.   |
| <b>Store staked point as</b> | Editable field | The point ID of the point staked.   |
| <b>Design height</b>         | Display only   | The entered design elevation.   |
| <b>Measured height</b>       | Display only   | The height measured at the stored point.  |
| <b>Cut/Fill</b>              | Display only   | The height difference between the <b>Design height</b> and the <b>Measured height</b> . |
| <b>2D distance</b>           | Display only   | Displays the horizontal difference from the staked point to the point to be staked.     |
| <b>3D distance</b>           | Display only   | Displays the spatial difference from the staked point to the point to be staked.        |

## Stake Results, Elevations page

### Next step

**Page** changes to the **Coords** page. This page displays the design coordinates as well as the differences between design and measured coordinates.

**Page** changes to the **Code** page where codes can be selected or typed in.

**Page** changes to the **Elevations** page.

---

On this page, multiple elevations can be stored to one staked point.

### Example

When measuring the centre of a manhole, the drain below may have pipelines joining at different height levels. To store and stakeout these pipeline inverts, additional heights can be entered. The cut and fill value will automatically be calculated, allowing to transfer this information to the stake marker.

| Key  | Description   |
|------|---|
| OK   | To return to the stake panel. To store all values.    |
| Last | To recall the last stored elevations and information. |
| Page | To change to another page on this panel.              |

### Description of fields

| Field     | Option         | Description   |
|-----------|----------------|---|
| Elevation | Editable field | The entered elevation is stored with the point and used to calculate the cut and fill values.             |
| Cut/Fill  | Display only   | Height of the point being stored<br>– Entered elevation<br>-----<br>= Cut or fill value (always positive) |

### Examples

For cut:

Height of the point being stored  
– Entered elevation  
-----

Result > 0

598.5672 m – 596.4856 m = 2.0816 m = cut  
The displayed value is 2.0816 m.

For fill:

Height of the point being stored  
– Entered elevation  
-----

Result < 0

598.5672 m – 599.7826 m = -1.2154 m = fill  
The displayed value is 1.2154 m.

---



| Field              | Option         | Description   |
|--------------------|----------------|---|
| <b>Information</b> | Editable field | Additional information that must be stored with the elevation.<br>Only the entered Information which also has an entered elevation is stored to the point being stored. |

## 54.5

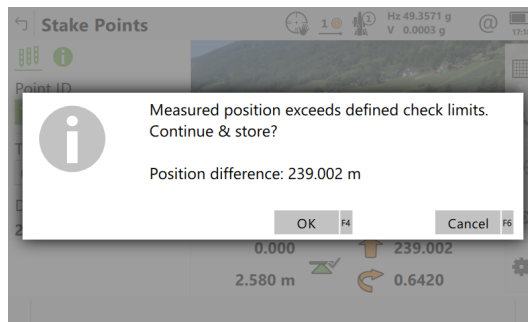
### Stakeout Difference Limit Exceeded

#### Description

If configured a check is made on the horizontal and/or vertical coordinate distance from the staked point to the point to be staked. Refer to [54.3 Configuring Stakeout](#) for information on configuring the check and the limits.

#### Access

If either of the configured difference limits are exceeded, a warning is displayed automatically when the point is stored.



| Key           | Description  |
|---------------|--|
| <b>Cancel</b> | To return to the <b>Stake Points</b> panel without storing the point. Staking out of the same point continues. |
| <b>OK</b>     | To accept the coordinate differences, store the point information and return to the <b>Stake Points</b> panel. |

## 54.6

### Staking Out a DTM or Points & DTM

#### Description

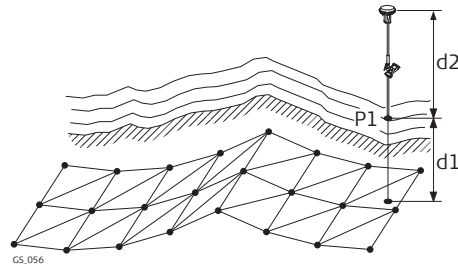
A **Digital Terrain Model** can be staked alone or together with points. The heights of the current positions are compared against the heights of a selected DTM job. The height differences are calculated and displayed.

Staking a DTM can be used for

- staking out where the DTM represents the surface to be staked.
- quality control purposes where the DTM represents the final project surface.

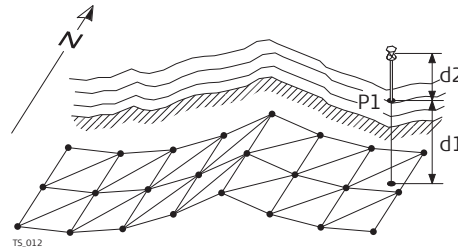
DTM jobs are created in Infinity or imported from a file or created in the **Volume calc** app. DTM jobs are stored in the \DBX directory on the active data storage device.

## Diagram



### For GS:

- P1 Point to be staked
- d1 Cut or fill
- d2 Antenna height



### For TS:

- P1 Point to be staked
- d1 Cut or fill
- d2 Reflector height

## Access

If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).

To stake out DTM heights only:

Select **Leica Captivate - Home: Stake DTM**.

To stake out positions of points and DTM heights:

Select **Leica Captivate - Home: Stake pts & DTM**.



The positions of points to be staked are stored in the selected design job.

Points which are measured during staking out are stored in the selected job.

Heights to be staked out are taken from the selected DTM job.

The DTM job to be used must be stored in the \DBX directory on the active data storage device.

Heights without positions are staked out relative to the selected DTM job.



The stakeout procedure is identical as for the normal Stakeout app but the heights to be staked are taken from the selected DTM job. The negative or positive height differences from the current position to the equivalent point in the selected DTM job is calculated and displayed. Height offsets apply.

55.1

Overview

Description

The Seismic Stakeout app includes all the standard stakeout functionality plus extra features that are specific to seismic survey. It supports exclusion zone files in order to warn users when the selected preplot point position or the current measured position falls inside a protected area. It provides a specific page in the main stakeout panel to help staking, offsetting or skidding preplot points. A "default line width annotation" feature is available for users who need to report the width of the cut line.

Terms

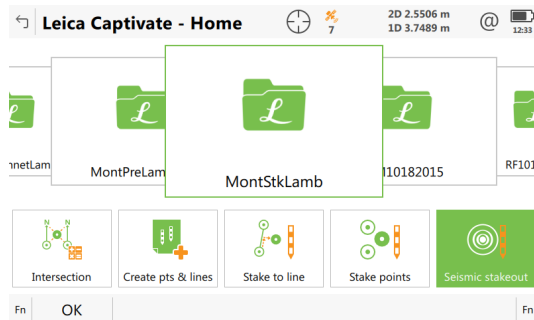
| Term           | Description  |
|----------------|--|
| Exclusion zone | Protected area where drilling is not allowed.  |
| Preplot        | Refers to design. For example preplot points and preplot job - instead of design points or design data job.  |
| Track and bin  | The preplot point IDs are comprised of a track(line) and bin(station). For example, if the point ID 162304 has 3 bin characters then its track would be 162 and its station 304. |

55.2

Accessing Stakeout

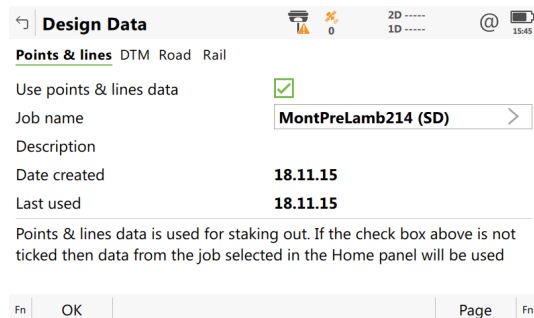
Access

Select **Leica Captivate - Home: Seismic stakeout.**



Design Data

This panel is displayed when **Choose design data when starting app which uses design data** is checked in **Settings**.



| Key         | Description   |
|-------------|---|
| OK          | To accept the selected job.   |
| Page        | To change to another page on this panel.                            |
| Fn Settings | To activate or deactivate job selection at the beginning of an app. |

#### Description of fields

| Field                   | Option          | Description  |
|-------------------------|-----------------|--|
| Use points & lines data | Check box       | When this box is checked, a separate design job can be selected. The design data refers to pre-plot points in the Seismic Stakeout app. The selected design job is visible in 3D viewer. |
| Job name                | Selectable list | Preplot points job   |
| Description             | Display only    | The detailed description of the job.   |
| Date created            | Display only    | The date of when the job was created.  |
| Last used               | Display only    | The date of when the job was last accessed.  |

## Choose Exclusion Zone

| Key         | Description   |
|-------------|---|
| OK          | To validate the selected exclusion zone file. Opens the <b>Define Line Settings</b> panel. The file is converted to an internal format (*.xnz) when used for the first time.                            |
| Display     | To open the Exclusion zone viewer after loading the zones in memory. The file is converted to an internal format (*.xnz) when used for the first time. Refer to <a href="#">Exclusion zone viewer</a> . |
| Fn Settings | To configure Seismic Stakeout app.  |


#### Description of fields

| Field     | Option   | Description  |
|-----------|----------|--|
| File type | ESRI SHP | Polygon shapefile in local grid coordinate system. The current system's units must be the same as the shapefile when used for the first time otherwise the conversion to the internal file format (*.xnz) will be wrong. |

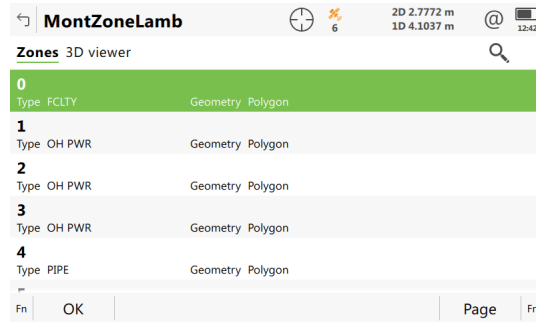
| Field                      | Option               | Description   |
|----------------------------|----------------------|---|
|                            | <b>GPSeismic LZO</b> | Leica exclusion zone format by GPSeismic software.  |
|                            | <b>Survey job</b>    | Leica database  |
| <b>Exclusion zone file</b> | Selectable list      | Available for <b>File type: ESRI SHP</b> and <b>File type: GPSeismic LZO</b> .<br>The file that contains exclusion zones against which the measured or selected preplot position will be tested. The file must be stored in the DATA\ZONE directory on the data storage device.<br><br>Open the selectable list to change the memory device as needed. Select <b>&lt;None&gt;</b> if no file is available for a given project area. Refer to <a href="#">Exclusion Zone Files - SHP</a> . |
| <b>Exclusion zone job</b>  | Selectable list      | Available for <b>File type: Survey job</b> .<br>Job that contains areas to be loaded as exclusion zones against which the measured or selected preplot position will be tested. The selected job must have the same coordinate system as the current working job.   |
| <b>No. of zones</b>        | Display only         | Number of exclusion zones included in the selected job. This number does not take account of multi-parts polygon child zones (for shapefile).   |
| <b>Description</b>         | Display only         | File description as read in the file's header.  |

## Exclusion Zone Files - SHP

| Time             | Date       | Size (kB) |
|------------------|------------|-----------|
| <None>           |            |           |
| 20131217_Buffers | 17.12.2013 | 992 KB    |
| 8312axzn         | 18.03.2013 | 605 KB    |
| Exclusion_8311   | 24.01.2013 | 1073 KB   |
| Infra8312        | 18.03.2013 | 605 KB    |
| MontZoneLamb     | 09.04.2013 | 32 KB     |

| Key                             | Description  |
|---------------------------------|--|
| <b>OK</b>                       | To accept the selection.   |
| <b>Copy</b>                     | To copy the selected file to the internal memory.  |
| <b>SD card, USB or Internal</b> | To change between the data storage devices and the internal memory.<br> The CS30/CS35 has two USB ports. The USB stick, that was inserted first, is used. |

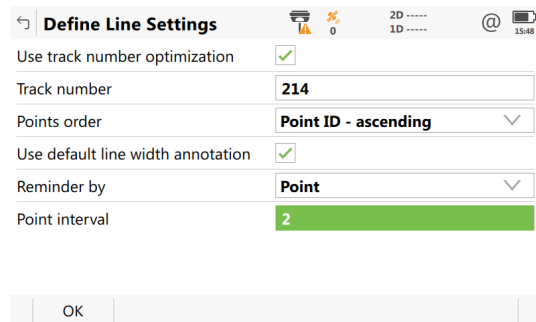
## Exclusion zone viewer



| Key | Description                      |
|-----|----------------------------------|
| OK  | To return to the previous panel. |

## Define Line Settings

Seismic stakeout is usually done following a line of preplot points. The app can take advantage of line settings definitions to improve the Seismic stakeout.



| Key | Description                                |
|-----|--|
| OK  | To open the <b>Seismic Stakeout</b> panel. |

### Description of fields

| Field                                | Option          | Description   |
|--------------------------------------|-----------------|---|
| <b>Use track number optimization</b> | Check box       | The track(line) number can be used internally by the app to filter preplot points that belong to the current line being staked. Enabling this option allows the app to automatically create the reference line needed for the <b>To line (cntrl job)</b> navigation direction. Refer to <a href="#">29.2 Screen, audio &amp; text input</a> .<br>The option also increase the performance of the preplot point test by reducing the number of exclusion zones loaded into memory. |
| <b>Track number</b>                  | Editable field  | Track number of the line being staked. Common prefix identifier of all preplot points that belong to a given line.  |
| <b>Points order</b>                  | Selectable list | Line walking direction as defined by preplot point IDs.   |

| Field                                    | Option          | Description  |
|--|-----------------|--|
| <b>Use default line width annotation</b> | Check box       | This option is for users who need to report the width of the cut line. It allows to store automatically the last entered line width in the staked point Annotation 4. Depending on the reminder method, a dialog will show-up after point store that recall the user to measure and update the line width value. |
| <b>Reminder by</b>                       |                 | Reminder method for line width annotation update.  |
|  | <b>Point</b>    | Reminds after a point interval   |
|  | <b>Distance</b> | Reminds after a distance interval  |
| <b>Point interval</b>                    | Editable field  | Number of staked point after which the default line width annotation must be updated.  |
| <b>Distance interval</b>                 | Editable field  | The distance after which the default line width annotation must be updated.  |

## 55.3

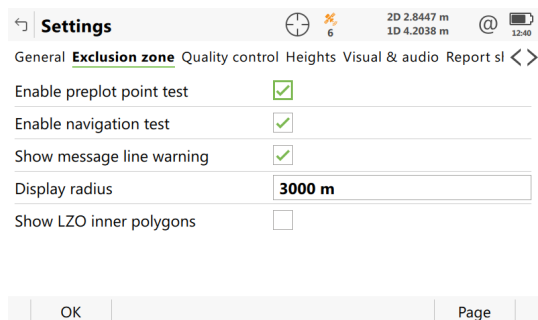
### Configuring Stakeout

#### Access

Select **Leica Captivate - Home: Seismic stakeout**. Press **Fn Settings**.

#### Settings, Exclusion zone page

For all other pages on this panel, refer to [54.3 Configuring Stakeout](#).

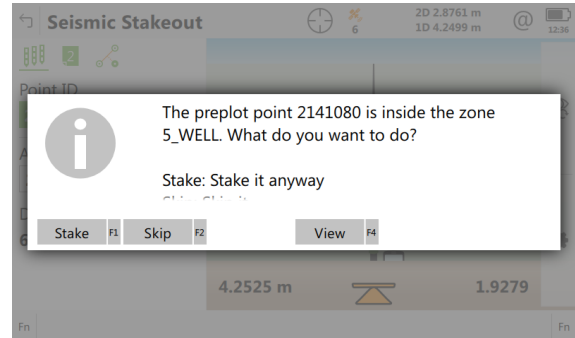
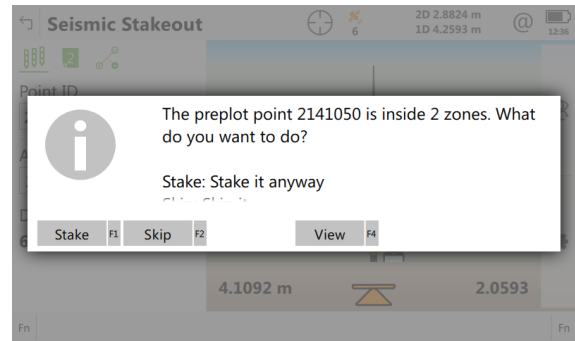


| Key         | Description   |
|-------------|---|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.                                      |

#### Description of fields

| Field                            | Option    | Description   |
|----------------------------------|-----------|---|
| <b>Enable preplot point test</b> | Check box | The preplot point test is done each time the current point ID selection changes in the Seismic Stakeout panel. The preplot point position is tested against exclusion zones and an appropriate warning message appears when the position is inside one or more zones. |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



**Enable navigation test**

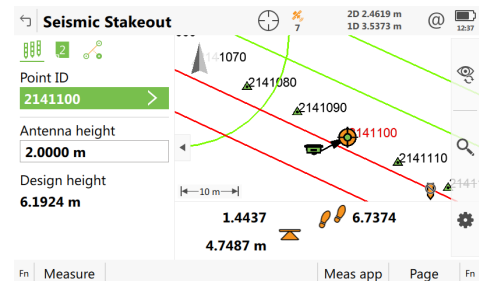
Check box

The navigation test is done continuously on the current measured position. The current position is tested against all exclusion zones in the surrounding area as defined by **Display radius**.



Appears in 3D viewer when the measured position falls inside one or more exclusion zones.

In addition, the touched zone is highlighted in red in the 3D viewer (that could be more than one zone).



Appears 3D viewer when an exclusion zone file is active and the navigation test is disabled.

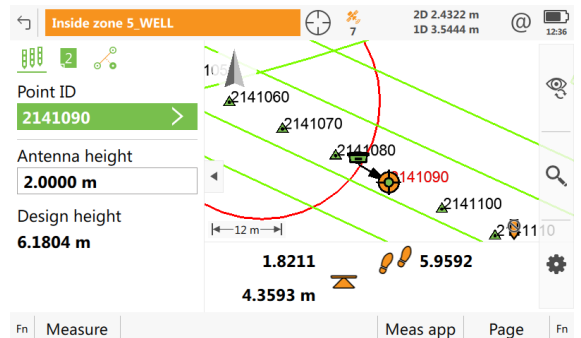
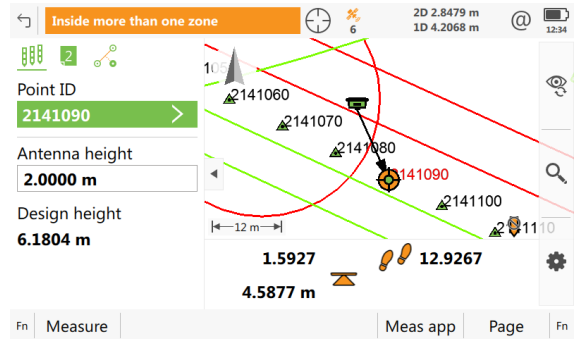
**Show message line warning**


Check box

Inside zone warning displayed at the message line when the current measured position falls inside one or more exclusion zones. The message line stays on for a few seconds when triggered even if the user gets out of the zone(s).



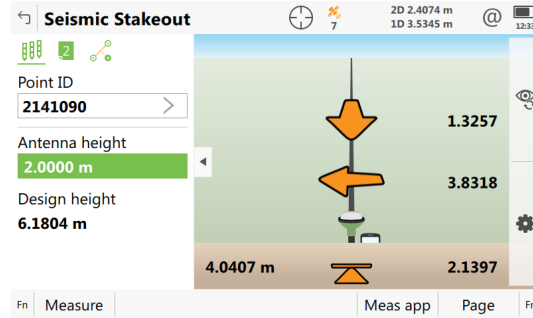
| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|



|                                |                |   |
|--------------------------------|----------------|---|
| <b>Display radius</b>          | Editable field | <p>This radius defines the area around the current measured position for which the exclusion zones will be added to the Seismic Stakeout panel.</p> <p> It is better to keep this value as small as possible to not load too many exclusion zones in memory. The app automatically readjusts this radius when more than 300 zones overlap the defined area</p> |
| <b>Show LZO inner polygons</b> | Check box      | <p>An inner polygon is created when adding an offset to an exclusion zone in GPSeismic (LZO format). Use this option to display inner polygons on the Seismic Stakeout panel. Inner polygons are displayed in yellow and no inclusion test is done against them.</p>  |

Seismic Stakeout, page

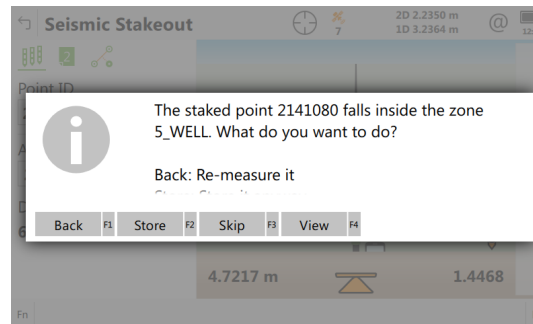
Same as standard Stakeout app, except for specific warning icons that appear in the right bottom corner of the 3D viewer. Refer to 54 Stakeout for a description of keys, fields and standard elements of the graphical display.



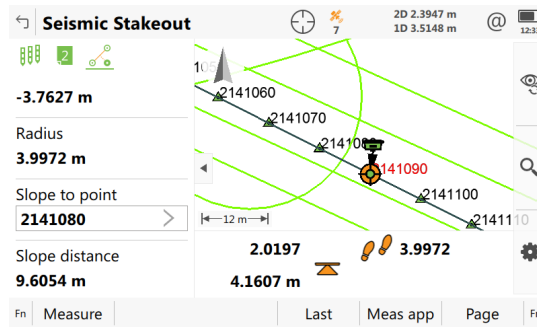
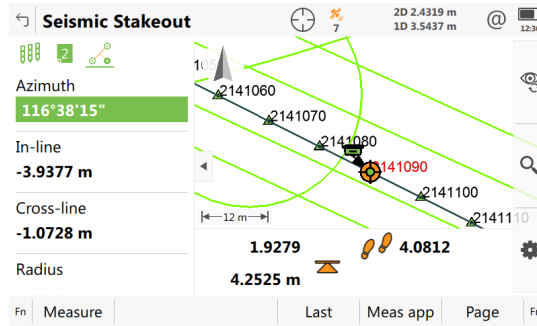
Description of specific elements of the graphical display

| Element | Description  |
|---------|--|
|         | Indicates that current measured position falls inside one or more exclusion zones. |
|         | Indicates that an exclusion zone file is active but navigation test is disabled.   |

If you try to store a staked point that falls inside one or more exclusion zones, then a warning message appears.



| Option       | Description   |
|--------------|---|
| <b>Back</b>  | Re-measure the point.   |
| <b>Store</b> | Store the point regardless of the warning. The touched zone(s) name(s) will be automatically stored in the staked point Annotation 2. |
| <b>Skip</b>  | Do not store the point and skip to next preplot point.  |
| <b>View</b>  | View touched zone(s).   |



Refer to [54.4 Staking Out](#) for a description of the standard keys.

| Key  | Description  |
|------|--|
| Last | To set the <b>Slope to point</b> to the last staked point. |

#### Description of fields

| Field          | Option         | Description   |
|----------------|----------------|---|
| <b>Azimuth</b> | Editable field | <p>Direction from the current preplot point for which the <b>In-line</b> and <b>Cross-line</b> offsets are computed.</p> <p>This azimuth value is automatically updated each time the selected preplot point changes in the 3D viewer.</p> <p>If the <b>Use track number optimization</b> is checked in the <b>Define Line Settings</b> panel, then the computed azimuth is the one from the first to the last point of the track.</p> <p>If the <b>Use track number optimization</b> is not checked in the <b>Define Line Settings</b> panel, then the computed azimuth is based on the next preplot point in the list. If no next point is available, then the azimuth is from the previous point to current one.</p> <p>For specific validation, enter an azimuth value.</p> |
| <b>In-line</b> | Display only   | Measured position in/out offset based on the line from the current preplot point to the given azimuth direction. Negative value is in.  |

| <b>Field</b>          | <b>Option</b>   | <b>Description</b>   |
|-----------------------|-----------------|--|
| <b>Cross-line</b>     | Display only    | Measured position left/right offset based on the line from the current preplot point to the given azimuth direction. Negative value is left.   |
| <b>Radius</b>         | Display only    | Horizontal distance from the measured position to the current preplot point.   |
| <b>Slope to point</b> | Selectable list | Point stored in the working job for which the slope distance from the current measured position is required. Useful when offsetting a preplot point to validate cable length from previous staked point. |
| <b>Slope distance</b> | Display only    | Slope distance from measured position to selected <b>Slope to point</b> .  |

**Description**

In this option, a known point stored in the job is used to set up the RTK base.

**Access**

Select **Leica Captivate - Base: Base setup\Over known point**.

**Over Known Point  
Enter the antenna  
height & select base  
antenna**

Type in the antenna height and select the antenna being used.

Back Next

| Key         | Description  |
|-------------|--|
| <b>Back</b> | To return to the previous panel.                           |
| <b>Next</b> | To confirm the settings and to continue to the next panel. |

**Description of fields**




| Field                  | Option          | Description  |
|------------------------|-----------------|--|
| <b>Antenna height</b>  | Editable field  | The height of the antenna that is being used.  |
| <b>Base antenna</b>    | Selectable list | Leica Geosystems antennas are predefined as default and can be selected from the list. Default antennas contain an elevation-dependent correction model. New antenna correction models can be set up and transferred to the instrument using Infinity. Open the list to define or edit antennas. Refer to <a href="#">24.2.2 Antennas</a> for information on antennas. |
| <b>Vertical offset</b> | Display only    | The vertical offset of the measurement reference point.  |

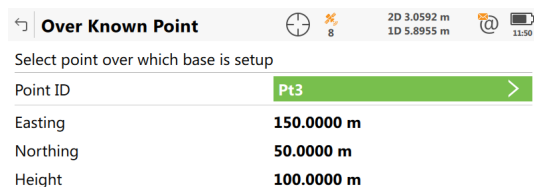
**Next step**

**Next** to access **Select point over which base is setup**.

**Select point over  
which base is setup**

Select the point to be used as base station.

-  A point could already be stored in the design job either by manual entry, by measuring or by transfer from Infinity.
-  To create a point, open the selectable list for **Point ID** and press **New**.
-  To edit a point, open the selectable list for **Point ID** and press **Edit**.



Fn Back Next Fn

| Key   | Description   |
|-------|---|
| Next  | To accept changes and access the subsequent panel.  |
| Coord | To view other coordinate types. Local coordinates are available when a local coordinate system is active. |
| Back  | To return to the previous panel.  |

### Next step

**Next** to access **Base setup complete..** Follow the instructions on the panel.

## 56.2

### Over last setup

#### Description

To use the same coordinates as when the instrument was last used as a base.

Availability:

The instrument has been used as base before. No point in the design job has the same point ID as the last used point.

After turning off, the base coordinates are stored in the System RAM. They can be used again the next time the instrument is used as a base. This functionality means that even if the data storage device that previously contained the base coordinates is formatted, the last used coordinates can still be used.

#### Access

Select **Leica Captivate - Base: Base setup\Over last setup.**

#### Over Last Setup

This panel is identical with the one in **Over known point.** Refer to [56.1 Over known point.](#)

### Next step

**Next** to access **Last used base point.**

#### Last used base point

The point ID and coordinates of the last used base are displayed in grid. When no local coordinate system is active, WGS 1984 coordinates are displayed. Refer to [56.1 Over known point](#) for information on the keys.

### Next step

**Next** to access **Base setup complete..** Follow the instructions on the panel.

## 56.3

### Over any point

#### Description

To use the coordinates of the current navigation position as base coordinates.

## Access

Select **Leica Captivate - Base: Base setup\Over any point.**

---

## Over Any Point

This panel is identical with the one in **Over known point.** Refer to [56.1 Over known point.](#)

### Next step

**Next** to access **Enter point ID & press 'Next' when ready to measure point.**

---

## Enter point ID & press 'Next' when ready to measure point

Type in a point ID for this new point. Refer to [56.1 Over known point](#) for information on the keys.

Code information or annotations can be added in the rover menu.

### Next step

**Next** to access **Base setup complete..** Follow the instructions on the panel.

---

## 57

## Measure - GS

### 57.1

### Measuring Points

#### 57.1.1

#### Post-Processed Kinematic and Static Operations

##### Requirements

A typical working style for a static or post-processed kinematic operation is used. Ensure that the working style has **GNSS Raw Data Logging** selected in the **GNSS Raw Data Logging** panel.



For information on camera and images refer to [34 Camera & Imaging](#).

##### Access


For RTK rover:

Select **Leica Captivate - Home: Measure**.

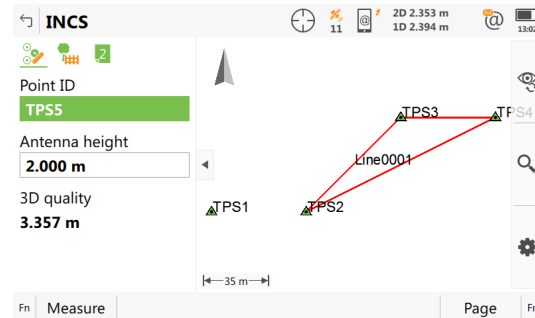


If configured for post-processed kinematic operations, the logging of moving observations begins.

##### Measure

The fields shown are from a typical working style for static or post-processed kinematic operations. The panel described consists of four pages. The explanations for the softkeys given here are valid for the  page and the two user-defined pages. Refer to [37 3D viewer](#) for information on the keys in 3D viewer.

The fields and functionality of this panel vary slightly when accessed from other apps where individual point measurements are needed.



| Key            | Description   |
|----------------|---|
| <b>Measure</b> | To start logging of static observations. The key changes to <b>Stop</b> .   |
| <b>Stop</b>    | To end recording of positions when enough data is collected. When <b>Automatically stop point measurement</b> is checked in <b>GS Quality Control, General</b> page, recording of positions ends automatically as defined by the stop criteria. The key changes to <b>Store</b> . |
| <b>Store</b>   | To store the point information. When <b>Automatically store point</b> is checked in <b>GS Quality Control, General</b> page, the measured point is stored automatically. The key changes to <b>Measure</b> .  |
| <b>Near</b>    | To compare the current position with the coordinates of all points already stored in the job and find the nearest point. This point ID is then suggested as the next point ID to be used.   |



| Key                | Description   |
|--------------------|---|
| <b>Page</b>        | To change to another page on this panel.                      |
| <b>Fn Settings</b> | To configure the pages displayed and auto point measurements. |
| <b>Fn Display</b>  | To configure what is displayed in the 3D viewer.              |
| <b>Fn Tools</b>    | Refer to <a href="#">39 Apps - The Toolbox</a> .              |

#### Description of fields

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Point ID</b>       | Editable field | The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of point IDs type over the point ID.</li> <li>For an individual number independent of the ID template <b>Fn Tools</b>.</li> </ul> |
| <b>Antenna height</b> | Editable field | The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style.   |
| <b>3D quality</b>     | Display only   | The current 3D coordinate quality of the computed position.  |

### 57.1.2

#### Real-Time Rover Operations

##### Requirements

- A typical working style for real-time rover operations is used.
- The appropriate real-time device is attached and working properly.




For information on camera and images refer to [34 Camera & Imaging](#).

##### Access

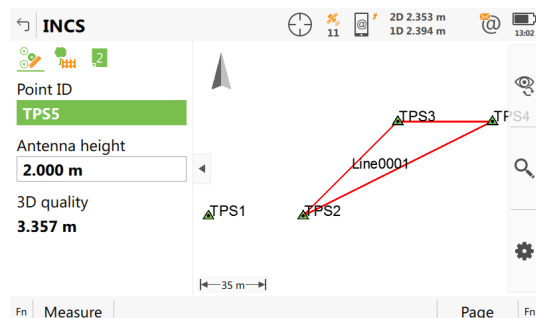
For RTK rover:

Select **Leica Captivate - Home: Measure**.

##### Measure

The fields shown are from a typical working style for real-time rover operations. The panel described consists of four pages. The explanations for the softkeys given here are valid for the  page and the two user-defined pages. Refer to [37 3D viewer](#) for information on the keys in 3D viewer.

The fields and functionality of this panel vary slightly when accessed from other apps where individual point measurements are needed.



| Key  | Description   |
|--|---|
| <b>Measure</b>                                   | To start logging of static observations. The key changes to <b>Stop</b> .   |
| <b>Stop</b>                                      | To end recording of positions when enough data is collected. When <b>Automatically stop point measurement</b> is checked in <b>GS Quality Control, General</b> page, recording of positions ends automatically as defined by the stop criteria. The key changes to <b>Store</b> . |
| <b>Store</b>                                     | To store the point information. When <b>Automatically store point</b> is checked in <b>GS Quality Control, General</b> page, the measured point is stored automatically. The key changes to <b>Measure</b> .  |
| <b>Near</b>                                      | To compare the current position with the coordinates of all points already stored in the job and find the nearest point. This point ID is then suggested as the next point ID to be used.   |
| <b>Page</b>                                      | To change to another page on this panel.  |
| <b>Fn Settings</b>                               | To configure the pages displayed and auto point measurements.   |
| <b>Fn Display</b>                                | To configure what is displayed in the 3D viewer.  |
| <b>Fn Connect</b><br>and<br><b>Fn Disconnect</b> | To connect/disconnect from the reference data.  |
| <b>Fn Tools</b>                                  | Refer to <a href="#">39 Apps - The Toolbox</a> .  |

#### Description of fields

| Field           | Option         | Description  |
|-----------------|----------------|--|
| <b>Point ID</b> | Editable field | The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways: <ul style="list-style-type: none"> <li>To start a new sequence of point IDs type over the point ID.</li> <li>For an individual number independent of the ID template <b>Fn Tools</b>.</li> </ul> |

| Field                 | Option         | Description  |
|-----------------------|----------------|--|
| <b>Antenna height</b> | Editable field | The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style. |
| <b>3D quality</b>     | Display only   | The current 3D coordinate quality of the computed position.  |

## 57.2

### Adding Annotations

#### Description

Annotations can be used to add either field notes or comments to points being surveyed.

#### Access

For RTK rover:

Select **Leica Captivate - Home: Measure**. Go to the **Page 3** page.



If it is not already displayed, the **Page 3** page can be configured to appear in the Measure app through the **User Defined Pages** panel. Refer to [27.2 User defined pages](#) for more information.

#### Connect

#### Description of fields

| Field  | Option         | Description  |
|--|----------------|--|
| <b>Annotation 1</b><br>to<br><b>Annotation 4</b> | Editable field | Type in the annotation. The annotation can be up to 16 characters long and can include spaces.   |
|  |                | When the ASCII input interface is configured and an annotation is reserved for the incoming ASCII string, then no other information can be typed in. |
|  |                | <b>ESC</b> to clear the entry.   |
|  |                | <b>Last</b> to recall all annotations entered for the previously surveyed point. Any annotations entered are overwritten.                            |
|  |                | <b>ENTER</b> . The next line is highlighted.   |

#### Next step

1. **Measure** to start the point measurement.
2. **Stop** to end the point measurement.
3. **Store** to store the point information including the annotations.

## 57.3

### Timed Measurements

#### Description

Surveying regulations in some countries require that several instruments in a session start the point measurement simultaneously at a predefined time.

Timed measurements are possible for all types of GS operations, except for real-time base operations.

## Requirements

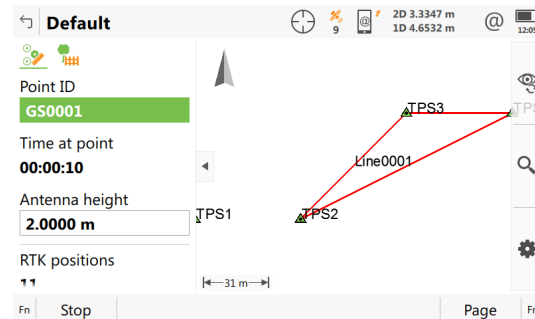
- **Automatically start measuring point on entering the Measure app:** **Timed** is configured in **GS Quality Control, Advanced** page. Refer to [26.3 GS quality control](#).
- **Time at point** is configured for one of the lines in one of the pages. Refer to [27.2 User defined pages](#).

## Access

For RTK rover:

Select **Leica Captivate - Home: Measure**.

## Connect



### Description of fields

| Field                | Option         | Description  |
|----------------------|----------------|--|
| <b>Start time</b>    | Editable field | The current local time with the seconds rounded to 00, for example for the current local time 07:37:12 it is 07:38:00.<br><br>Type in the start time in hours, minutes and seconds for when the point measurement begins.<br><br>Press <b>Measure</b> . The point measurement does not start yet. The name of the field changes to <b>Time to go</b> .                   |
| <b>Time to go</b>    | Display only   | The countdown time in hours, minutes and seconds before the point measurement starts automatically. The point measurement starts when it is 00:00:00.<br><br>Then, data is logged as configured in the working style. Any measurement counter-defined to be used in a page is displayed and starts incrementing. The name of the field changes to <b>Time at point</b> . |
| <b>Time at point</b> | Display only   | The time in hours, minutes and seconds from when the point is measured until point measurement is stopped.<br><br>Press <b>Stop</b> and <b>Store</b> when enough data is collected. The name of the field changes to <b>Start time</b> .   |

**Description**

The camera can be used to capture images of an object of interest.

In respect to the user, the camera needs to be directed toward the left or the right side, so that it always faces the object of interest while walking along it.

To assure a good visual overlap of the images, the system captures the images with a rate of 2 Hz.

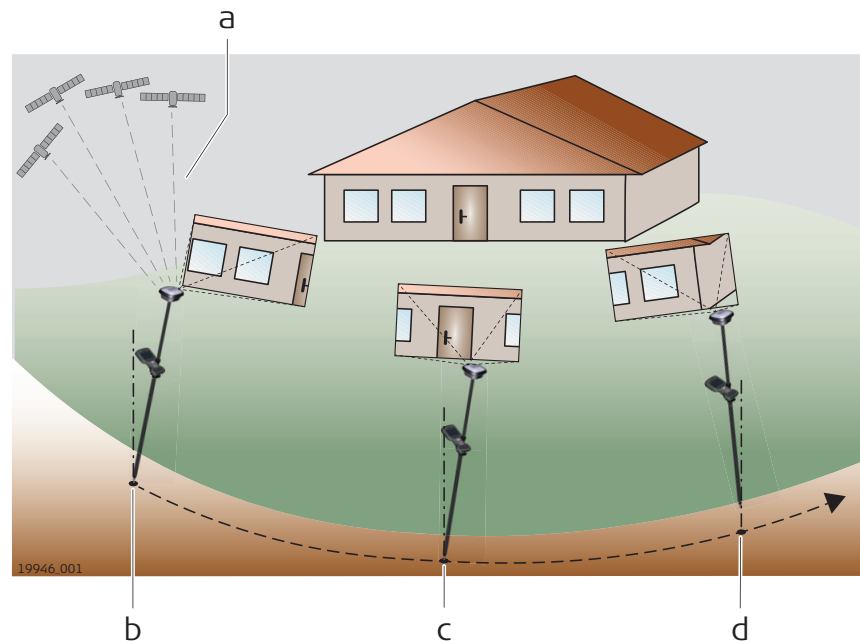
In order to get the best accuracy of point coordinates computed from the images, the images within one sequence should be captured along a U-shaped trajectory.

The images captured within one sequence will be stored as an image group.

The coordinates of any characteristic point captured in the images can be computed right away. One point needs to be picked manually in one image. The algorithm will automatically find the picked point in other images from the image group. The algorithm will select and use the images that are the most optimal for the calculation of the 3D position of the point.

Advantages:

- No need to measure each point individually with the pole tip of the GS sensor
- No need to physically access the points
- Capture images of the areas with weak or no satellite signal

**Diagram**

- a GNSS signal
- b Position of captured image i
- c Position of captured image i+1
- d Position of captured image i+2

## 58.2

## GS Imaging

### Access

Select **Leica Captivate - Home: GS imaging**.

### GS Imaging

The **GS imaging** app is only visible on the CS30/CS35 or the CS20 LTE.

| Icon                       | Availability   |
|----------------------------|--|
| <b>Capture image group</b> | Accessible if a GS18 I is connected via WLAN or cable.           |
| <b>Measure in images</b>   | Visible for all GS sensors and TS instruments in GS and TS mode. |
| <b>Manage image groups</b> |  |

## 58.3

## Capturing an Image Group

### Access

Select **Capture image group** in **GS Imaging**.

### Job name

The view shows a live video stream from the GS18 I camera.

| Key           | Description  |
|---------------|--|
| <b>Start</b>  | To start capturing an image group.<br>While the capturing is in progress, walk along the object of interest. The images are taken automatically with a rate of 2 Hz.<br>GS18 I is ready to capture an image group when all of the following conditions are fulfilled: <ul style="list-style-type: none"><li>• The GS18 I must be configured as real-time rover and connected to a CS20 LTE or CS30/CS35 via cable or WLAN.</li><li>• The live video stream is visible.</li><li>• The tilt compensation is initialised.</li><li>• The 3D coordinate quality value is better than 10 cm.</li></ul> While the capturing is in progress, the additional information on the left side is updated. |
| <b>Stop</b>   | To stop capturing an image group.<br>The maximum capturing time is 60 seconds. If the maximum capturing time has been reached, the capturing process stops automatically.<br>After the capturing process has been stopped, the image group is processed and transferred to the field controller.   |
| <b>Store</b>  | Available after the image group has been processed and transferred to the field controller.<br>To store the image group in the current active working job.   |
| <b>Cancel</b> | To stop the image capturing process.   |

### Description of fields

| Field                   | Option         | Description   |
|-------------------------|----------------|---|
| <b>Image group name</b> | Editable field | The name of the image group.<br>The configured image group ID template is used.<br>The name can be changed. |
| <b>Capturing time</b>   | Display only   | The elapsed time in relation to the maximum capturing time of 60 seconds                                    |

| Field                      | Option       | Description  |
|----------------------------|--------------|--|
| <b>Number of images</b>    | Display only | The number of images taken for the image group. The value becomes visible after the processing.  |
| <b>Image group quality</b> | Display only | The value depicts the expected quality of a single point measurement using the image group. The value is visible after the processing. |

## 58.4

### Measuring in Images

#### Access




| Action |   |
|--------|---|
| 1.     | Select <b>Measure in images</b> in <b>GS Imaging</b> .      |
| 2.     | Highlight an image group in the list in <b>GS Imaging</b> . |
| 3.     | Tap <b>Open</b> .   |



#### Measure

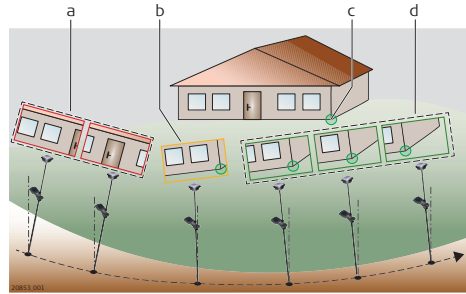
The layout of the panel and the fields displayed are fixed.

The individual keys, fields and icons are explained.

Refer to [58.6 Working with the GS imaging App](#) for information about the workflow.

| Key            | Description   |
|----------------|---|
| <b>Measure</b> | <p>To measure the coordinates of the point marked in the image.</p> <p>All images of the group, where the marked point is found, are used to determine the coordinates and its 3D quality.</p> <p> If the marked point cannot automatically be found within other images, add the point manually in other images.</p> <p>The key changes to <b>Store</b>.</p>  |
| <b>Store</b>   | <p>To store the point information. When <b>Automatically store point</b> is checked in <b>Imaging Quality Control</b>, the measured point is stored automatically.</p> <p>The measured point is saved to the database. The point symbol  for a point of class Measured (Meas) appears in the images, including the point ID.</p> <p>The key changes to <b>Measure</b>.</p> <p> If the value for the coordinate quality exceeds the settings defined in <b>Imaging Quality Control</b>, a warning message appears.</p> |
| <b>Remove</b>  | <p>To exclude the currently displayed image from the coordinate calculation. The point coordinates and the quality are recalculated.</p>  |
| <b>Add</b>     | <p>To add the point marked in an image to the calculation of point coordinates. The point coordinates and the quality are recalculated.</p>   |

| Key                             | Description   |
|---------------------------------|---|
| <b>Previous</b> and <b>Next</b> | To browse through the images, where the measured point is visible in the image.   |
|                                 |  In case the marked point cannot be found in other images: When going through the other images using <b>Previous</b> and <b>Next</b> , the measured point is not marked with the  . Instead an epipolar line appears on the image. The point which was marked in the other image is located along this line. The line helps to pick the marked point in other images. |





- a Measured point invisible in images
- b Measured point visible in image, but image not used for calculation
- c Measured point
- d Measured point visible in images and images used for calculation



### Description of fields

| Field              | Option         | Description  |
|--------------------|----------------|--|
| <b>Point ID</b>    | Editable field | The identifier for the measured points marked in the image. The configured point ID template is used. The ID can be changed in the following ways:<br>To start a new sequence of point IDs type over the point ID. |
| <b>2D quality</b>  | Display only   | The current 2D coordinate quality of the computed point coordinates.   |
| <b>Used images</b> | Display only   | The number of images used for the calculation of the point coordinates.  |
| <b>Code</b>        |                | To type in a point code or to select a code from the list. Refer to <a href="#">28 Coding</a> for information about coding and linework.   |

### Point symbols in the 3D viewer


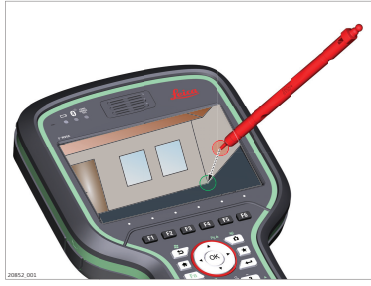



| Symbol  | Description  |
|---|--|
|  | Used for a picked point.   |
|  | Used for a measured point in images which are included in the calculation of the 3D coordinates. |



| Symbol  | Description   |
|---|---|
|  | Used for a measured point in images which are excluded from the calculation of the 3D coordinates. The symbol marks the approximate position of the measured point in the selected image. |
|  | Used for a stored point in images which are included for the calculation of the point coordinates.  |


### Icons in the toolbar of the 3D viewer

When the background of an icon is green, the functionality is active.

| Icon  | Description   |
|---|---|
|    | <p>Snapping</p> <p>To snap the picked point automatically to the closest corner or edge within a certain pixel region.</p>  |
|  |   |
|  | <p>Zoom extents</p> <p>To fit all displayable data into the image area, using the largest possible scale.</p>   |
|  | <p>Zoom real-time</p> <p>To zoom into the data dragging the stylus in the image viewer area upwards to zoom in, or downwards to zoom out.</p>   |
|  | <p>Zoom window</p> <p>To zoom to a specified area window. An area window can be drawn by dragging the stylus on the panel in a diagonal line to make a rectangular area. This action causes the panel to zoom to the selected area.</p> |

### Functionalities the 3D viewer

The functionalities are available as long as no tool from the toolbar, except the snapping tool, is active.

| Functional-ity  | Stylus taps on screen | Time            | Description   |
|-----------------|-----------------------|-----------------|---|
| Marker          | 1x                    | < 1 sec         | Marks the tapped point on the image by  . The marked point can then be measured with <b>Measure</b> . If the snapping tool is active, the next nearby edge or corner is marked automatically. If the snapping tool is inactive, the image coordinates where the stylus touched the image, mark the picked point for measurement. |
| Double tap zoom | 2x<br>On image        | < 1 sec         | Zooms into the image. The image will be centered to the tapped position. Can be repeated.   |
| Drag            | 1x<br>+ hold          | Over whole time | Moves the whole image with the movement of the stylus.  |

## 58.5

### Managing Image Groups

#### Access

1. Select **View & edit data** from the job menu.
2. **Page** until the **Image groups** page is active.

#### Job name, Image groups page

Listed are all image groups in the job with information about the image group quality, the number of images in each group and the time and the date of when the image group was stored.

| Key           | Description   |
|---------------|---|
| <b>OK</b>     | To close the panel and return to the panel from where this panel was accessed.  |
| <b>Edit</b>   | To edit the name of an image group. Check one image group. When multiple image groups are checked, only the highlighted group is displayed for editing. |
| <b>Delete</b> | To delete an image group. Check one or multiple image groups for deleting.  |
| <b>Page</b>   | To change to another page on this panel.  |

## 58.6

### Working with the GS imaging App

#### Capturing an image group step-by-step








GS18 I is ready to capture an image group when all of the following conditions are fulfilled:

- The GS18 I must be configured as real-time rover and connected to a CS20 LTE, CS20 BASIC, CS35 or CS30 via cable or WLAN.
- The live video stream is visible.
- The tilt compensation is initialised.
- The 3D coordinate quality value is better than 10 cm.

| Action   | Result   |
|--|--|
| 1. <b>Leica Captivate - Home: GS imaging\Capture image group</b>   |  |
| 2. <b>Start</b><br>Walk along the object of interest while the camera is directed toward the left or the right side in respect to the user.<br><b>Stop</b><br>Wait until the image processing has been finished.<br><b>Store</b><br><b>Capturing time</b><br>The value indicates how much time has passed since the capturing of images was started. The capturing time is limited to 60 seconds.<br><b>Number of images</b><br>The value indicates the number of images that were captured within the image group | The capturing time increases constantly during the capturing. After 60 seconds, the capturing stops automatically.<br><br>The number of images will be shown after the capturing is stopped. |
| 3. <b>Image group quality</b><br>The value indicates the expected quality of a point measurement inside the image group  | The quality will be shown after the capturing is stopped.  |


### Measuring in images step-by-step

| Action  | Result  |
|---|---|
|  At least one image group must be stored within the active job.  |   |
| 1. <b>Leica Captivate - Home: GS imaging\Measure in images.</b>   |   |
| 2. Select an image group.   |   |
| 3. Pick a characteristic point in the image.<br>The picked point will be marked with the symbol  in the image. |  |
|  The snapping tool option can be used to automatically snap the point to the closest corner point.             |  |
| 4. <b>Measure</b><br><b>For editing a measurement</b>   |   |


**Action**

**Result**



If an image was used for the calculation of the 3D coordinates of the picked point, the symbol  will appear in the selected image.



If an image was not used for the calculation of the 3D coordinates of the picked point, the symbol  will appear in the selected image. The symbol marks the approximate position of the measured point in the selected image.



5. To remove an image from the measurement, select the image with **Previous** or **Next** and press **Remove**.

The coordinates and its CQ values will be re-calculated automatically after the image has been removed from the measurement.

6. To add an image to the measurement, select the image with **Previous** or **Next**. Pick the point in this image and press **Add**. The image will be added to the measurements.

The coordinates and its CQ values will be re-calculated automatically after the image has been added to the measurement.

7. **Store**  
When the point is stored, the point symbol appears in all images of the image group.



**Description**

The Survey app is used for point measurement. Angles and distances for points can be measured and the calculated coordinates stored using **Measure**, **Distance** and **Store**.



For information on camera and images refer to [34 Camera & Imaging](#).

**Access**

Select **Leica Captivate - Home: Measure**.

**Leica Captivate -  
Home,  
page**

The fields shown are from a typical working style. The panel described consists of four pages.

The fields and functionality of this panel vary slightly when accessed from other apps where individual point measurements are needed.



| Key                | Description   |
|--------------------|---|
| <b>Measure</b>     | To measure and store distances and angles.  |
| <b>Start tilt</b>  | Available if the following three conditions are all met: <ul style="list-style-type: none"> <li>• <b>AP tilt compensation</b> is enabled</li> <li>• A prism is selected as target, except <b>Leica reflective tape</b></li> <li>• AP20 T or AP20 is connected</li> </ul> To start a tilt measurement which includes a change of following settings: <ul style="list-style-type: none"> <li>• Checking the tilt compensator (level bubble) of the TS</li> <li>• Locking of TS to the prism</li> <li>• Starting continuous EDM measurements, followed by tilt initialisation</li> </ul> |
| <b>Stop</b>        | Available if <b>Measure distance: Continuously</b> and <b>Distance</b> was pressed. Stops the distance measurements. The key changes back to <b>Measure</b> or <b>Start tilt</b> .  |
| <b>Distance</b>    | To measure and display distances.   |
| <b>Store</b>       | To record data.<br>If <b>Measure distance: Continuously</b> and/or <b>Automatically measure points</b> is checked, records measured point and continues tracking.   |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the pages displayed and auto point measurements.   |

| Key               | Description   |
|-------------------|---|
| <b>Fn Display</b> | To configure what is displayed in the 3D viewer.  |
| <b>Fn 2 Face</b>  | Available for <b>Measure distance: Once</b> and <b>Measure distance: Once &amp; fast</b> . To take an angle and distance measurement in Face I and Face II. The point stored is an average of the two measurements. Using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |
| <b>Fn Tools</b>   | Refer to <a href="#">39 Apps - The Toolbox</a> .  |

#### Description of fields

| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Point ID</b>             | Editable field | The identifier for measured points. The configured point ID template is used. The ID can be changed: <ul style="list-style-type: none"> <li>To start a new sequence of point IDs overwrite the point ID.</li> <li>For an individual number independent of the ID template <b>Fn Tools</b>.</li> </ul> |
| <b>Target height</b>        | Editable field | The last used target height is suggested when accessing the Measure app. An individual target height can be typed in.   |
| <b>Target height (auto)</b> | Editable field | Requires: <ul style="list-style-type: none"> <li>AP20 H, AP20 T or AP20</li> <li>GLS51, GLS51F, CRP4 or CRP5 pole</li> </ul> The target height is measured by the Auto-Pole and automatically updated.  |
| <b>Hz</b>                   | Display only   | The current horizontal angle.   |
| <b>V</b>                    | Display only   | The current vertical angle.   |
| <b>Horizontal distance</b>  | Display only   | The horizontal distance after <b>Distance</b> was pressed. No distance is displayed when accessing the panel and after <b>Store</b> or <b>Measure</b> .   |
| <b>Difference in height</b> | Display only   | The height difference between setup and measured point after <b>Distance</b> . Displays ----- when accessing the panel and after <b>Store</b> or <b>Measure</b> .   |
| <b>Easting</b>              | Display only   | Easting coordinate of the measured point.   |
| <b>Northing</b>             | Display only   | Northing coordinate of the measured point.  |
| <b>Height</b>               | Display only   | Elevation of the measured point.  |

**Description**

Auto points are used to log points automatically at a specified rate. Additionally, individual auto points can be stored outside the defined rate.

Auto points can be collected in the Measure app. A  page is visible when logging of auto points is active.

Auto points are used in moving applications to document a track which was walked or driven along. Auto points that are logged between starting and stopping logging of auto points form one chain. A new chain is formed each time logging of auto points is started.

Up to two offset points related to one auto point can be logged. The offset points can be both to the left or right and they can be coded independently of each other and of the auto points.



Logging of auto points is possible for both TS and GS.

**Coding of auto points**

Coding of auto points is similar to coding manually occupied points. Refer to [28 Coding](#) for information on coding.

The differences are:

| Type         | Description   |
|--------------|---|
| Point coding | Always available.                                       |
| Free coding  | Always available. Same as for manually measured points. |
| Quick coding | Not available.  |

Codes of auto points overwrite the codes of points with the same point ID but a different code, existing in the job.

Codes of auto points can be changed when no auto points are being logged.

Up to eight attributes can be stored with a code.

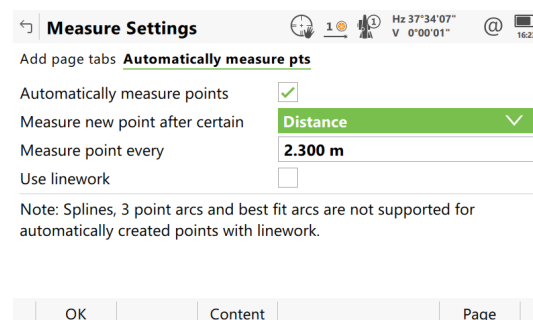
**Averaging of auto points**

An average is never calculated for auto points even if a manually occupied point of class **Measured** already exists with the same point ID.

**Access**

Select **Leica Captivate - Home: Measure**.

Press **Fn Settings**.

**Measure Settings, Automatically measure pts page**


**Measure Settings**

Add page tabs **Automatically measure pts**

Automatically measure points


Measure new point after certain **Distance** ▾

Measure point every **2.300 m**



Use linework

Note: Splines, 3 point arcs and best fit arcs are not supported for automatically created points with linework.



OK Content Page

| Key     | Description  |
|---------|--|
| OK      | To accept changes and return to the panel from where this panel was accessed.  |
| Content | To configure what is viewed in the  page in the Measure app. Available for <b>Automatically measure points</b> checked. |
| Page    | To change to another page on this panel.   |

#### Description of fields

| Field                                   | Option  | Description  |
|---|---|--|
| <b>Automatic-ly meas-ure points</b>     | Check box  | Activates the logging of auto points. All other fields on the panel are active and can be edited.  |
| <b>Measure new point after cer-tain</b> | <b>Time</b>   | Auto points are logged according to a time interval. The time interval is independent from the update interval for the position on the panel.  |
|   | <b>Distance</b>   | The difference in distance from the last stored auto point, which must be reached before the next auto point is logged. The auto point is logged with the next available computed position.  |
|   | <b>Difference in height</b>   | The height difference from the last stored auto point, which must be reached before the next auto point is logged. The auto point is logged with the next available computed position.   |
|   | <b>Distance or height</b>   | Before the next auto point is logged, either the difference in distance or the difference in height must be reached. The auto point is logged with the next available computed position.   |
|   | <b>Distance &amp; time</b>  | An auto point is stored when the position of the antenna/prism does not move more than the distance configured in <b>Minimum distance between points</b> within the <b>Stop time</b> .<br>Once a point has been stored, the position must change more than the distance configured in <b>Minimum distance between points</b> before the routine starts again.            |
|   | <b>Key press</b>  | An auto point is stored upon pressing <b>Measure</b> (for GS) / <b>Store</b> (for TS) in the <b>Measure</b> app,  page. In the beginning, the chain to which the auto points are assigned must be started with <b>Start</b> . In the end, the chain must be closed with <b>Stop</b> . |
| <b>Measure point every</b>              |   | Available unless <b>Measure new point after certain: Distance or height, Measure new point after certain: Distance &amp; time</b> or <b>Measure new point after certain: Key press</b> .   |



| Field                                  | Option                                 | Description   |
|--|--|---|
|  | Editable field                         | For <b>Measure new point after certain: Distance</b> and <b>Measure new point after certain: Difference in height</b> . The difference in distance or height before the next auto point is logged.              |
|  | From <b>0.1 sec</b> to <b>60.0 sec</b> | For <b>Measure new point after certain: Time</b> . The time interval before the next auto point is logged.<br>For GS07 logging rates of 0.2 s and slower are supported.   |
| <b>When distance changed by</b>        | Editable field                         | Available for <b>Measure new point after certain: Distance or height</b> . The value for the difference in distance before the next auto point is logged.   |
| <b>Or when height changed by</b>       | Editable field                         | Available for <b>Measure new point after certain: Distance or height</b> . The value for the height difference before the next auto point is logged.  |
| <b>Minimum distance between points</b> | Editable field                         | Available for <b>Measure new point after certain: Distance &amp; time</b> . The distance within which the position is considered stationary.  |
| <b>Stop time</b>                       | Editable field                         | Available for <b>Measure new point after certain: Distance &amp; time</b> . The time while the position must be stationary until an auto point is stored.   |
| <b>Store points</b>                    |  | Available for GS.<br> Changing this setting while auto points are being logged stops the logging. It must then be restarted. |
|  | <b>To MDB (pts only)</b>               | Logs auto point to a job file. Point logging at up to 20 Hz. Coding and logging of offset points is not possible. Points cannot be displayed in 3D viewer or output using format files.                         |
|  | <b>To DBX (pts&amp;codes)</b>          | Logs auto points to the DBX. Point logging at up to 1 Hz. Coding and logging of offset points is possible. Points can be displayed in 3D viewer or output using format files.                                   |
| <b>Logging starts when</b>             |  | Available for GS.   |
|  | <b>Accessing the Measure app</b>       | Logging of auto points starts immediately when the <b>Measure</b> app is accessed.  |
|  | <b>Press 'Start' in Measure app</b>    | Logging of auto points starts upon pressing <b>Start</b> on the  page in the <b>Measure</b> app.                           |

| Field  | Option                        | Description   |
|--|-------------------------------|---|
| <b>Do not store point if 3D CQ exceeds limit</b> | Check box                     | Available for GS.<br>If checked, monitoring of the coordinate quality is activated. Auto points are stored when the coordinate quality is within the defined limit. For example, only phase fixed solutions can be logged by defining a CQ limit.   |
| <b>3D quality limit</b>                          | Editable field                | Available for GS if <b>Do not store point if 3D CQ exceeds limit</b> is checked.<br>Limit for the coordinate quality above which an auto point is no longer automatically stored. When the CQ of the auto point falls again below the defined value then the storing of auto points begins again. |
| <b>Beep when</b>                                 | <b>Point is stored</b>        | Available for GS.<br>Instrument beeps when storing an auto point.   |
|  | <b>3D quality is exceeded</b> | Instrument beeps when auto points are not stored.   |
|  | <b>Never</b>                  | Instrument never beeps.   |
| <b>Use line-work</b>                             | Check box                     | When this box is checked, creating a line is possible by selecting a code with linework attached. This is only possible for straight lines, not for any other geometry.   |

### Next step

| IF the page content     | THEN  |
|-------------------------|---|
| is not to be configured | <b>OK</b> closes the panel and returns to the previous panel. |
| is to be configured     | <b>Content.</b>   |

### Auto Points Page Content

**Page Settings 1**

Name: Measure

1st line: Point ID

2nd line: Code

3rd line: Target height

4th line: Separator

5th line: Hz angle

6th line: V angle

7th line: Horizontal distance

Buttons: Fn, OK, Clear, Fn

| Key               | Description  |
|-------------------|--|
| <b>OK</b>         | To accept changes and to return to previous panel. |
| <b>Clear</b>      | To set all fields to <b>Unused line</b> .          |
| <b>Fn Default</b> | To recall the default settings.                    |

## Description of fields

| Field                        | Option  | Description   |
|------------------------------|---|---|
| <b>1st line</b>              | Display only                                      | Fixed to <b>Point ID</b> .  |
| <b>2nd line to 16th line</b> |   | For each line, one of the following options can be selected.  |
|                              | <b>Angle right</b>                                | For TS:<br>Displays the horizontal angle difference between the backsight point and the current telescope position.   |
|                              | <b>% completed</b>                                | For GS:<br>Display only field for the percentage of the time for which the point has been occupied based on the setting for <b>Stop measurement based on</b> in the <b>GS Quality Control</b> panel. Appears in the page during the point occupation if <b>Automatically stop point measurement</b> is checked. |
|                              | <b>Annotation 1 to Annotation 4</b>               | Editable field for comments to be stored with the point.  |
|                              | <b>Antenna height</b>                             | For GS:<br>Editable field for antenna height for static and moving observations.  |
|                              | <b>Attribute (free) 01 to Attribute (free) 20</b> | Display only field for attributes for free codes.   |
|                              | <b>Attribute 01 to Attribute 20</b>               | Editable field for attributes for codes.  |
|                              | <b>Azimuth</b>                                    | For TS:<br>Display only field for the azimuth.  |
|                              | <b>Code</b>                                       | Editable field for codes.   |
|                              | <b>Code (free)</b>                                | Editable field for free codes.  |
|                              | <b>Code description (free)</b>                    | Display only field for the description of free codes.   |
|                              | <b>Code description</b>                           | Display only field for the description of codes.  |
|                              | <b>Easting</b>                                    | For TS:<br>Display only field for Easting coordinate of measured point.   |
|                              | <b>GDOP</b>                                       | For GS:<br>Display only field for the current GDOP of the computed position.  |
|                              | <b>HDOP</b>                                       | For GS:<br>Display only field for the current HDOP of the computed position.  |

| Field | Option                         | Description   |
|-------|--------------------------------|---|
|       | <b>Height</b>                  | For TS:<br>Display only field for the height coordinate of the measured point.  |
|       | <b>Difference in height</b>    | For TS:<br>Display only field for the height difference between setup and reflector.  |
|       | <b>Horizontal distance</b>     | For TS:<br>Display only field for horizontal distance.  |
|       | <b>Humidity</b>                | For GS:<br>Editable field for relative humidity to be stored with point.  |
|       | <b>Hz (compensated)</b>        | For TS:<br>Display only field for the compensated horizontal angle of tilt measured points. The value is recalculated to a virtually levelled pole.   |
|       | <b>Hz angle</b>                | For TS:<br>Display only field for the horizontal angle.   |
|       | <b>Line string number</b>      | The string number when creating line work with auto points. If the code is changed, the input box automatically changes to the next available string number. If no linework exists yet, default value is 1. The values range from 1 to 999. |
|       | <b>Local ellipsoid height</b>  | For GS:<br>Display only field for the elevation of the current GNSS position.   |
|       | <b>Logged raw data counter</b> | For GS:<br>Display only field for the number of static observations recorded over the period of point occupation. Appears in the page when recording of static observations is configured.  |
|       | <b>Northing</b>                | For TS:<br>Display only field for Northing coordinate of measured point.  |
|       | <b>Offset height</b>           | For TS:<br>Editable field for height offset for measured point.   |
|       | <b>Offset in/out</b>           | For TS:<br>Editable field for horizontal distance offset, in the direction of line of sight.  |
|       | <b>Offset left/right</b>       | For TS:<br>Editable field for horizontal distance offset for measured point, perpendicular to the line of sight.  |
|       | <b>Offset mode</b>             | For TS:<br>Select offset mode.  |

| Field | Option                              | Description  |
|-------|-------------------------------------|--|
|       | <b>PDOP</b>                         | For GS:<br>Display only field for the current PDOP of the computed position.   |
|       | <b>PPM total</b>                    | For TS:<br>Display only field for the total ppm value.   |
|       | <b>Point ID</b>                     | Editable field for the point ID.   |
|       | <b>Pressure</b>                     | For GS:<br>Editable field for atmospheric pressure.  |
|       | <b>Prism constant</b>               | For TS:<br>Display only field for additive constant of currently selected reflector.   |
|       | <b>1D quality</b>                   | Display only field for the current height coordinate quality of computed position.   |
|       | <b>2D quality</b>                   | Display only field for the current 2D coordinate quality of computed position.   |
|       | <b>3D quality</b>                   | Display only field for the current 3D coordinate quality of computed position.   |
|       | <b>RTK positions</b>                | For GS:<br>Display only field for the number of positions recorded over the period of point occupation. Appears in the page of real-time rover settings. |
|       | <b>SD (compensated)</b>             | For TS:<br>Display only field for the compensated slope distance of tilt measured points. The value is recalculated to a virtually levelled pole.        |
|       | <b>Separator</b>                    | Insert half line space.  |
|       | <b>Slope distance</b>               | For TS:<br>Display only field for measured slope distance.   |
|       | <b>Slope distance (last stored)</b> | For TS:<br>Display only field for the last recorded distance.  |
|       | <b>Standard deviation</b>           | For TS:<br>Display only field of standard deviation in millimetres of averaged distances.  |
|       | <b>Target height</b>                | For TS:<br>Editable field for prism height.  |
|       | <b>Unused line</b>                  | Insert full line space.  |
|       | <b>Temperature (dry)</b>            | For GS:<br>Editable field for dry temperature to be stored with point.   |
|       | <b>Temperature (wet)</b>            | For GS:<br>Editable field for wet temperature to be stored with point.   |

| Field | Option                        | Description  |
|-------|-------------------------------|--|
|       | <b>Time at point</b>          | For GS:<br>Display only field for the time from when the point is occupied until point occupation is stopped. Appears in the page during the point occupation. |
|       | <b>V (compensated)</b>        | For TS:<br>Display only field for the compensated vertical angle of tilt measured points. The value is recalculated to a virtually levelled pole.              |
|       | <b>V angle</b>                | For TS:<br>Display or select vertical angle.   |
|       | <b>VDOP</b>                   | For GS:<br>Display only field for the current VDOP of the computed position.   |
|       | <b>WGS84 ellipsoid height</b> | For GS:<br>Display only field for the current GNSS position.   |
|       | <b>WGS84 latitude</b>         | For GS:<br>Display only field for the current GNSS position.   |
|       | <b>WGS84 longitude</b>        | For GS:<br>Display only field for the current GNSS position.   |

## 60.3

### Measuring Auto Points

#### Requirements

- **Automatically measure points** in **Measure Settings, Automatically measure points** page.
- For GS: The rover menu must be used.

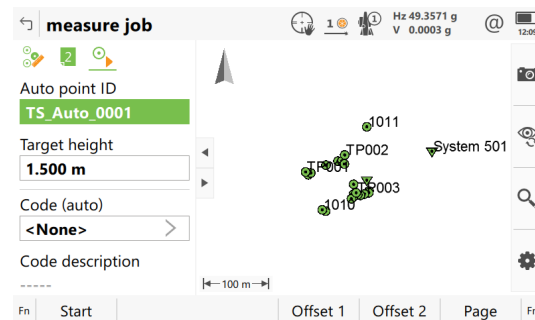
#### Access

Select **Leica Captivate - Home: Measure**.

Go to the  page.

#### Measure

Before logging of auto points has started, the page appears as shown:



| Key                | Description   |
|--------------------|---|
| <b>Start</b>       | <ul style="list-style-type: none"> <li>To start logging of auto points.</li> <li>To start logging of offset points, if configured.</li> <li>For <b>Logging starts when: Press 'Start' in Measure app</b>:<br/>To start the chain to which the auto points are assigned. The first auto point is stored.</li> <li>For <b>Logging starts when: Accessing the Measure app</b>:<br/>Logging of auto points starts immediately when the Measure app is accessed. <b>Start</b> need not be pressed.</li> <li>For TS: <ul style="list-style-type: none"> <li><b>Measure distance: Continuously</b> becomes active.</li> <li>For <b>Measure: Prism</b> instrument locks onto prism.</li> <li>For <b>Measure distance: Greater than 4km, Measure: Prism</b> is set and instrument locks onto the prism.</li> </ul> </li> </ul> |
| <b>Start tilt</b>  | <p>Available if the following three conditions are all met:</p> <ul style="list-style-type: none"> <li><b>AP tilt compensation</b> is enabled</li> <li>A prism is selected as target, except <b>Leica reflective tape</b></li> <li>AP20 T or AP20 is connected</li> </ul> <p>To start logging tilt compensated auto points.</p>   |
| <b>Stop</b>        | <ul style="list-style-type: none"> <li>To end recording of auto points.</li> <li>To end recording offset points, if configured.</li> <li>For <b>Measure new point after certain: Key press</b>:<br/>To end the chain to which the auto points are assigned.</li> </ul>  |
| <b>Measure</b>     | <p>Available for GS.<br/>To store a point at any time.</p>  |
| <b>Store</b>       | <p>Available for TS.<br/>To store a point at any time.</p>  |
| <b>Offset 1</b>    | <p>Available when <b>Store points: To DBX (pts&amp;codes)</b> in <b>Measure Settings, Automatically measure pts</b> page.<br/>To configure recording of the first type of offset points.<br/>Refer to <a href="#">60.4.2 Configuring Offset Points</a>.</p>   |
| <b>Offset 2</b>    | <p>Available when <b>Store points: To DBX (pts&amp;codes)</b> in <b>Measure Settings, Automatically measure pts</b> page.<br/>To configure recording of a second type of offset points.<br/>Refer to <a href="#">60.4.2 Configuring Offset Points</a>.</p>  |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure auto points. Refer to <a href="#">60.2 Configuring Auto Points</a> .   |
| <b>Fn Display</b>  | To configure what is displayed in the 3D viewer.  |

### Description of fields for the default settings

| Field                       | Option                 | Description   |
|-----------------------------|------------------------|---|
| <b>Auto point ID</b>        | Editable field         | Available unless <b>GS auto points: Date &amp; time/TS auto points: Date &amp; time in ID Templates</b> .<br>The identifier for auto points. The configured ID template for auto points is used. The ID can be changed. To start a new sequence of point IDs, type over the point ID.   |
|                             | <b>Date &amp; time</b> | Available for <b>GS auto points: Date &amp; time/TS auto points: Date &amp; time in ID Templates</b> .<br>The current local time and date is used as identifier for auto points.  |
| <b>Antenna height</b>       | Editable field         | Available for GS.<br>The antenna height for auto points as defined in the active working style is suggested.  |
| <b>Target height</b>        | Editable field         | Available for TS.<br>The target height as defined in the active settings is suggested.  |
| <b>Code (auto)</b>          |                        | The point code for the auto point.<br>No stringing is possible between automatically measured points, even if the code has the linework functionality assigned.<br><br>Depending on the setting for <b>Allow new codes to be created in Coding, Code &amp; attributes</b> page, the field is a simple list or a selectable list and an editable field at the same time. |
| <b>Code description</b>     | Display only           | The description of the code.  |
| <b>Line string number</b>   | Editable field         | Available when <b>Use linework</b> is checked.<br>The string number when creating line work with auto points. If the code is changed, the input box automatically changes to the next available string number. If no linework exists yet, default value is 1. The values range from 1 to 999.   |
| <b>Measured auto points</b> | Display only           | Available after pressing <b>Start</b> . The number of auto points logged since <b>Start</b> has been pressed.   |
| <b>3D quality</b>           | Display only           | Available for GS.<br>The current 3D coordinate quality of the computed position.  |
| <b>Slope distance</b>       | Display only           | The measured slope distance.<br>When <b>Start</b> is pressed, <b>Measure distance: Continuously</b> is set and the slope distance is constantly updated.  |
| <b>Hz</b>                   | Display only           | The current horizontal angle.   |



| Field | Option       | Description                 |
|-------|--------------|-----------------------------|
| V     | Display only | The current vertical angle. |

#### Next step

| IF                                 | THEN   |
|------------------------------------|--|
| auto points are to be logged       | <b>Start.</b> Then, for <b>Measure new point after certain: Key press, Measure</b> whenever you want to log an auto point. |
| offset points are to be configured | <b>Offset 1</b> or <b>Offset 2.</b> Refer to <a href="#">60.4 Offset Points of Auto Points</a> .                           |

## 60.4

## Offset Points of Auto Points

### 60.4.1

### Overview

#### Description

Offset points

- can be created with auto points when auto points are stored to the DBX.
- can be to the left or to the right of auto points.
- are automatically computed with the logging of auto points, if configured.
- form a chain relative to the chain of auto points to which they are related. Subsequent computed chains are independent from each other.
- can be coded independently of auto points.
- have the same time of when they were stored as the auto points to which they are related.
- have the same coding functionality, properties and averaging functionality as auto points.

Up to two offset points can be related to one auto point.

The panels for the settings of offset points are identical except for the title **Auto Points - Offset 1** and **Auto Points - Offset 2**. For simplicity, the title **Auto Points - Offset 1** is used in the following description.

#### Computation of off-set points

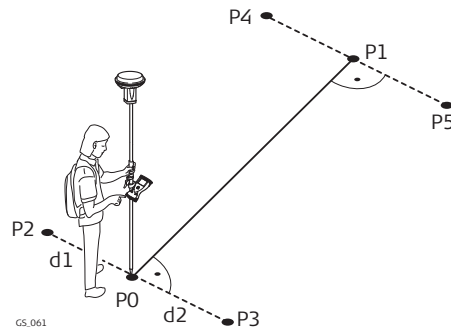
The computation of offset points depends on the number of auto points in one chain.

##### One auto point

No offset points are computed or stored.

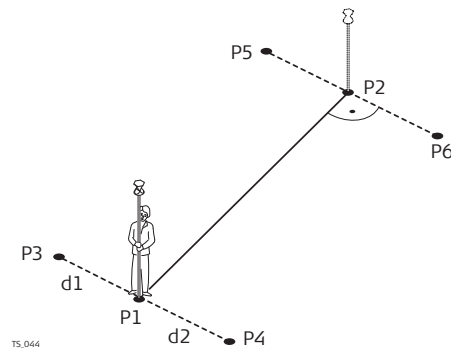
## Two auto points

The configured offsets are applied perpendicular to the line between two auto points.



### For GS:

- P0 First auto point
- P1 Second auto point
- P2 First offset point for P0
- P3 Second offset point for P0
- P4 First offset point for P1
- P5 Second offset point for P1
- d1 Horizontal offset to the left
- d2 Horizontal offset to the right



### For TS:

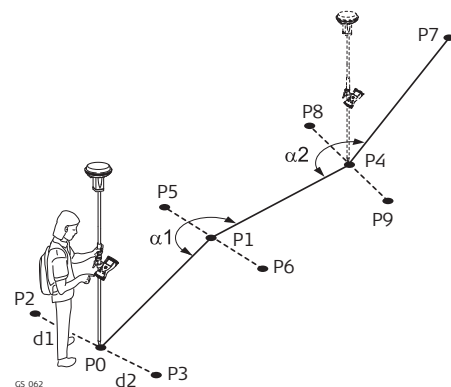
- P1 First auto point
- P2 Second auto point
- P4 First offset point for P1
- P3 Second offset point for P1
- P5 First offset point for P2
- P6 Second offset point for P2
- d1 Horizontal offset to the left
- d2 Horizontal offset to the right

## Three or more auto points

The first offset points are computed perpendicular to the line between the first and the second auto point.

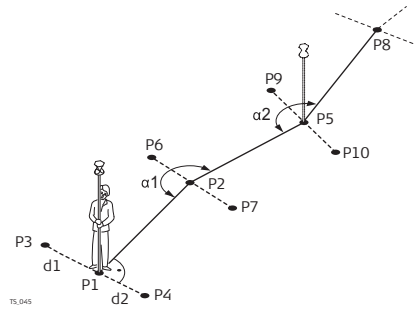
The last offset point is computed perpendicular to the line between the last auto point and the one before.

All other offset points are computed on a bearing. The bearing is half of the angle between the last and the next measured auto point.



### For GS:

- P0 First auto point
- P1 Second auto point
- P2 First offset point for P0
- P3 Second offset point for P0
- P4 Third auto point
- P5 First offset point for P1
- P6 Second offset point for P1
- P7 Fourth auto point
- P8 First offset point for P4
- P9 Second offset point for P4
- d1 Horizontal offset to the left
- d2 Horizontal offset to the right
- $\alpha_1$  Angle between P0 and P4
- $\alpha_2$  Angle between P1 and P7



**For TS:**

- P1 First auto point
- P2 Second auto point
- P3 First offset point for P1
- P4 Second offset point for P1
- P5 Third auto point
- P6 First offset point for P2
- P7 Second offset point for P2
- P8 Fourth auto point
- P9 First offset point for P5
- P10 Second offset point for P5
- d1 Horizontal offset to the left
- d2 Horizontal offset to the right
- $\alpha 1$  Angle between P1 and P5
- $\alpha 2$  Angle between P2 and P8

**60.4.2**

**Configuring Offset Points**

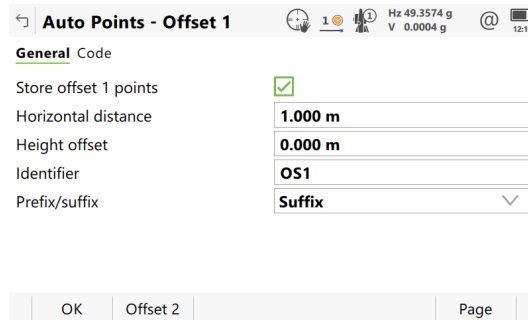
**Requirements**

For GS, configure **Store points: To DBX (pts&codes)** in **Measure Settings, Automatically measure pts** page.

**Access**

Press **Offset 1** or **Offset 2** in the **Measure** on the page.

**Auto Points - Offset 1, General page**



| Key                                 | Description   |
|-------------------------------------|---|
| <b>OK</b>                           | To accept changes and return to the panel from where this panel was accessed. |
| <b>Offset 2</b> and <b>Offset 1</b> | To switch between configuring offset point type one and two.                  |
| <b>Page</b>                         | To change to another page on this panel.                                      |

**Description of fields**

| Field   | Option    | Description   |
|---|-----------|---|
| <b>Store offset 1 points</b> and <b>Store offset 2 points</b> | Check box | Activates logging of offset points. All other fields on the panel are active and can be edited with this setting. |

| Field                      | Option         | Description  |
|----------------------------|----------------|--|
| <b>Horizontal distance</b> | Editable field | The horizontal offset between -1000 m and 1000 m at which the offset point is collected.   |
| <b>Height offset</b>       | Editable field | The height offset between -100 m and 100 m from the related auto point.  |
| <b>Identifier</b>          | Editable field | The identifier with up to four characters is added in front of or at the end of the ID of the auto point. This ID is then used as the point ID for the related offset point. This functionality could support an automatic workflow into CAD packages including setting symbols and stringing lines. |
| <b>Prefix/suffix</b>       | <b>Prefix</b>  | Adds the setting for <b>Identifier</b> in front of the auto point ID.  |
|                            | <b>Suffix</b>  | Adds the setting for <b>Identifier</b> at the end of the auto point ID.  |

### Next step

**Page** changes to the **Code** page.

## Auto Points - Offset 1, Code page

| Key              | Description   |
|------------------|---|
| <b>OK</b>        | To accept changes and return to the panel from where this panel was accessed. |
| <b>New attrb</b> | To create more attributes for the selected code.                              |
| <b>Last</b>      | To recall the last used attribute values for the selected code.               |
| <b>Default</b>   | To recall the default attribute values for the selected code.                 |
| <b>Page</b>      | To change to another page on this panel.                                      |

### Description of fields

| Field       | Option          | Description   |
|-------------|-----------------|---|
| <b>Code</b> | Selectable list | The code for the offset point. The attributes are shown as display only, editable field or selectable list depending on their definition. |
| Attributes  | Editable field  | Up to eight attribute values can be stored.   |

| Field                     | Option       | Description   |
|---------------------------|--------------|---|
| <b>Line string number</b> | Display only | The string number when creating line work with auto points. If the code is changed, the input box automatically changes to the next available string number. If no linework exists yet, default value is 1. The values range from 1 to 999. |

**Next step**

| IF  | THEN  |
|---|---|
| offset point configuration is finished    | <b>OK</b> to return to the Measure panel.   |
| a second offset point is to be configured | <b>Page</b> and then <b>Offset 2</b> or <b>Offset 1</b> to change to the settings panel for the second point. |

**Example for offset point IDs**

The offset point ID is a combination of the auto point ID and an identifier as a prefix or suffix.

The right most part of the auto point ID is incremented within the point ID. If the length of the auto point ID plus identifier is greater than 16 characters, then the auto point ID is truncated from the left.

| Auto point ID        | Identifier | Prefix/Suffix | Offset point ID               |
|----------------------|------------|---------------|-------------------------------|
| Auto1234<br>Auto1235 | OS1        | Prefix        | OS1Auto1234<br>OS1Auto1235... |
| Auto1234<br>Auto1235 | OS1        | Suffix        | Auto1234OS1<br>Auto1235OS1... |



Refer to [27.3 ID templates](#) for more information on point IDs.

## 61

## Hidden Point on TS

### 61.1

### Overview

#### Description

Hidden points cannot be measured directly by a TS instrument, because they are not directly visible.

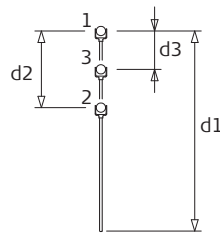
A hidden point can be calculated from measurements to prisms mounted on a hidden point rod. The spacing and length of the hidden point rod are known. The hidden point rod can be held at any angle, as long as it is stationary for all measurements.

Measurements for the hidden point are calculated as if the hidden point was observed directly. These calculated measurements can also be recorded.

The hidden point rod can have either two or three prisms. If three prisms are used the average will be calculated.

#### Hidden point rod

The prisms on the hidden point rod are also called auxiliary points after they have been measured.



- 1 Prism 1
- 2 Prism 2
- 3 Prism 3
- d1 Rod length
- d2 Distance from prism 1 to prism 2
- d3 Distance from prism 1 to prism 3

#### Hidden point tasks

The Hidden Point app can be used for the following tasks:

- The hidden point app can be used to obtain accurate three-dimensional coordinates for a point that is blocked from direct measurement by an obstruction.
- Determination of flow line locations and elevations in inspection hatches, without measuring from the rim to the flow line. Estimation corrections for nonverticality of the measuring tape and eccentricity from the rim measurement to the flow line.
- Determination of recesses in building corners for detailed surveys, without estimating right angle offsets, with or without taping of the dimensions.
- Measurements behind overhangs, buttresses and columns for quantity determinations in underground construction or mining, without estimating right angle offsets, with or without taping of the dimensions.
- Measurements of industrial process piping or other equipment in close quarters.
- Detailed architectural surveys for remodelling or cultural preservation or restoration work
- Any place where accurate measurements would require many more instrument setups in order to achieve line of sight from the instrument to the points being measured.



The TS Hidden Point app does not generate a report sheet.



**AP tilt compensation** cannot be used.

## 61.2

## Accessing Hidden Point and Measuring

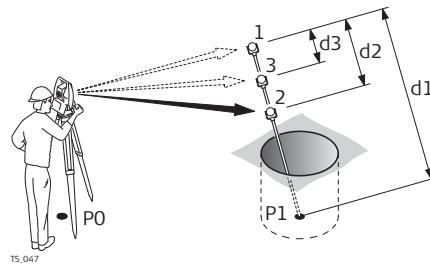
### Access

Select **Leica Captivate - Home: TS hidden point** menu.



If this app is used for the first time, the **Settings** panel is displayed.

### Diagram



- d1 Rod length
- d2 Distance from prism 1 to prism 2
- d3 Distance from prism 1 to prism 3

### Measure Reflector 1, Hidden point page

Measure **Hidden point**

Auxiliary point ID **Aux0003**

Hz **0.0010 g**

V **0.0002 g**

Slope distance -----

Difference in height -----

Rod length **10.000 m**

Fn Measure Distance Store Page Fn

| Key                | Description   |
|--------------------|---|
| <b>Measure</b>     | To measure and store the prism, and access the next panel.  |
| <b>Distance</b>    | To measure a distance.  |
| <b>Store</b>       | To store data.  |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the <b>TS hidden point</b> app. Refer to <a href="#">61.3 Configuring Hidden Point</a> . |

### Description of fields

| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Auxiliary point ID</b>   | Editable field | The point ID of the auxiliary point, the prism on the hidden point rod. The Auxiliary Points ID template is used. |
| <b>Hz</b>                   | Display only   | The horizontal angle to prism 1, the auxiliary point, is displayed.   |
| <b>V</b>                    | Display only   | The vertical angle to prism 1, the auxiliary point, is displayed.   |
| <b>Slope distance</b>       | Display only   | The slope distance to prism 1, the auxiliary point, is displayed.   |
| <b>Difference in height</b> | Display only   | The height difference to prism 1, the auxiliary point, is displayed.  |

| Field             | Option         | Description  |
|-------------------|----------------|--|
| <b>Rod length</b> | Editable field | The length of the rod can be adjusted before the hidden point result is displayed. The rod length always keeps the distances R1-R2 for two prisms and R1-R3 for three prisms into account. |

### Next step

Take the measurements to prism 2 and, if desired, to prism 3. After the last prism of the hidden point rod is measured, **Hidden Point Result, Hidden point result** page is accessed.

## Hidden Point Result, Hidden point result page

| Field                | Value      |
|----------------------|------------|
| Point ID             | TPS5       |
| Hz                   | 111.1112 g |
| V                    | 0.0637 g   |
| Slope distance       | 24.000 m   |
| Difference in height | 25.580 m   |
| Easting              | 1.024 m    |
| Northing             | 0.996 m    |

| Key                                   | Description  |
|---------------------------------------|--|
| <b>Store</b>                          | To measure the prism and exit the app.   |
| <b>Next</b>                           | To store the hidden point and to access <b>Measure Reflector 1</b> to take more hidden point measurements.   |
| <b>Page</b>                           | To change to another page on this panel.   |
| <b>Fn Individ ID</b><br><b>Fn Run</b> | To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template. Refer to <a href="#">27.3 ID templates</a> . |

### Description of fields

| Field                       | Option         | Description  |
|-----------------------------|----------------|--|
| <b>Point ID</b>             | Editable field | The name of the hidden point. The configured point ID template is used.  |
| <b>Hz</b>                   | Display only   | The calculated horizontal angle to the computed hidden point. ----- is displayed for unavailable information.              |
| <b>V</b>                    | Display only   | The calculated vertical angle to the computed hidden point. ----- is displayed for unavailable information.                |
| <b>Slope distance</b>       | Display only   | The calculated slope distance to the computed hidden point. ----- is displayed for unavailable information.                |
| <b>Difference in height</b> | Display only   | The calculated height difference from instrument to computed hidden point. ----- is displayed for unavailable information. |



| Field                               | Option       | Description  |
|-------------------------------------|--------------|--|
| <b>Easting, Northing and Height</b> | Display only | The calculated coordinates of the computed hidden point. ----- is displayed for unavailable information. |

### Next step

**Page** changes to the **Code** page. Type in a code if desired. In the 3D viewer, solid arrows indicate measured distances.

## 61.3

### Configuring Hidden Point

#### Access

In **Measure Reflector 1** press **Fn Settings**.

#### Settings

Settings

Page to show: Measure

Measurement tolerance: 0.020 m

Once hidden point is measured delete the rod points:

Number of reflectors on the rod: 2


Rod length: 10.000 m

Distance between reflector 1 & 2: 10.000 m

Fn OK Fn

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To accept changes and return to the panel from where this panel was accessed.      |
| <b>Edit</b> | To configure the selected page. Refer to <a href="#">27.2 User defined pages</a> . |

#### Description of fields

| Field  | Option          | Description  |
|--|-----------------|--|
| <b>Page to show</b>  | Selectable list | The user-defined page to be shown in <b>Measure Reflector 1</b> , <b>Measure Reflector 2</b> and <b>Measure Reflector 3</b> .  |
| <b>Measurement tolerance</b>                               | Editable field  | Limit of the difference between input and measured spacing of the prisms.<br> For three prisms being used, limit for maximum deviation of the three measurements.                                       |
| <b>Once hidden point is measured delete the rod points</b> | Check box       | The auxiliary points are deleted when the hidden point is stored.<br><br>The auxiliary points are prism 1, prism 2 and prism 3 of the hidden point rod.<br>The Auxiliary Points ID template is used for the auxiliary points. The point ID template is used for the computed hidden point. |

| Field  | Option               | Description  |
|--|----------------------|--|
| <b>Number of reflectors on the rod</b>             | <b>2</b> or <b>3</b> | Two or three prisms are used on the rod.   |
| <b>Automatic-ly turn instrument to reflector 3</b> | Check box            | Available for <b>Number of reflectors on the rod: 3</b> . The third prism is aimed at automatically.   |
| <b>Rod length</b>                                  | Editable field       | Total length of hidden point rod.  |
| <b>Distance between reflector 1 &amp; 2</b>        | Editable field       | Spacing between the centres of prism 1 and prism 2.  |
| <b>Distance between reflector 1 &amp; 3</b>        | Editable field       | Available for <b>Number of reflectors on the rod: 3</b> . Spacing between the centres of prism 1 and prism 3. Prism 3 is situated between prism 1 and prism 2. |

#### Next step

**OK** returns to the panel from where this panel was accessed from.

## 62

## Traverse

### 62.1

### Overview

#### Description

The Traverse app is used to fulfil one of the most common operations done by surveyors; to establish a control point base system to be used as a skeleton for other survey operations. For example, topographic survey, point stakeout, line stakeout or road stakeout.



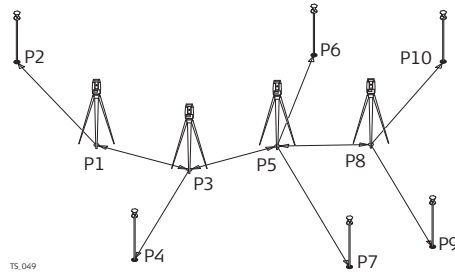
If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).



**AP tilt compensation** cannot be used.

#### Types of traverse

- External reference & closed loop
- Internal reference & position check
- Open end & position check
- Closed end traverse



- P1 Traverse point
- P2 Backsight point
- P3 Traverse point
- P4 Sideshot point
- P5 Traverse point
- P6 Sideshot point
- P7 Sideshot point
- P8 Closing point
- P9 Sideshot point
- P10 Closing angle point

### 62.2

### Accessing Traverse

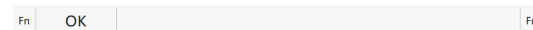
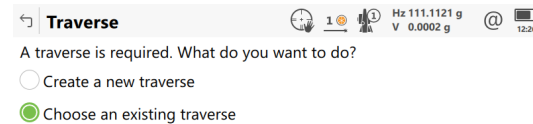
#### Access

Select **Leica Captivate - Home: Traverse**.



If traverses exist, then the **Traverse** panel opens. If no traverse exists, then the **New Traverse** panel opens.

#### Traverse



| Key         | Description   |
|-------------|---|
| OK          | To select the highlighted option and to continue with the subsequent panel.         |
| Fn Settings | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> . |

### Next step

| IF                                      | THEN  |
|---|---|
| a traverse is to be created or selected | highlight the relevant option and press <b>OK</b> .                     |
| Traverse is to be configured            | <b>Fn Content.</b> Refer to <a href="#">62.6 Configuring Traverse</a> . |

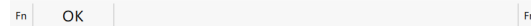
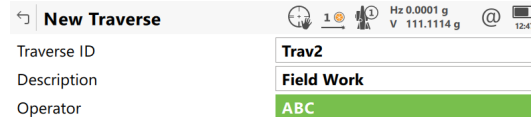
## 62.3

### Creating/Editing a Traverse

#### Access

- In **Traverse**, select **Create a new traverse**. Press **OK**.
- In **Manage Traverses**, press **New** or **Edit**.

#### New Traverse/ Edit Traverse



| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To store the settings.  |
| <b>Fn Settings</b> | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> . |

#### Description of fields

| Field              | Option                         | Description   |
|--------------------|--------------------------------|---|
| <b>Traverse ID</b> | Editable field                 | The ID of the traverse.   |
| <b>Description</b> | Editable field                 | A line for a detailed description of the traverse, for example, work to be performed. Optional. |
| <b>Operator</b>    | Editable field                 | The name of the person who is creating the traverse. Optional.                                  |
| <b>Date</b>        | Display only                   | Available in the <b>Edit Traverse</b> panel. The date of when the traverse was created.         |
| <b>Time</b>        | Display only                   | Available in the <b>Edit Traverse</b> panel. The time of when the traverse was created.         |
| <b>Status</b>      |                                | Available in the <b>Edit Traverse</b> panel.  |
|                    | <b>Open</b>                    | The traverse is not closed in position.   |
|                    | <b>Position closed</b>         | The traverse has been closed in position on a control point.                                    |
|                    | <b>Posn &amp; angle closed</b> | The traverse has been closed both in position and angularly.                                    |
|                    | <b>Adjusted</b>                | The traverse data is the result from an adjustment.   |

## 62.4

## Selecting an Existing Traverse

### Access

In **Traverse**, select **Choose an existing traverse**. Press **OK**.

### Existing Traverse

Existing Traverse

Traverse ID: 1

Description: -----

Operator: -----

Date: 29.09.17

Time: 12:39:43

Status: Open

Fn OK Data Fn

| Key         | Description   |
|-------------|---|
| OK          | To accept the settings.   |
| Data        | To display traverse data. Refer to <a href="#">62.5 Traverse Data</a> . Not available for adjusted traverses. |
| Fn Settings | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> .                           |

### Description of fields

The fields are identical with those fields in the **Edit Traverse** panel. Refer to [62.3 Creating/Editing a Traverse](#).

### Next step

**ENTER** when **Traverse ID** is highlighted. Accesses **Manage Traverses**.

### Manage Traverses

All traverses of the job are displayed.

Manage Traverses

1

Date: 29.09.2017

traverse

Date: 29.09.2017

Fn OK New Edit Data Fn

| Key  | Description  |
|------|--|
| OK   | To confirm selection of highlighted traverse and return to <b>Choose an existing traverse</b> .                                  |
| New  | To create a new traverse. Refer to <a href="#">62.3 Creating/Editing a Traverse</a> .  |
| Edit | To edit the traverse ID and description of the highlighted traverse. Refer to <a href="#">62.3 Creating/Editing a Traverse</a> . |
| Data | To display traverse data. Refer to <a href="#">62.5 Traverse Data</a> for more information.                                      |

| Key                | Description   |
|--------------------|---|
| <b>Fn Settings</b> | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> . |

## 62.5

### Traverse Data

#### Description

This panel allows the review and editing of traverse setups inside of a traverse. Allows access to **Point Results** for editing.

#### Access

**Data** in **Manage Traverses**.

OR

**Data** in a confirmation window of the **Point Results** panel.

#### Traverse Data

The screenshot shows the 'Traverse Data' panel. At the top, there is a title bar with 'Traverse Data' and various icons. Below the title bar, there is a section labeled 'Points'. Under 'Points', there are two rows of data:

| setup1             | No. sets | No. FS |
|--------------------|----------|--------|
| Backsight ID chair | 1        | 1      |
| tps15n             | 1        | 1      |

Below the table, there is a control bar with buttons for 'Fn', 'OK', 'Edit', 'Delete', and 'Fn'.

|    |    |      |        |    |
|----|----|------|--------|----|
| Fn | OK | Edit | Delete | Fn |
|----|----|------|--------|----|

| Key           | Description  |
|---------------|--|
| <b>OK</b>     | To return to where this panel was accessed from.   |
| <b>Edit</b>   | To access the <b>Point Results</b> panel. Refer to <a href="#">62.8 Traverse Point Results</a> . |
| <b>Delete</b> | To delete the LAST traverse setup permanently.   |
| <b>Page</b>   | To change to another page on this panel.   |

#### Description of metadata

| Metadata            | Description   |
|---------------------|---|
| -                   | Point ID of the setup.                                  |
| <b>Backsight ID</b> | The backsight point measured from the current setup ID. |
| <b>No. sets</b>     | Number of measured sets.                                |
| <b>No. FS</b>       | Number of measured foresight points.                    |

## 62.6

### Configuring Traverse

#### Access

Select **Leica Captivate - Home: Traverse**. Press **Fn Settings**.

## Settings, Parameters page

Settings

Parameters Quality control Report sheet

Measure sequence **B'F'...F''B''**

Allow multiple foresight points

When using automatic target aiming, automatically measure the targets

Show additional page from User defined pages

OK Page

| Key         | Description  |
|-------------|--|
| <b>OK</b>   | To accept changes and to return to the panel from where this panel was accessed.   |
| <b>Edit</b> | Available on the <b>Parameters</b> page when a list item in <b>Page to show</b> is highlighted. To edit the page currently being displayed. Refer to <a href="#">27.2 User defined pages</a> . |
| <b>Page</b> | To change to another page on this panel.   |

### Description of fields

| Field  | Option               | Description   |
|--|----------------------|---|
| <b>Measure sequence</b>  | <b>B'F'...F''B''</b> | All points are measured in face I, then measured in face II in reverse sequential order.  |
|  | <b>B'F'...B''F''</b> | All points are measured in face I, then measured in face II.  |
|  | <b>B'B''F'F'...</b>  | Backsight point is measured in face I immediately followed by face II. Other points are measured in face I, face II order.  |
|  | <b>B'B''F'F'...</b>  | Backsight point is measured in face I immediately followed by face II. Other points are measured in alternating face order.   |
|  | <b>B'F'...</b>       | All points are measured in face I only.   |
| <b>Allow multiple foresight points</b>                                       | Check box            | Option to define if only one foresight point or multiple points are used during the sets.   |
| <b>When using automatic target aiming, automatically measure the targets</b> | Check box            | For instruments with automatic aiming and this option checked, automatic aiming search and automatic aiming measurements are done to specified targets and subsequent sets. |
| <b>Show additional page from User defined pages</b>                          | Check box            | The user-defined page to be shown in the Traverse panel.  |

| Field               | Option          | Description   |
|---------------------|-----------------|---|
| <b>Page to show</b> | Selectable list | Available when <b>Show additional page from User defined pages</b> is checked.<br>The names of the available pages. |

#### Next step

Page changes to the **Quality control** page.

### Settings, Quality control page

#### Description of fields

| Field                                  | Option         | Description  |
|--|----------------|--|
| <b>Check for errors before storing</b> | Check box      | The entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements. |
| <b>H<sub>z</sub> tolerance</b>         | Editable field | Tolerance for horizontal directions.   |
| <b>V tolerance</b>                     | Editable field | Tolerance for vertical directions.   |
| <b>Distance tolerance</b>              | Editable field | Tolerance for distance.  |
| <b>Check for backsight height</b>      | Check box      | The entered height tolerance for the backsight point is checked during the measurements to verify accurate pointing and measurements.      |
| <b>Height limit</b>                    | Editable field | Tolerance for the backsight height.  |

#### Next step

Page changes to the **Report sheet** page. Refer to [38 Apps - General](#).

## 62.7

### Traverse Methods

### 62.7.1

#### Starting Traverse

#### Start traverse step-by-step

The quickest setup method is described.

1. Start the Traverse app.
2. **Traverse**  
Select **Create a new traverse**.
3. **OK** to access **New Traverse**.
4. **New Traverse**  
Type in the name of the new traverse.
5. **OK** to access **Settings**.  
Check the settings.
6. **OK** to access **Total Station Setup**.  
Any standard setup method can be used.
7. **Set** to set the setup and orientation.
8. A confirmation window is displayed.

#### Forsight pt



9. **Forsght, Set:**  
**Foresight ID** The name of the foresight point.  
**Target height** The target height of the foresight point.  
**Number of sets** The number of sets to be measured.


---

10. **Measure** to measure and record. The measurement settings for the first measurement to each point are used for all further sets.

---

11. **Point Results**  
**OK** to move to the next setup, to return to the **Point Results** panel (and set a point as a closing point), to survey a sideshot, to view traverse data or to end the traverse.

---

12. **Move** to move to the next setup.  
 After pressing **Move**, Traverse is exited. To continue with the traverse from the next setup refer to [62.7.2 Continuing an Existing Traverse](#).

## 62.7.2

### Continuing an Existing Traverse

#### Measure traverse step-by-step

1. Start the Traverse app.



---

2. **Traverse**  
Select **Choose an existing traverse**.


---

3. **OK** to access **Existing Traverse**.

---

4. **Existing Traverse**  
**Traverse ID** The name of the traverse. **ENTER** to select a different existing traverse.  
 **Data** to view data of the active traverse.  
 **Fn Settings** to change the working style settings.

---

5. **OK** to access **Backsight, Set:**  
Enter **Instrument height**.  
**Hz, V** and **Horizontal distance** The measured values are displayed.  
**Calc azimuth** The calculated azimuth from the current setup point to the backsight point.  
**Difference in horizontal distance** and **Difference in height** The difference between the computed and measured values.  
 **More** to change between the displayed values.


---

6. **Measure** to measure and record the backsight point.

---

7. **Forsght pt** to measure a foresight point.

---

8. **Forsght, Set:**  
**Foresight ID** The name of the foresight point.  
**Target height** The target height of the foresight point.  
**Number of sets** The number of sets to be measured.  
 **Meas app** to measure sideshot points.

---

9. **Measure** to measure and record the foresight points. The measurement settings for the first measurement to each point are used for all further sets.

10. **Point Results**  
**OK**

---

11. A confirmation window is displayed.  
**Move** to move to the next setup.

---

12. Repeat steps 1. to 11. until traverse is ready to be closed.

### 62.7.3

### Closing Traverse

#### Close traverse step-by-step

1. Refer to paragraph 62.7.2 [Continuing an Existing Traverse](#) to measure a traverse. Measure a backsight on a new setup.

---

2. The confirmation window in **Forsght, Set:** is displayed.  
**Close** to begin the process for closing the traverse.

---

3. The confirmation window to select a known point is displayed.  
**OK**

---

4. The job panel for the design job is displayed.  
Highlight the closing point.

---

5. **OK** to select the highlighted point.

---

6. **Forsght, Set:**  
**Measure** to measure and record the closing point.

---

7. **Point Results**  
**OK** to view traverse results.


---

8. **Traverse Results**  
**OK** to display the confirmation window.

---

9. **C ang** to close the traverse with angular closure.

---

-  Optionally the traverse can be adjusted.

---

10. Move to the closure point and start Traverse app.

---

11. **Traverse**  
Select **Choose an existing traverse**.

---

12. **OK** to access **Existing Traverse**.

---

13. **Existing Traverse**  
**Traverse ID** The name of the traverse to be closed is displayed.

---

14. **OK** to access **Close Angle**.

---

15. **Close Angle**  
**Closing method** To measure onto a known point or a known azimuth.  
**Foresight ID** The point ID of the foresight point.  
**Known azimuth** Available for **Closing method : By known azimuth**. Known azimuth for foresight point.

---

16. **OK** to access **Backsight, Set:**.

---

17. **Measure** to measure all sets.

---

18. **Point Results**  
**OK** to view traverse results.

---

19. **Traverse Results**

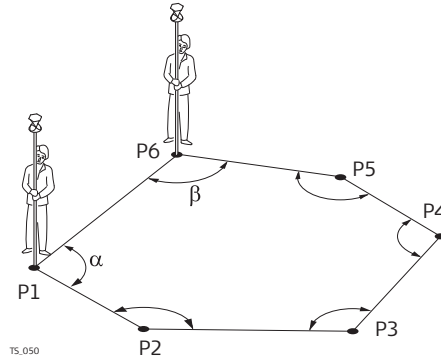
**OK** to exit viewing traverse results.

20. **Exit** to quit the Traverse app.

 Optionally the traverse can be adjusted.

### Close traverse on internal reference

This option is used for determining the closure of a closed loop traverse, consisting of a single control point with an arbitrary backsight azimuth. This function allows completion of a traverse without having to reoccupy the initial setup to measure a closing angle. The positional closure is calculated by comparing the control position of the initial setup to the measured position of the final foresight. The angular closure is calculated by comparing the set azimuth of the initial backsight to the azimuth of the final measured leg.



The first setup is on P1, and an assumed direction to backsight P6. Upon closing the traverse, with the last setup over P6, the closing point is P1. In this case, the only point that is considered as a control is P1.

1. The first setup is on P1 in the diagram shown. Begin the traverse, moving in the direction P1, P2...P6.
2. The last setup point is on P6 in the diagram shown. When on the last setup point, measure a backsight.
3. **Close**
4. The closing point is on P1 in the diagram shown. Select the closing point from the available list.  
**OK**
5. Measure all the sets to the closing point as per a standard traverse.
6. **Point Results**  
**OK** when the review of the results is completed.
7. **Yes** to confirm the automatic calculation.
8. **Traverse Results**  
The traverse closure is shown with positional and angular values.

## 62.7.4

### Creating a Control Point from Backsight by Azimuth

#### Description

If a traverse is to be established on existing control points, two control points must be defined to start the traverse. If the traverse absolute position is arbitrary, it can be convenient to define the control in the field with arbitrary values. This functionality is an option to turn the averaged position value into a control point when a backsight by azimuth is collected.

#### Access

At the beginning of a traverse, when all the measurements are completed to the backsight: On the **Point Results** panel, select **Page** to reach the **Bcksight** page. **Fn Design**.

OR

Anytime during the traverse: On the **Traverse Data** panel, highlight the first setup then **Edit**. On the **Point Results** panel, select **Page** to reach the **Bcksght** page. **Fn Design**.

## 62.8

### Traverse Point Results

#### Description

Point observation results are displayed on this panel.

#### Access

Is displayed automatically after measuring all sets from the current setup.

#### Point Results, Foresight page and Bcksght page

The screenshot shows the 'Point Results' panel with the following data:

| Field            | Value      |
|------------------|------------|
| Point ID         | tps15      |
| Target height    | 1.500 m    |
| Point type       | Foresight  |
| No. of used sets | 1/1        |
| Hz arc average   | 0.0003 g   |
| V average        | 111.1112 g |
| Distance average | 13.875 m   |

At the bottom, there are navigation buttons: Fn, OK, Add sets, Sets, Close, More, Page, and Fn.

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | While measuring a traverse: Displays a confirmation window with traverse measurement options. Otherwise: To return to <b>Traverse Data</b> .  |
| <b>Add sets</b>    | To add more sets while still at the setup. It could be necessary on particular legs of a traverse that more than the designated number of sets is required. Possibly some of the sets from the first run exceeded the tolerance limit and must be disabled. |
| <b>Sets</b>        | To include or exclude measured sets in the calculation of a foresight point. Check a set to include it into the calculation. Uncheck a set to exclude it from the calculation.  |
| <b>Close</b>       | To set a point as a closing point if not selected before measurement. Or to revert a closing point to a normal foresight.   |
| <b>More</b>        | To display additional information.  |
| <b>Page</b>        | To change to another page on this panel.  |
| <b>Fn Settings</b> | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> .   |
| <b>Fn Edit</b>     | To edit point code and annotations.   |
| <b>Fn Check</b>    | Available on the <b>Foresight</b> page. To check inverse distances and closure between the selected point and a point from the fixpoint job.  |
| <b>Fn Design</b>   | Available on the <b>Bcksght</b> page of the initial setup. Refer to <a href="#">62.7.4 Creating a Control Point from Backsight by Azimuth</a> .   |

### Description of fields

| Field                              | Option  | Description  |
|------------------------------------|---|--|
| <b>Point ID</b>                    | Selectable list or display only                         | Selected point ID.   |
| <b>Target height</b>               | Selectable list or display only                         | The target height of the target point.   |
| <b>Point type</b>                  | <b>Foresight, Closing point</b> or <b>Closing angle</b> | Available on the <b>Foresight</b> page.<br>The current point type.   |
| <b>No. of used sets</b>            | Display only  | Available on the <b>Foresight</b> page.<br>The number of sets out of all measured sets used for the calculation. |
| <b>Number of sets</b>              | Display only  | Available on the <b>Bcksight</b> page.<br>The number of sets the point was measured in.                          |
| <b>Hz arc average</b>              | Display only  | Average horizontal angle.  |
| <b>V average</b>                   | Display only  | Average vertical angle.  |
| <b>Distance average</b>            | Display only  | Average distance.  |
| <b>Hz arc standard deviation</b>   | Display only  | Standard deviation of horizontal angle.  |
| <b>V standard deviation</b>        | Display only  | Standard deviation of vertical angle.  |
| <b>Distance standard deviation</b> | Display only  | Standard deviation of distance.  |
| <b>Hz spread</b>                   | Display only  | Spread of horizontal angle.  |
| <b>V spread</b>                    | Display only  | Spread of vertical angle.  |
| <b>Distance spread</b>             | Display only  | Spread of distance.  |

### Next step

**Page** changes to the **Stn info** page.

Point Results,  
Stn info page

### Description of fields

| Field                    | Option         | Description                           |
|--------------------------|----------------|---------------------------------------|
| <b>Setup ID</b>          | Display only   | The ID of the instrument setup.       |
| <b>Instrument height</b> | Editable field | Current instrument height. Editable.  |
| <b>Easting</b>           | Display only   | Easting value of the setup position.  |
| <b>Northing</b>          | Display only   | Northing value of the setup position. |

| Field       | Option       | Description                               |
|-------------|--------------|---|
| Height      | Display only | Orthometric height of the setup position. |
| Scale       | Display only | Scale factor used in the calculation.     |
| Temperature | Display only | Temperature set on the instrument.        |
| Pressure    | Display only | Atmospheric ppm set on the instrument.    |

### Next step

| IF accessed               | THEN  |
|---------------------------|---|
| after sets measurement    | <p><b>OK</b> opens a confirmation window with options that depend on the traverse status:</p> <ul style="list-style-type: none"> <li>For an open traverse:<br/>Move to next setup, return to <b>Point Results</b>, to survey a sideshot, to view traverse data or to quit the Traverse app.</li> <li>For a closed traverse:<br/>Move to close angle, return to <b>Point Results</b>, to survey a sideshot, to adjust the traverse or to quit the Traverse app.</li> </ul> |
| from <b>Traverse Data</b> | <b>OK</b> returns to <b>Traverse Data</b> .   |

## 62.9

### Traverse Results

#### Description

Traverse closure results are displayed on this panel.

#### Access

Is displayed automatically after the traverse closing point is measured or selected.

#### Traverse Results, Position page

| Traverse Results   |          |
|--------------------|----------|
| Position           | Angle    |
| Starting point     | setup1   |
| Closing point      | tps019   |
| Length of error    | 52.914 m |
| Direction of error | 0.2758 g |
| Height difference  | -6.824 m |
| Total distance     | 40.993 m |
| 2D accuracy        | 1/0      |

| Key                                  | Description   |
|--------------------------------------|---|
| <b>OK</b>                            | To move to close angle, to survey a sideshot, to adjust the traverse or to quit the Traverse app. |
| <b>N &amp; E</b> or <b>L &amp; D</b> | To view the misclosure error in north/east or length/direction.                                   |
| <b>Adjust</b>                        | To adjust the traverse.   |
| <b>Data</b>                          | To display traverse data.   |
| <b>Page</b>                          | To change to another page on this panel.  |

| Key               | Description   |
|-------------------|---|
| <b>FnSettings</b> | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> . |

#### Description of fields

| Field                     | Option       | Description                                 |
|---------------------------|--------------|---|
| <b>Starting point</b>     | Display only | The point ID of the traverse start point.   |
| <b>Closing point</b>      | Display only | The point ID of the traverse closing point. |
| <b>Length of error</b>    | Display only | The length of the misclosure error.         |
| <b>Direction of error</b> | Display only | The direction of the misclosure error.      |
| <b>Difference north</b>   | Display only | Error in north.                             |
| <b>Difference east</b>    | Display only | Error in east.                              |
| <b>Height difference</b>  | Display only | Error in height.                            |
| <b>Total distance</b>     | Display only | Total length of the traverse.               |
| <b>2D accuracy</b>        | Display only | Position ratio of misclosure.               |
| <b>1D accuracy</b>        | Display only | Height ratio of misclosure.                 |

#### Next step

**Page** changes to the **Angle** page.

#### Traverse Results, Angle page

#### Description of fields

| Field                     | Option       | Description   |
|---------------------------|--------------|---|
| <b>Foresight ID</b>       | Display only | Point ID of the closing angle point. Displays ----- if no values are available.             |
| <b>Known azimuth</b>      | Display only | Defined azimuth of closing line. Displays ----- if no values are available.                 |
| <b>Azimuth average</b>    | Display only | Mean value of the measured azimuth closing line. Displays ----- if no values are available. |
| <b>Angular misclosure</b> | Display only | Angular misclosure of traverse. Displays ----- if no values are available.                  |

#### Next step

**OK** to move to close angle, to survey a sideshot, to adjust the traverse or to quit the app.

## 62.10

## Traverse Adjustment

### 62.10.1

### Accessing Traverse Adjustment

#### Description

- A traverse adjustment can be performed on three components: 2D positions, angles and elevations.
- Various adjustment methods are available for selection. Once the adjustment is performed, the results can be reviewed. Adjusted points are stored into a new job, and a report can be generated.
- If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).



Survey points have to be measured while Traverse is running to be part of the adjustment calculations.

#### Access

The traverse adjustment option can be reached in different ways based on specific conditions.

Upon completing the observations onto the closing point, **Adjust** to access **Traverse Adjustment**.

OR

After the measurements are done on the closing line for angular closure, **Adjust** to access **Traverse Adjustment**.

OR

When the traverse is closed: **Result** in **Traverse Data**, then **Adjust** in **Traverse Results** to access **Traverse Adjustment**.

#### Traverse Adjustment, Method page

Traverse Adjustment

Method

Traverse ID 1

Horiz adjustment **Compass rule**

Angle balance **No distribution**

Vert adjustment **Equally**

Fn OK Fn

| Key         | Description   |
|-------------|---|
| OK          | To calculate the result.  |
| Page        | To change to another page on this panel.  |
| Fn Settings | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> . |

#### Description of fields

| Field            | Option              | Description  |
|------------------|---------------------|--|
| Traverse ID      | Display only        | The ID of the traverse.  |
| Horiz adjustment | <b>Compass rule</b> | Suitable for surveys, where angles and distances were measured with equal precision. |



| Field                  | Option                 | Description  |
|------------------------|------------------------|--|
|                        | <b>Transit rule</b>    | Suitable for surveys, where angles were measured with a higher precision than the distances. |
|                        | <b>No distribution</b> | No distribution is made.   |
| <b>Angle balance</b>   | <b>Equally</b>         | The angle misclosure is distributed equally.   |
|                        | <b>No distribution</b> | No distribution is made.   |
| <b>Vert adjustment</b> | <b>Equally</b>         | The height error distributed equally.  |
|                        | <b>By distance</b>     | The height error distributed by distance.  |
|                        | <b>No distribution</b> | No distribution is made.   |

### Next step

**OK** starts the adjustment calculation.

## 62.10.2

### Adjustment Results

#### Description

The results of the adjustment calculations can be reviewed by accessing the different pages.

#### Access

**OK** in **Traverse Adjustment**.

#### Adjustment Results, Position page

| Position           | Angle Points Method |
|--------------------|---------------------|
| Closure data type  | <b>Adjusted</b>     |
| Starting point     | <b>setup1</b>       |
| Closing point      | <b>tps019</b>       |
| Length of error    | <b>0.000 m</b>      |
| Direction of error | <b>0.0000 g</b>     |
| Height difference  | <b>0.000 m</b>      |
| Total distance     | <b>40.993 m</b>     |

Fn OK N & E More Page Fn

| Key                           | Description   |
|-------------------------------|---|
| <b>OK</b>                     | To access the next panel.   |
| <b>N &amp; E or L &amp; D</b> | To view the misclosure error in north/east or length/direction.                     |
| <b>More</b>                   | To display the values for the unadjusted, the balanced and the adjusted solution.   |
| <b>Page</b>                   | To change to another page on this panel.  |
| <b>Fn Settings</b>            | To configure the Traverse app. Refer to <a href="#">62.6 Configuring Traverse</a> . |

### Description of fields

| Field                     | Option   | Description   |
|---------------------------|--|---|
| <b>Closure data type</b>  | <b>Adjusted, Unadjusted</b> or <b>Balanced</b> | <b>More</b> to change between the options and display the values accordingly. |
| <b>Starting point</b>     | Display only                                   | The point ID of the traverse start point.                                     |
| <b>Closing point</b>      | Display only                                   | The point ID of the traverse close point.                                     |
| <b>Length of error</b>    | Display only                                   | The length of the misclosure error.   |
| <b>Direction of error</b> | Display only                                   | The direction of the misclosure error.  |
| <b>Difference north</b>   | Display only                                   | Error in north.   |
| <b>Difference east</b>    | Display only                                   | Error in east.  |
| <b>Height difference</b>  | Display only                                   | Error in height.  |
| <b>Total distance</b>     | Display only                                   | Total length of the traverse.   |
| <b>2D accuracy</b>        | Display only                                   | Position ratio of misclosure.   |
| <b>1D accuracy</b>        | Display only                                   | Height ratio of misclosure.   |

### Next step

**Page** changes to the **Angle** page.

### Adjustment Results, Angle page

### Description of fields

| Field                     | Option       | Description   |
|---------------------------|--------------|---|
| <b>Closure data type</b>  | Display only | <b>More</b> to change between the options.  |
| <b>Known azimuth</b>      | Display only | Defined azimuth of closing line. Displays ----- if no values are available.                 |
| <b>Azimuth average</b>    | Display only | Mean value of the measured azimuth closing line. Displays ----- if no values are available. |
| <b>Angular misclosure</b> | Display only | Angular misclosure of traverse. Displays ----- if no values are available.                  |

### Next step

**Page** changes to the **Points** page.

### Adjustment Results, Points page

The adjusted points are listed including the function for each point. **Display** shows the coordinate values of the highlighted point.

**Next step**

**Page** changes to the **Method** page.

---

**Adjustment Results, Method page**

The adjustment methods previously selected in **Traverse Adjustment** and used for the adjustment are displayed.

**Next step**

3D viewer provides an interactive display of the data.

**OK** accesses **Adjustment Store**.

---

**Adjustment Store**

**Description of fields**

| Field                          | Option               | Description   |
|--------------------------------|----------------------|---|
| <b>Traverse ID</b>             | Display only         | The ID of the traverse.   |
| <b>Store adjusted job to</b>   | Selectable list      | The location to save the adjusted job.  |
| <b>New job</b>                 | Editable field       | The new job name. Once adjustment results have been reviewed and accepted, the adjusted position of the points is stored in a separate job.                     |
| <b>Include measured points</b> | Check box            | Survey points can be included or not. Adjusted points are stored in the new job as a triplet of class <b>Adjusted (Adj)</b> .                                   |
| <b>Store point ID with</b>     | <b>Same point ID</b> | Adjusted points are stored in the new job with the original point IDs.  |
|                                | <b>Prefix</b>        | Adjusted points are stored in the new job with a prefix in front of the original point IDs.   |
|                                | <b>Suffix</b>        | Adjusted points are stored in the new job with a suffix at the end of the original point IDs.   |
| <b>Prefix / suffix</b>         | Editable field       | Available when <b>Prefix</b> or <b>Suffix</b> is selected in <b>Store point ID with</b> . The value that is added to the front or end of the original point ID. |

---

**Next step**

**Store** stores the results.

---

63.1

Overview

Description

The Volume Calculations app allows surfaces to be measured and volumes (and other information) to be computed from these surfaces.

Volume calculations tasks

The Volume calculations app can be used for the following tasks:

- Measuring points (surface points and boundary points) defining a new surface or extending existing surfaces from the job.
- Calculating the triangulation of the measured surface points to establish the surface.
- Calculating volumes from a base (3D point, entered elevation) or by a stockpile method.

The surface calculation can be made from:

- existing point data in the job.
- manually occupied points.
- entered coordinates.

Activating the app

If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).



Volume Calculations are possible for RTK rover and TS.

Point types

Surfaces can be created from points stored as:

- Local grid
- Height mode can be ellipsoidal or orthometric.

Heights and positions are always taken into account. Points must have full coordinate triplets.

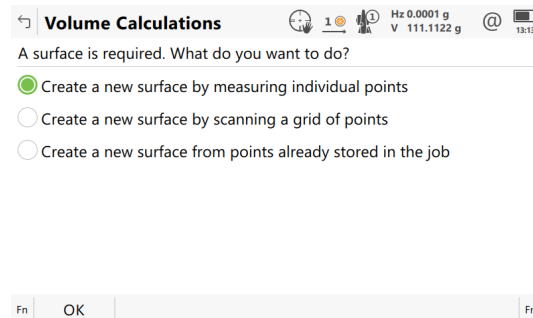
63.2

Accessing Volumes & Surfaces

Access

Select **Leica Captivate - Home: Volume calc.**

Volume Calculations



| Key         | Description  |
|-------------|--|
| OK          | To select the highlighted option and to continue with the subsequent panel.                                  |
| Fn Settings | To configure the Volume Calculations app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> . |

### Description of options

| Option   | Description                               |
|--|---|
| <b>Create a new surface by scanning a grid of points</b> | Available in TS mode.                     |
| <b>Choose an existing surface</b>                        | Available when surfaces exist in the job. |

## 63.3 Configuring Volumes & Surfaces

**Access** Select **Leica Captivate - Home: Volume calc.** Press **Fn Settings**.  
Refer to [38 Apps - General](#) for information on the **Report sheet** page.

## 63.4 Calculating Volumes

### 63.4.1 Create a New Surface by Measuring New Points

**Access** Select **Create a new surface by measuring individual points** in **Volume Calculations**.

#### New Surface

#### Description of fields

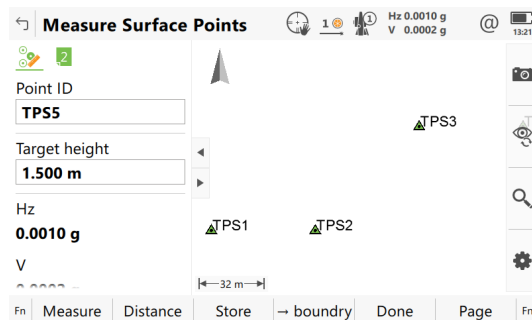
| Field               | Option         | Description                         |
|---------------------|----------------|-------------------------------------|
| <b>Surface name</b> | Editable field | The name/number of the new surface. |

#### Next step

**OK** to access **Define Grid Scan Area**.

#### Measure Surface Points, page

The pages shown are from a typical working style. An extra page is available when a user-defined page is used.



| Key            | Description   |
|----------------|---|
| <b>Measure</b> | For GS:<br>To start measuring the surface point. The key changes to <b>Stop</b> . |
| <b>Measure</b> | For TS:<br>To measure a distance and store distance and angles.                   |

| Key  | Description   |
|--|---|
| <b>Stop</b>                                      | For GS:<br>To end measuring the surface point. The key changes to <b>Store</b> .  |
| <b>Distance</b>                                  | For TS:<br>To measure a distance.   |
| <b>Store</b>                                     | To store the measured surface point. The key changes to <b>Measure</b> .  |
| <b>Near</b>                                      | For GS:<br>To search the job for the point nearest to the current position when the key is pressed. The point is selected as the point to be measured and is displayed in the first field on the panel. After measuring and storing the nearest point, the next point suggested is the one which was suggested before the key was pressed.<br>Available when <b>Measure</b> is displayed.         |
| <b>→ boundary</b><br>and<br><b>→ surface</b>     | To change the type of point to be measured between surface point and boundary point.  |
| <b>Done</b>                                      | To finish measuring.  |
| <b>Page</b>                                      | To change to another page on this panel.  |
| <b>Fn Settings</b>                               | To configure SmartCode and auto point measurements.   |
| <b>Fn Display</b>                                | To configure what is displayed in the 3D viewer.  |
| <b>Fn2 Face</b>                                  | Available for <b>Measure distance: Once</b> and <b>Measure distance: Once &amp; fast</b> . To take an angle and distance measurement in Face I and Face II. The point stored is an average of the two measurements. Using instruments fitted with auto aiming, the point is automatically measured in both faces. The resulting point is stored and the instrument is returned to the first face. |
| <b>Fn Tools</b>                                  | Refer to <a href="#">39 Apps - The Toolbox</a> .  |
| <b>Fn Connect</b><br>and<br><b>Fn Disconnect</b> | For GS:<br>To connect/disconnect from the <b>GPS</b> reference data.  |

#### Description of fields

| Field           | Option         | Description  |
|-----------------|----------------|--|
| <b>Point ID</b> | Editable field | The identifier for measured points. The configured point ID template is used. The ID can be changed: <ul style="list-style-type: none"> <li>To start a new sequence of point IDs overtype the point ID.</li> <li>For an individual number independent of the ID template <b>Fn Tools</b>.</li> </ul> |

| Field                       | Option         | Description   |
|-----------------------------|----------------|---|
| <b>Antenna height</b>       | Editable field | For GS:<br>The antenna height as defined in the active working style is suggested. Changes in the antenna height, while working in the app, do update the antenna height defined in the active working style. |
| <b>3D quality</b>           | Display only   | For GS:<br>The current 3D coordinate quality of the computed position.  |
| <b>Target height</b>        | Editable field | For TS:<br>The last used target height is suggested when accessing this panel. An individual target height can be typed in.   |
| <b>H<sub>z</sub></b>        | Display only   | For TS:<br>The current horizontal angle.  |
| <b>V</b>                    | Display only   | For TS:<br>The current vertical angle.  |
| <b>Horizontal distance</b>  | Display only   | For TS:<br>The horizontal distance after <b>Distance</b> was pressed. No distance is displayed when accessing the panel and after <b>Store</b> or <b>Measure</b> .  |
| <b>Difference in height</b> | Display only   | For TS:<br>The height difference between setup and measured point after <b>Distance</b> was pressed. Displays ----- when accessing the panel and after <b>Store</b> or <b>Measure</b> .                       |

#### Next step

Measure all points. Then press **Done**.

## 63.4.2

### Create a New Surface by Using Grid Scan

#### Access

For TS:

Select **Create a new surface by scanning a grid of points** in **Volume Calculations**.

#### New Surface

##### Description of fields

| Field               | Option         | Description                         |
|---------------------|----------------|-------------------------------------|
| <b>Surface name</b> | Editable field | The name/number of the new surface. |

#### Next step

**OK** to access **Define Grid Scan Area**.

#### Grid scan points to surface

Refer to [45.9 Grid Scan on Surface - TS](#) for defining the grid scan area, defining the scan settings as well as starting and ending grid scanning.

## Access

Select **Create a new surface from points already stored in the job** in **Volume Calculations**.



When accessing the **Edit Surface** panel after selecting **Create a new surface from points already stored in the job** the **Points** page is active. Any other time this panel is accessed the **General** page is active.

## New Surface

## Description of fields

| Field               | Option         | Description                         |
|---------------------|----------------|-------------------------------------|
| <b>Surface name</b> | Editable field | The name/number of the new surface. |

## Next step

**OK** to access **Edit Surface** after points being added.

Edit Surface,  
General page

**Edit Surface** Hz 0.0010 g V 0.0002 g 13:23

**General** Points 3D viewer

Surface name **Mysurface**

Number of surface points **0**

Number of boundary points **0**

Point ID of last stored point ----

Date stored ----

Time stored ----

Surface status **Triangulation needed**

Fn OK Page Fn

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To accept all settings and continue with the next panel.                                 |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> . |

## Description of fields

| Field                                | Option          | Description  |
|--------------------------------------|-----------------|--|
| <b>Surface name</b>                  | Selectable list | Name of the surface to be triangulated.                |
| <b>Number of surface points</b>      | Display only    | Number of points inside the surface.                   |
| <b>Number of boundary points</b>     | Display only    | Number of boundary points of the surface.              |
| <b>Point ID of last stored point</b> | Display only    | ID of the last measured point of the chosen surface.   |
| <b>Date stored</b>                   | Display only    | Date of the last measured point of the chosen surface. |

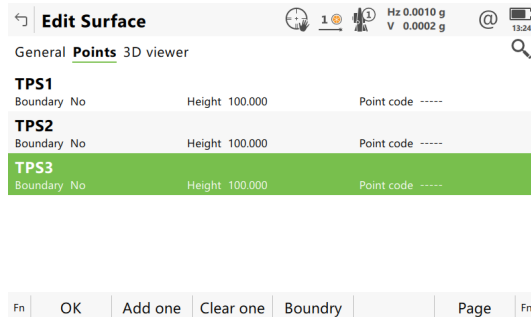


| Field                 | Option                      | Description  |
|-----------------------|-----------------------------|--|
| <b>Time stored</b>    | Display only                | Time of the last measured point of the chosen surface.                                 |
| <b>Surface status</b> | <b>Triangulation done</b>   | The surface has been triangulated and not been modified since the last triangulation.  |
|                       | <b>Triangulation needed</b> | The surface has been modified since the last triangulation or no triangulation exists. |

### Next step

Page changes to the **Points** page.

## Edit Surface, Edit Surface page



| Key                 | Description  |
|---------------------|--|
| <b>OK</b>           | To accept all settings and continue with the next panel.   |
| <b>Add all</b>      | To add one point from the job to the surface.  |
| <b>Clear one</b>    | To remove one point from the surface.  |
| <b>Boundary</b>     | To use this point for the boundary.  |
| <b>Page</b>         | To change to another page on this panel.   |
| <b>Fn Settings</b>  | To configure the Volume Calculations app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> . |
| <b>Fn Add all</b>   | To add all points from the job to the surface.   |
| <b>Fn Clear all</b> | To remove all points from the surface.   |

### Next step

**OK** continues to **Surface Task Selection**.

## 63.4.4

### Choosing an Existing Surface

#### Access

Select **Choose an existing surface** in **Volume Calculations**.

#### Existing Surface

The fields available are identical with the fields in **Surface status, General** page. Refer to [63.4.3 Create a New Surface from Previously Stored Points](#).

### Next step

Select the desired surface ID then press **OK**. **OK** continues to **Surface Task Selection**. Refer to [63.4.5 Selecting the Surface Task](#).

## 63.4.5

## Selecting the Surface Task

### Surface Task Selection

#### Description of the options

| Options  | Description   |
|--|---|
| <b>Add more points to the surface by measuring individual points</b> | To measure points defining a new surface or extending existing surfaces and boundaries by surveying. Refer to <a href="#">63.4.1 Create a New Surface by Measuring New Points</a> .   |
| <b>Add more points to the surface by scanning a grid of points</b>   | To add more points to the surface by grid scanning new points. The grid scan procedure restarts.  |
| <b>Review &amp; edit the surface</b>                                 | To view the surface summary and add/remove points from the surface. Refer to <a href="#">63.4.3 Create a New Surface from Previously Stored Points</a> .  |
| <b>Edit the boundary &amp; triangulate surface</b>                   | To define/redefine the boundary using manual point selection, or one of the existing automatic methods, and then create a triangulation. A DXF model can then be exported if desired. Refer to <a href="#">63.4.6 Boundary Definition</a> . |
| <b>Calculate the volume</b>  | Available after the surface has been triangulated.<br>To compute the volume of a surface by a reference (3D point, entered elevation) or by the stockpile method. Refer to <a href="#">63.4.7 Compute Volumes</a> .                         |
| <b>Exit the app</b>  | To end the app and return to the panel from where Volume Calculations was accessed.   |

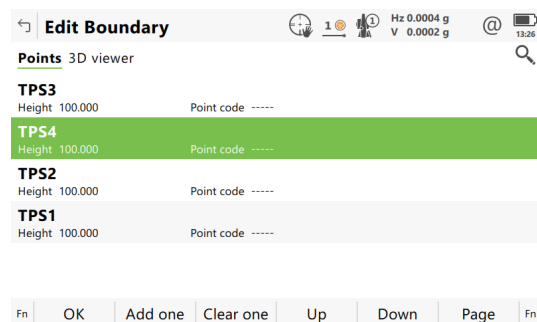
#### Next step

Select the task to do next. **OK** selects an option.

## 63.4.6

## Boundary Definition

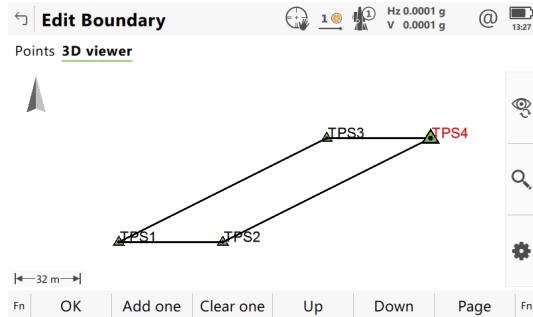
### Edit Boundary, Points page



| Key              | Description   |
|------------------|---|
| <b>OK</b>        | To start calculating the triangulation.   |
| <b>Add one</b>   | To add points from the job to the surface.  |
| <b>Clear one</b> | To remove the marked point from the boundary definition or completely from the surface. |

| Key                | Description  |
|--------------------|--|
| <b>Up</b>          | To move up the focused point one step within the boundary definition.  |
| <b>Down</b>        | To move the focused point one step down within the boundary definition.                                      |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the Volume Calculations app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> . |
| <b>Fn Tools</b>    | To access the <b>Boundary Tools Menu</b> .   |

## Edit Boundary, 3D viewer page



| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To start calculating the triangulation.  |
| <b>Add one</b>     | To add points from the job to the surface.   |
| <b>Clear one</b>   | To remove the marked point from the boundary definition or completely from the surface.                      |
| <b>Up</b>          | To move up the focused point one step within the boundary definition.  |
| <b>Down</b>        | To move the focused point one step down within the boundary definition.                                      |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the Volume Calculations app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> . |
| <b>Fn Display</b>  | To configure what is displayed in 3D viewer.   |
| <b>Fn Layers</b>   | To turn CAD layers on or off.  |
| <b>Fn Tools</b>    | To access the <b>Boundary Tools Menu</b> .   |


### Next step

| IF you want to                  | THEN   |
|---------------------------------|--|
| check the triangulation results | <b>OK</b> to access <b>Triangulation Results</b> . |

## Triangulation Results

The **Summary** page and the **Details** page contain only display only fields. Information such as the number of triangles/surface points/boundary points, the minimum/maximum elevation or the 3D area is shown.

3D viewer contains a plot of the triangles of the triangulation and also its boundary.

Triangulation Results  Hz 0.0004 g V 0.0002 g @ 13:28

**Summary** Details 3D viewer

|                           |                               |
|---------------------------|-------------------------------|
| Surface name              | <b>Mysurface</b>              |
| Area                      | <b>2500.000 m<sup>2</sup></b> |
| Number of triangles       | <b>2</b>                      |
| Number of surface points  | <b>0</b>                      |
| Number of boundary points | <b>4</b>                      |

Fn OK Store DTM Store DXF Page Fn

| Key                | Description   |
|--------------------|---|
| <b>OK</b>          | To return to <b>Surface Task Selection</b> .                    |
| <b>Store DTM</b>   | To go to a panel where the surface can be saved as DTM job.     |
| <b>Store DXF</b>   | To go to a panel where the triangulation can be saved as a DXF. |
| <b>Page</b>        | To change to another page on this panel.                        |
| <b>Fn Settings</b> | To configure the report sheet.                                  |

## Boundary Tools Menu

### Description of fields

| Field                            | Description  |
|----------------------------------|--|
| <b>Add multiple points</b>       | Lists all points in the job.   |
| <b>Remove all points</b>         | Method to remove all points that are indicated in <b>Edit Boundary, Points</b> page.   |
| <b>Sort points by time</b>       | Method to sort all points in <b>Edit Boundary, Points</b> page by the time they were stored.                                       |
| <b>Sort points by proximity</b>  | Method to sort all points <b>Edit Boundary, Points</b> page by the closest proximity.  |
| <b>Compute rubber band bndry</b> | Method to define a new boundary as if a rubber band was placed around the points. The current list of boundary points are ignored. |

### Next step

Select the task to do next. **OK** selects an option and returns to the boundary definition.

## Volume Calculation

Volume Calculation

Surface name: Mysurface

Number of triangles: 2

Volume calculation method: Stockpile

Fn OK Fn

| Key         | Description  |
|-------------|--|
| OK          | To compute the volume.   |
| Lowest ht   | Available for <b>Volume calculation method: Surface to entered height</b> .<br>To enter the smallest possible value for <b>Height</b> automatically. |
| Fn Settings | To configure the app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> .   |

## Description of fields

| Field                     | Option                           | Description  |
|---------------------------|----------------------------------|--|
| Surface name              | Selectable list or display only  | Surface chosen from the triangulated surfaces currently stored to the job.   |
| Number of triangles       | Display only                     | Number of triangles from the triangulation of the surface.   |
| Volume calculation method |                                  | To calculate the volume of the triangulated surface.   |
|                           | <b>Stockpile</b>                 | Volume between the triangulated surface and the DTM surface defined by the boundary points of the surface.   |
|                           | <b>Surface to entered height</b> | Volume between the triangulated surface and the entered height.  |
|                           | <b>Surface to point</b>          | Volume between the triangulated surface and the height of a selected point.  |
|                           | <b>Surface to surface</b>        | Volume difference between two surfaces.<br>Examples: <ul style="list-style-type: none"> <li>A measured excavation against the original DTM</li> <li>The same stockpile measured in different stages</li> </ul> |
| Height                    | Editable field or display only   | Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> .<br>The height to which the volume is calculated.                            |

| Field                          | Option          | Description  |
|--------------------------------|-----------------|--|
| <b>Comparison surface name</b> | Selectable list | Available for <b>Volume calculation method: Surface to surface</b> .<br>Surface chosen from the triangulated surfaces currently stored to the job. |

### Next step

OK calculates the volume and continues to **Volume Calculation Results**.

## Volume Calculation Results, Summary page

| Field        | Value                   |
|--------------|-------------------------|
| Surface name | Mysurface               |
| Area         | 2500.000 m <sup>2</sup> |
| Net volume   | 0.000 m <sup>3</sup>    |

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To close the triangulation of the surface.   |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">63.3 Configuring Volumes &amp; Surfaces</a> . |

### Description of fields

| Field                                 | Option       | Description  |
|---------------------------------------|--------------|--|
| <b>Surface name</b>                   | Display only | Name of the surface used for the calculation. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> .                 |
| <b>Point ID</b>                       | Display only | The point to which the volume is calculated. Available for <b>Volume calculation method: Surface to point</b> .  |
| <b>Height</b>                         | Display only | The elevation of the point to which the volume is calculated. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> . |
| <b>Area</b>                           | Display only | Area of the base plane.  |
| <b>Net volume</b>                     | Display only | Volume of the surface.   |
| <b>Volume above reference surface</b> | Display only | Cut of the volume. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> .  |

| Field                                 | Option       | Description  |
|---------------------------------------|--------------|--|
| <b>Volume below reference surface</b> | Display only | Fill of the volume. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> . |

**Next step**

**Page** changes to the **Details** page.

**Volume Calculation Results, Details page**

**Description of fields**

| Field                    | Option       | Description  |
|--------------------------|--------------|--|
| <b>Minimum elevation</b> | Display only | Minimal elevation of the triangulated surface.   |
| <b>Maximum elevation</b> | Display only | Maximal elevation of the triangulated surface.   |
| <b>Average thickness</b> | Display only | Average thickness of the calculated volume.  |
| <b>Perimeter</b>         | Display only | Perimeter of the measured surface area. Intersection of the measured surface to the reference datum. |

## 64

## Inspect Surfaces

### 64.1

### Overview

#### Description

The app can be used to compare two surfaces.

The surfaces can be defined by scans, points, planes or solid.

The result is displayed in a map but can be shown as statistics, exported as report or exported as surface.

#### Activating the app

If the message panel appears which requires that the app must be activated using a licence key then refer to [30.3 Entitlements & licences](#).

### 64.2

### Accessing Inspect surfaces

#### Access

Select **Leica Captivate - Home: Inspect surfaces**.

#### Define Reference Surface

Define the reference surface to which another surface is compared to.

| Key         | Description  |
|-------------|--|
| OK          | To select the highlighted option and to continue with the subsequent panel.        |
| Fn Settings | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |

#### Description of options

| Option                          | Description  |
|---------------------------------|--|
| By scanning a new surface       | Available in TS mode.  |
| From existing scans             | Available when surfaces exist in the job.<br>To create a reference surface from existing scans in the selected job.  |
| From existing points            | To create a reference surface from points in the selected job.   |
| From a point cloud or .dxf file | Import DXF, PTS or ASCII data.<br>A surface will be created based on the triangulation settings in <b>Settings</b> . |



| Option                                   | Description  |
|--|--|
| <b>From a pre-defined plane or solid</b> | Select from: <ul style="list-style-type: none"> <li>• <b>Horizontal plane</b><br/>Choose or measure a point to define the height of the horizontal plane.</li> <li>• <b>Vertical plane</b><br/>Choose or measure two points to define the orientation of the vertical plane.</li> <li>• <b>Plane (defined by 3 points)</b><br/>Choose or measure three points to define the plane.</li> <li>• <b>Cylinder</b><br/>Choose or measure two points to define the axis of the cylinder and enter the radius of the cylinder.</li> <li>• <b>Cone</b><br/>Choose or measure two points to define the axis of the cone, and enter the radius for the two bases.</li> </ul> |
| <b>From design data</b>                  | Select from: <ul style="list-style-type: none"> <li>• <b>From road design data</b><br/>To compare the on-site scanned point cloud with a road job design.</li> <li>• <b>From tunnel design data</b><br/>To compare the on-site scanned point cloud with a tunnel job design.</li> <li>• <b>From IFC design data</b><br/>To compare the on-site scanned point cloud with one or more IFC objects.</li> <li>• <b>From DTM design data</b><br/>To compare the on-site scanned point cloud with a DTM job</li> </ul>   |

### 64.3

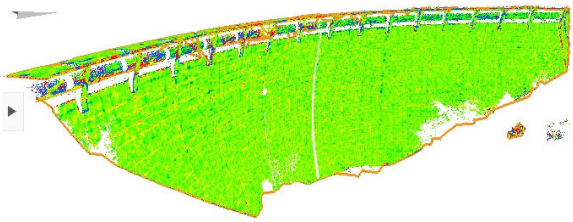
### Configuring Inspect surfaces

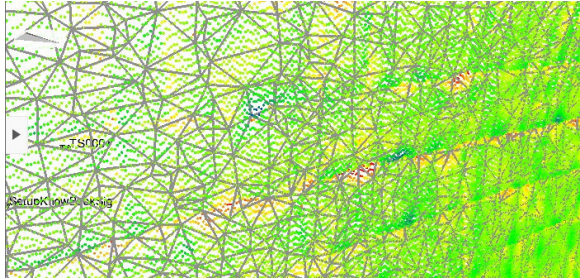
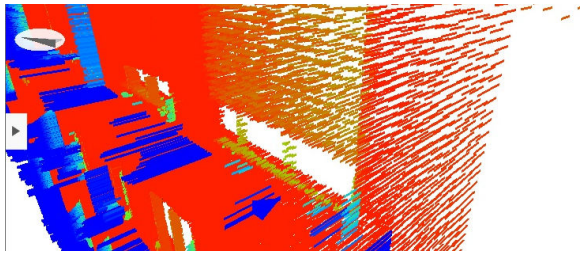
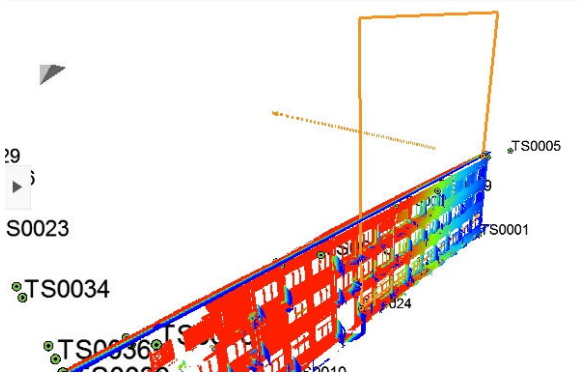
Access

In **Define Reference Surface**, press **Fn Settings**.

Settings,  
Display page

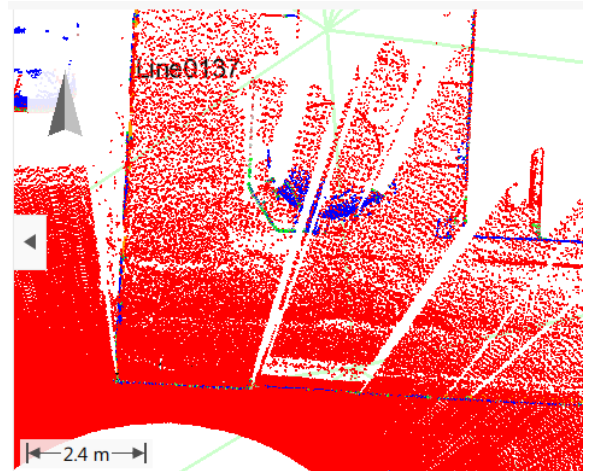
#### Description of fields

| Field   | Option    | Description  |
|---|-----------|--|
| <b>Boundary of the triangulated reference surface</b> | Check box | When this box is checked, a contour line is displayed in orange. A contour line defines the limits for the DTM.  |

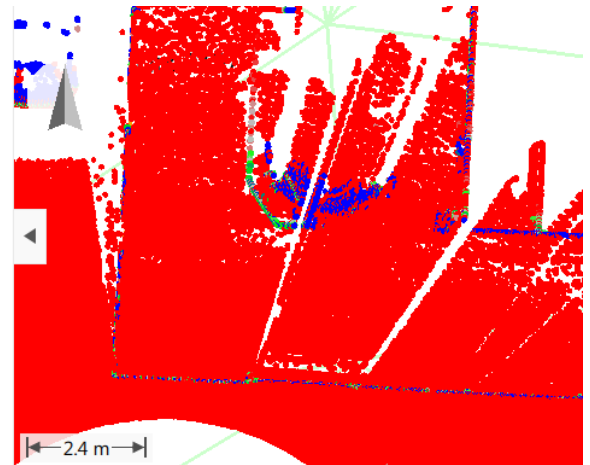
| Field   | Option    | Description   |
|---|-----------|---|
| <b>Mesh triangulation</b>                             | Check box | <p>When this box is checked, mesh lines are displayed.</p> <p>A mesh is a collection of vertices, edges, and faces that describe the shape of the reference surface.</p>  |
| <b>Normal vector from points to reference surface</b> | Check box | <p>When this box is checked, the normal to the surface is shown as a vector.</p>    |
| <b>Pre-defined plane / solid</b>                      | Check box | <p>When this box is checked, a pre-defined plane or solid is displayed in the comparison map.</p>   |
| <b>Point cloud point size</b>                         |           | <p>To change the pixel size of a single scan point displayed in the viewer. To best view the scan points in different areas.</p>  |

| Field | Option | Description |
|-------|--------|-------------|
|-------|--------|-------------|

**Small** A small point represent each scan point.



**Large** A large point represent each scan point.



**Next step**

Page changes to the **Projection** page.

Settings,  
Projection page

**Description of fields**

| Field                 | Option         | Description   |
|-----------------------|----------------|---|
| <b>Lower distance</b> | Editable field | The minimum distance from the reference surface which is projected. |
| <b>Upper distance</b> | Editable field | The maximum distance from the reference surface which is projected. |

| Field                                   | Option    | Description  |
|---|-----------|--|
| <b>Reverse the projection direction</b> | Check box | When this box is checked, the direction of the projection is in the opposite direction to the original.<br>When creating the surface from an imported DXF, the positive direction of the plane is unknown. The positive direction of the plane must be known to decide if the point is inside or outside of the plane.<br>Use this option to find out the positive direction of the plane. |

#### Next step

**Page** changes to the **Triangulation** page.

#### Settings, Triangulation page

| Key         | Description   |
|-------------|---|
| OK          | To accept changes and return to the panel from where this panel was accessed. |
| <b>Page</b> | To change to another page on this panel.                                      |

#### Description of fields

| Field  | Option         | Description   |
|--|----------------|---|
| <b>Create a rough triangulation</b>                      | Check box      | When this box is checked, the speed of the calculation is increased when the surface contains more than 1000 points. Points outside the limits defined for <b>Maximum distance to neighbouring groups of points</b> and <b>Deviation error</b> are excluded from the triangulation. |
| <b>Maximum distance to neighbouring groups of points</b> | Editable field | When <b>Create a rough triangulation</b> is checked, points beyond this defined distance are excluded from the triangulation.   |
| <b>Deviation error</b>                                   | Editable field | When <b>Create a rough triangulation</b> is checked, points closer to the surface are excluded from the triangulation.  |









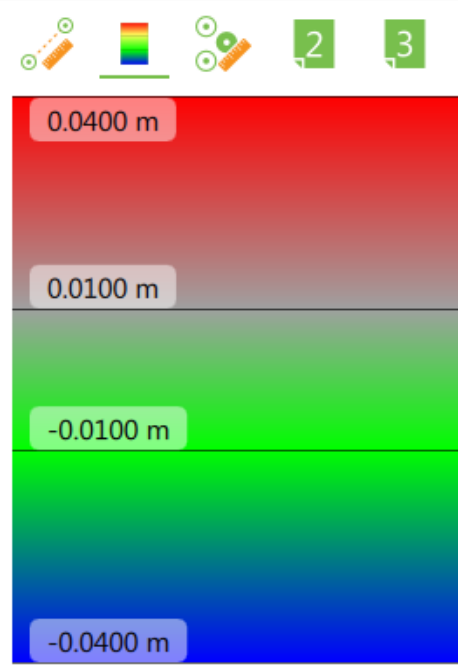




#### Next step

**Page** changes to the **Colour scale** page.

#### Settings, Colour scale page

Define the colours for distance ranges. When the surfaces are compared, the colours show the distance ranges to the reference plane in the 3D viewer.

The colour range corresponds to the legend in the **Measure Mode** panel.

| Settings, Colour scale page   | Measure Mode  |   |   |          |   |   |           |   |   |           |   |   |   |
|---|---|---|---|----------|---|---|-----------|---|---|-----------|---|---|---|
| <table border="1"> <tr><td>0.0400 m</td><td></td><td>▼</td></tr> <tr><td>0.0100 m</td><td></td><td>▼</td></tr> <tr><td>-0.0100 m</td><td></td><td>▼</td></tr> <tr><td>-0.0400 m</td><td></td><td>▼</td></tr> </table> | 0.0400 m  |  | ▼ | 0.0100 m |  | ▼ | -0.0100 m |  | ▼ | -0.0400 m |  | ▼ |  |
| 0.0400 m  |  | ▼   |   |          |   |   |           |   |   |           |   |   |   |
| 0.0100 m  |  | ▼   |   |          |   |   |           |   |   |           |   |   |   |
| -0.0100 m   |  | ▼   |   |          |   |   |           |   |   |           |   |   |   |
| -0.0400 m   |  | ▼   |   |          |   |   |           |   |   |           |   |   |   |

| Key            | Description   |
|----------------|---|
| <b>OK</b>      | To accept changes and return to the panel from where this panel was accessed.   |
| <b>Insert</b>  | To add a line for distance and colour definition. The new line is inserted below the line which is highlighted.   |
| <b>Delete</b>  | To remove the highlighted line.   |
| <b>Page</b>    | To change to another page on this panel.  |
| <b>Fn Load</b> | To load a template for the colour scale range. The templates are stored in the instrument configuration. Templates can not be copied to another instrument. |
| <b>Fn Save</b> | To save the current definition of distances and colours as template for the colour scale range.   |

**Description of fields**

| Field           | Option         | Description  |
|-----------------|----------------|--|
| <b>Distance</b> | Editable field | Click in the field and enter a distance. Tap outside the field to stop the editing process.<br><br>The distance entered, is shown in the colour selected in the adjoining <b>Colour</b> field is used. For a smooth transition to the colour applying to the distance field below, the colours are shaded. |

| Field         | Option          | Description  |
|---------------|-----------------|--|
| <b>Colour</b> | Selectable list | The selected colour is used to display the objects at the defined distance.<br>Click on the field to open the selectable list. Scroll up and down to see the whole colour range.<br>Tap on a colour for selection.<br>Tap outside the field to stop the selection process. |

## 64.4 Creating a Reference Surface

### 64.4.1 From Existing Scans

**Access** Select **From existing scans** in **Define Reference Surface**.

#### Select Scans

Check the box in front of a scan ID to select a scan to use.  
Uncheck the box in front of a scan ID to deselect a scan.

| Key                             | Description  |
|---------------------------------|--|
| <b>OK</b>                       | To continue to the next panel.   |
| <b>Fn Settings</b>              | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |
| <b>Fn Delete</b>                | To delete the highlighted scans.   |
| <b>Fn None</b> or <b>Fn All</b> | To deactivate or activate all scans for the reference plane definition.            |

#### Next step

**OK** to access **Define Object to Compare**.

### 64.4.2 From Existing Points

**Access** Select **From existing points** in **Define Reference Surface**.

#### Select Points, 3D viewer page

Tap on the points forming the reference surface.  
Or select a point from the points list on the **Points** page. Refer to [7.2 Accessing Data Management](#).

| Key                | Description  |
|--------------------|--|
| <b>OK</b>          | To continue to the next panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> .           |
| <b>Fn Display</b>  | To configure what is displayed in 3D viewer.   |
| <b>Fn Layers</b>   | To turn CAD layers on or off.  |
| <b>Fn Filter</b>   | To define sort and filter settings. Refer to <a href="#">7.6 Point Sorting and Filters</a> . |
| <b>Fn Page</b>     | To change to another page on this panel.   |

### Next step

OK to access **Define Object to Compare**.

## 64.4.3

### From a Pre-Defined Plane or Solid

#### Access

Select **From a pre-defined plane or solid** in **Define Reference Surface**.

Select from:

- **Horizontal plane**  
Choose or measure a point to define the height of the horizontal plane.
- **Vertical plane**  
Choose or measure two points to define the vertical plane.
- **Plane defined by three points**  
Choose or measure three points to define the plane.
- **Cylinder**  
Choose or measure two points to define the axis of the cylinder and enter the radius of the cylinder.
- **Cone**  
Choose or measure two points to define the axis of the cone, and enter the radius for the two bases.

#### Define plane or cylinder

| Key         | Description   |
|-------------|---|
| OK          | To continue to the next panel.  |
| Meas app    | To measure a point manually for the plane definition. Available when <b>Point</b> , <b>1st point</b> , <b>2nd point</b> or <b>3rd point</b> is highlighted. |
| Fn Settings | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> .  |

#### Description of fields

| Field                          | Option          | Description  |
|--------------------------------|-----------------|--|
| <b>Point</b>                   | Selectable list | The point ID of the point defining the height of a horizontal plane. Available for <b>Horizontal plane (defined by one point)</b> .  |
| <b>1st point and 2nd point</b> | Selectable list | The point ID of points which are part of a vertical, tilted or cylindrical plane. Available for <b>Vertical plane (defined by 2 points)</b> , <b>Plane (defined by 3 points)</b> and <b>Cylinder (2 points &amp; radius)</b> . |
| <b>3rd point</b>               | Selectable list | The point ID of a point belonging to a tiled plane. Available for <b>Plane (defined by 3 points)</b> .   |
| <b>Radius</b>                  | Editable field  | The radius of the cylinder or cone. Value must be between 0.0010 m and 500 m. Available for <b>Cylinder (2 points &amp; radius)</b> and for <b>Cone (2 points &amp; 2 radii)</b> .   |

### Next step

OK to import the data and to access **Define Object to Compare**.

**Requirements**

The requirements depend on the selected file format:

- At least one ASCII file with any file extension, is stored in the \DATA or \GSI directory of the data storage device.
- At least one file in DXF format with the file extension \*.dxf has to be stored in the \DATA directory of the data storage device.
- At least one file in PTS format with the file extension \*.pts has to be stored in the \DATA directory of the data storage device.



Do not remove the data storage device while importing the data.

**Access**

Select **From a point cloud or .dxf file** in **Define Reference Surface**.

**Import Data**

| Key         | Description  |
|-------------|--|
| OK          | To import the data.  |
| Fn Settings | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |

**Description of fields**

| Field                      | Option                             | Description  |
|----------------------------|------------------------------------|--|
| <b>Data type to import</b> | Selectable list                    | Defines if ASCII, PTS or DXF data is imported.   |
|                            | <b>PTS data</b>                    | The PTS format does not retain any original scan or registration information. The PTS format is often used when exporting final registered point clouds that have been unified.                          |
|                            | <b>Entities to import</b>          | Available for <b>Data type to import: DXF data</b> .   |
|                            | <b>3D Face &amp; Polyface mesh</b> | When this option is selected, the 3D Face and Polyface mesh entities are imported. The triangulation is created based on the existing model in the DXF.  |
|                            | <b>3D Face vertices</b>            | When this option is selected, the three or four points from the 3D Face entity are imported. Only the points are imported. The surface will be created based on the triangulation settings.              |
|                            | <b>Points</b>                      | When this option is selected, point objects are imported.  |
| <b>From</b>                | Selectable list                    | Defines from which storage device the data is imported.  |
| <b>From file</b>           | Selectable list                    | For <b>Data type to import: ASCII data (point ID,E,N,Ht)</b> and <b>Data type to import: ASCII data (point ID,N,E,Ht)</b> : All files in the \DATA directory on the data storage device can be selected. |



| Field | Option | Description  |
|-------|--------|--|
|       |        | For <b>Data type to import: DXF data</b> and <b>Data type to import: PTS data</b> : All files with extension *.dxf or *.pts in the \DATA directory on the data storage device can be selected. |

**Next step**

OK to import the data and to access **Define Object to Compare**.

**64.4.5**

**From Design Data**

**Requirements**

The requirements depend on the selected file format:

- Inspect Surfaces Road & Inspect Surfaces Tunnel are an option in the application and an additional license for each one must be loaded to be available.
- At least one Road or Tunnel job has to be stored in the \DBX directory of the data store device.

**Access**

Select **From design data** in **Define Reference Surface**.

**Choose Design Data**

Select the design data to use as reference.

For tunnel slicing and analysis, select **From tunnel design data**.

| Key                | Description  |
|--------------------|--|
| OK                 | To import the data.  |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |

**Next step**

OK to access Define Design Data.

**Define Design Data**

| Key                | Description  |
|--------------------|--|
| OK                 | To continue with the next panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |

**Description of fields**

| Field                 | Option         | Description                                  |
|-----------------------|----------------|--|
| <b>Type of design</b> | Display only   | According to selection in previous screen.   |
| <b>Layer</b>          | Display only   | The selection layer for the selected design. |
| <b>Centerline</b>     | Display only   | The name of the centreline.                  |
| <b>Start chainage</b> | Editable field | The comparison starts here.                  |
| <b>Chainage end</b>   | Editable field | The comparison ends here.                    |

### Next step

OK to access **Overview**.

## 64.5

### Define Object to Compare

#### Define Object to Compare

Define the surface to which the reference surface is compared to.

| Key         | Description  |
|-------------|--|
| OK          | To select the highlighted option and to continue with the subsequent panel.        |
| Fn Settings | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |

#### Description of options

| Option                  | Description  |
|-------------------------|--|
| Choose existing scan(s) | Select a scan in the same way as for the definition of the reference plane. Refer to <a href="#">64.4.1 From Existing Scans</a> .  |
| Select points from job  | Select points in the same way as for the definition of the reference plane. Refer to <a href="#">64.4.2 From Existing Points</a> . |
| Measure new points      | Accesses the <b>Measure Mode</b> where measured points are compared to the defined surface.  |

### Next step

OK to access the settings for the colour definition. The panel is the same as in the configuration of the app. Refer to [Settings, Colour scale page](#).

OK to confirm the surfaces to compare and to access **Compare Mode**.

#### Overview

Check the objects selected for the comparison.

| Key         | Description  |
|-------------|--|
| OK          | To calculate the comparison.   |
| Fn Settings | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> . |

#### Description of fields

| Field                  | Option         | Description   |
|------------------------|----------------|---|
| Reference surface name | Editable filed | The selected reference object.  |
| Use projection offset  | Check box      | When this box is checked, the reference object can be shifted by a defined value.                               |
| Offset                 | Editable filed | Available when <b>Use projection offset</b> is checked.<br>The amount by which the reference object is shifted. |

| Field                         | Option         | Description  |
|-------------------------------|----------------|--|
| <b>Number of points</b>       | Display only   | The number of points in the selected reference object.   |
| <b>Number of triangles</b>    | Display only   | The number of triangles in the selected reference object.  |
| <b>Comparison object name</b> | Editable filed | The object which will be compared against the reference.   |
| <b>Number of points</b>       | Display only   | The number of points in the object to be compared.   |
| <b>Use design data</b>        | Check box      | Available: <ul style="list-style-type: none"> <li>If <b>From design data</b> is selected in <b>Define Reference Surface</b> AND <b>From road design data</b> or <b>From tunnel design data</b> is selected in Choose Design Data</li> <li>If <b>From existing scans</b> is selected in <b>Define Reference Surface</b> so that the reference surface and the object to compare both come from existing scans.</li> </ul> |
| <b>Type of design</b>         | Display only   | Information about the sort of design data.   |
| <b>Layer</b>                  | Display only   | The layer from which the data is used for the comparison.  |

### Next step

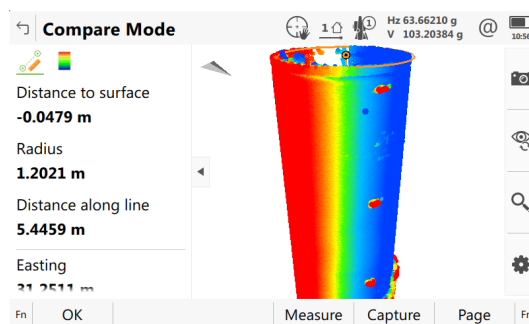
**OK** to access **Compare Mode** and **Measure Mode**. Refer to [64.5 Define Object to Compare](#).

## 64.6

### Compare Mode and Measure Mode

### Comparison

The panel shows the comparison results according to the defined settings. When in measure mode, measure a point to get the comparison result. Tap on a point in the 3D viewer. The displayed values are updated.



| Key       | Description   |
|-----------|---|
| <b>OK</b> | To exit the app without storing any comparison results. |

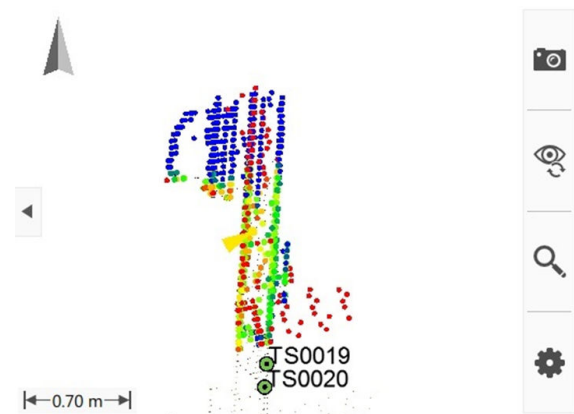
| Key                | Description  |
|--------------------|--|
| <b>Capture</b>     | Screenshots can be taken from the display as additional information.<br>The screenshot is displayed and can be edited by sketching.<br>The screenshot can be linked with points manually. Sketching on the screenshot is possible. |
| <b>Measure</b>     | To measure to any point and to compare it against the current reference surface.   |
| <b>Page</b>        | To change to another page on this panel.   |
| <b>Fn Settings</b> | To configure the app. Refer to <a href="#">64.3 Configuring Inspect surfaces</a> .   |
| <b>Fn Tools</b>    | Refer to <a href="#">64.8 The Toolbox</a> .  |

#### Description of fields

| Field  | Option       | Description  |
|--|--------------|--|
| <b>Distance to surface</b>   | Display only | The distance of the selected point to the reference surface. |
| <b>Easting, Northing and Height</b>                                  | Display only | The coordinates of the selected point.                       |
| <b>Easting projection, Northing projection and Height projection</b> | Display only | The coordinates projected onto the reference surface.        |

#### When a tunnel job or road job design is selected

Tap on a point to display the information.



|                            |              |  |
|----------------------------|--------------|--|
| <b>Distance to surface</b> | Display only | Perpendicular distance between the measured point and the triangulated reference surface <ul style="list-style-type: none"> <li>• Positive<br/>Point outside of the tunnel</li> <li>• Negative<br/>Point inside of the tunnel</li> </ul> |
| <b>Chainage</b>            | Display only | Exact chainage value on the alignment which corresponds to the selected point.   |

| Field                    | Option       | Description   |
|--------------------------|--------------|---|
| <b>Vertical offset</b>   | Display only | Vertical offsets from the selected point to the alignment <ul style="list-style-type: none"> <li>• Positive<br/>Above the centreline</li> <li>• Negative<br/>Below the centreline</li> </ul>  |
| <b>Horizontal offset</b> | Display only | Horizontal offsets from the selected point to the alignment <ul style="list-style-type: none"> <li>• Positive<br/>The point is to the right of the horizontal alignment.</li> <li>• Negative<br/>The point is to the left of the horizontal alignment.</li> </ul> |

### Next step

**Fn Tools** to access the report options.

## 64.7

### Tunnel Slice Scanning and Analysis

#### Comparing an as-build slice of a tunnel against the tunnel design



Refer to [50.3.6 Tunnel Slice Scanning and Analysis](#) before starting here.

1. In **Define Reference Surface**, select **From design data**.
2. In **Choose Design Data**, select **From tunnel design data**.
3. In **Define Design Data**, select the design job to use. Define the starting chainage and the ending chainage for which the comparison is applied.
4. In **Define Object to Compare**, select **Choose existing scan(s)**.
5. Select the scan by checking the box to the left of the name.
6. In **Settings** define the colours to be used for the visual representation.
7. In **Overview**, check the selection. Apply an offset if needed.
8. Check the results. Refer to [64.6 Comparison](#).

#### Comparing an as-build slice of a tunnel against the tunnel design



Requirements:

- One or more scans measured in an early stage of the tunnel construction. Used to define the reference surface.
- One or more scans measured at the current moment. This corresponds to the shortcrete. For every entity in this point cloud, the to the reference surface is calculated.
- Optional: Alignment data. The design data of the tunnel to get the chainage value and the offsets.

All scans must be in the same working job

1. In **Define Reference Surface**, select **From existing scans**.
2. In **Select Scans**, select the scan used as reference.
3. In **Define Object to Compare**, select **Choose existing scan(s)**.
4. In **Select Scans**, select the scan of the point cloud to be compared.

5. In **Settings** define the colours to be used for the visual representation.

---

6. In **Overview**:
  - Check the selection.
  - Apply an offset if needed.
  - Check **Use design data**. Verify the selected design data and layer.

---

7. Check the results. Refer to [64.6 Comparison](#).

## 64.8

## The Toolbox

### Access

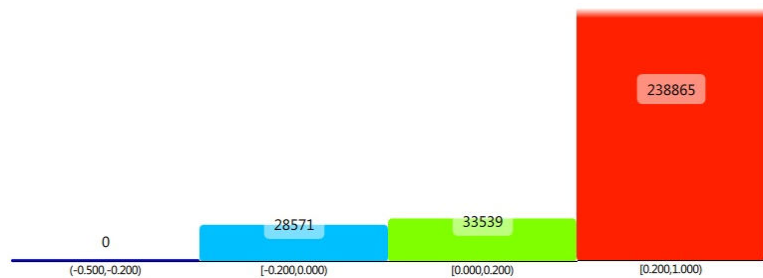
Press **Fn Tools** on any page in the some apps.

### Description

The toolbox contains additional functionality for the **Compare Mode**.

### Description of options

| Icon                      | Description  |
|---------------------------|--|
| <b>Statistical report</b> | To show a bar chart with the number of points falling into each distance range. The distance ranges are shown in their defined colour. |



### Create report

To create a report in xml format or in a defined format using a stylesheet.

```
<?xml version="1.0" encoding="UTF-8"?>
- <SurfaceAnalyser appVersion="1.22.000" xmlVersion="1.01" xmlns="urn:SurfaceAnalyser-1.01">
- <ReferenceInfo name="Plane">
- <Plane>
- <Point z="451.122563" y="5250606.088727" x="546604.329864"/>
- <Point z="451.291747" y="5250615.340075" x="546613.288414"/>
- <Point z="451.177688" y="5250614.650646" x="546630.527154"/>
- </Plane>
- </ReferenceInfo>
- <PointCloudInfo name="sta007" pointCount="510267" source="scan"/>
- <Statistics standardDeviation="0.247490" errorMax="0.499997" errorMin="-0.499999" excludedPointCount="328541" calculatedPointCount="181726"/>
- <Histogram>
- <Bin color="#0000ff" count="24486" high="-0.040000" low="-0.500000"/>
- <Bin color="#0000ff" count="1553" high="0.010000" low="-0.040000"/>
- <Bin color="#00ff00" count="1055" high="0.010000" low="-0.010000"/>
- <Bin color="#000000" count="1453" high="0.040000" low="0.010000"/>
- <Bin color="#ff0000" count="153179" high="0.500000" low="0.040000"/>
- </Histogram>
- </PointCloud>
- <Points>
- <Point z="453.809911" y="5250690.999127" x="546568.862997">
- <Projection z="453.342431" y="5250691.010241" x="546568.860349" color="#0000ff" dist="-0.467620"/>
- </Point>
- <Point z="453.648915" y="5250691.001343" x="546568.859434">
- <Projection z="453.342408" y="5250691.008630" x="546568.857698" color="#0000ff" dist="-0.306599"/>
- </Point>
- </Points>
```

## 65 QuickVolume

### 65.1 Overview

**Description** The app allows volumes to be computed from ALL scans and/or ALL measured points stored in a job.

### 65.2 Accessing Volume Calculations

**Access** Select **Leica Captivate - Home: QuickVolume**.

**Surface Name**

| Key | Description   |
|-----|---|
| OK  | To start the triangulation. All points and scans within the selected job are used in the triangulation. |

#### Description of fields

| Field                       | Option          | Description  |
|-----------------------------|-----------------|--|
| Surface name                | Selectable list | Name of the surface to be triangulated.  |
| Include all scans           | Check box       | When this box is checked, all scans from the job are included in the volume calculation.           |
| Include all measured points | Check box       | When this box is checked, all measured points from the job are included in the volume calculation. |

### 65.3 Volume Calculations

**Calculate Volume**

| Key       | Description   |
|-----------|---|
| OK        | To accept all settings and continue with the next panel.  |
| Lowest ht | To set the minimum elevation point of the current surface as elevation value. Available for <b>Volume calculation method: Surface to entered height</b> . |

#### Description of fields

| Field                     | Option                    | Description  |
|---------------------------|---------------------------|--|
| Volume calculation method |                           | To calculate the volume of the triangulated surface.   |
|                           | Stockpile                 | Volume between the triangulated surface and the DTM surface defined by the boundary points of the surface. |
|                           | Surface to entered height | Volume between the triangulated surface and the entered height.  |
|                           | Surface to point          | Volume between the triangulated surface and the height of a selected point.                                |

#### Next step

OK calculates the volume and continues to **Volume Calculation Results**.

| Key   | Description                              |
|-------|--|
| Store | To return to <b>Surface Name</b> .       |
| Page  | To change to another page on this panel. |

**Description of fields**

| Field                                 | Option       | Description  |
|---------------------------------------|--------------|--|
| <b>Surface name</b>                   | Display only | Name of the surface used for the calculation.  |
| <b>Point ID</b>                       | Display only | The point to which the volume is calculated. Available for <b>Volume calculation method: Surface to point</b> .  |
| <b>Height</b>                         | Display only | The elevation of the point to which the volume is calculated. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> . |
| <b>Area</b>                           | Display only | Area of the base plane.  |
| <b>Net volume</b>                     | Display only | Volume of the surface.   |
| <b>Volume above reference surface</b> | Display only | Cut of the volume. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> .  |
| <b>Volume below reference surface</b> | Display only | Fill of the volume. Available for <b>Volume calculation method: Surface to entered height</b> and <b>Volume calculation method: Surface to point</b> .   |

**Next step**

3D viewer provides an interactive display of the data.



## Appendix A

## Menu Tree

---

### Menu tree for GS RTK rover and TS

- |-- Active job
  - | |-- Job menu
  - | |-- View & edit job properties
  - | |-- View & edit data
  - | |-- Import data
    - | |-- ASCII
    - | |-- XML
    - | |-- DXF
    - | |-- DTM
    - | |-- Alignment
  - | |-- Export data
    - | |-- ASCII
    - | |-- ASCII with format file
    - | |-- DXF
    - | |-- XML
    - | |-- XML with stylesheet
    - | |-- Fbk, Rw5, Raw
  - | |-- Send data
  - | |-- Delete
- |-- Tap here to create new job
- |-- Tap here to choose design data
- |-- Create pts & lines
  - | |-- Create points
  - | |-- Create lines
  - | |-- Create arcs
  - | |-- Create polylines
  - | |-- Extend existing polyline
  - | |-- Create offset line & pts
- |-- Settings
  - | |-- Connections
    - | |-- CS connection wizard (TS)
    - | |-- AP connection wizard (TS)
    - | |-- TS connection wizard (CS, not for CS30/CS35)
    - | |-- GS connection wizard (GS, not for CS30/CS35)
    - | |-- RTK rover wizard (GS)
    - | |-- Internet wizard (not for CS30/CS35)
    - | |-- All other connections
  - | |-- GS sensor (GS)
    - | |-- Satellite tracking
    - | |-- Antenna heights
    - | |-- GNSS raw data logging
  - | |-- TS instrument (TS)
    - | |-- Measure & target
    - | |-- Target search
    - | |-- Atmospheric corrections
    - | |-- Level & compensator
    - | |-- Lights & accessories
    - | |-- Cameras
    - | |-- Check & adjust

- | |-- Point storage
  - | |-- Duplicate points
  - | |-- Prompt before storing
  - | |-- GS quality control (GS)
  - | |-- TS offsets & checks (TS)
- | |-- Customisation
  - | |-- Working style wizard
  - | |-- User defined pages
  - | |-- ID templates
  - | |-- Hot keys & favourites
  - | |-- Coding
  - | |-- App visibility
- | |-- System
  - | |-- Software startup
  - | |-- Screen, audio & text input
  - | |-- Regional
  - | |-- Restrict access
- | |-- Tools
  - | |-- Transfer user objects
  - | |-- Update software
  - | |-- Entitlements & licences
  - | |-- Format memory
  - | |-- Calculator
  - | |-- FTP data transfer
- | |-- Cloud services
  - | |-- Leica Exchange
  - | |-- BIM 360 Docs
  - | |-- Leica ConX
  - | |-- Bricsys 24/7
- | |-- About Leica Captivate
- | |-- 3D viewer
- | |-- Switch to base (not for GS07/CS20)
- | |-- Setup (TS)
- | |-- Scanning (MS60)
- | |-- Measure
  - | |-- Stake points
  - | |-- Stake to line
  - | |-- Stake DTM
  - | |-- Stake pts & DTM
  - | |-- Measure to line
  - | |-- GS imaging
  - | |-- QuickVolume
  - | |-- Volume calc
  - | |-- Traverse (TS)
  - | |-- Measure sets (TS)
- | |-- COGO
  - | |-- Inverse
  - | |-- Bearing & distance
  - | |-- Intersection
  - | |-- Line & arc calculation
  - | |-- Shift, rotate & scale
  - | |-- Area division
  - | |-- Angle
  - | |-- Horizontal curve
  - | |-- Triangle
- | |-- Stake road

- |-- Check road
- |-- Stake rail
- |-- Check rail
- |-- Stake tunnel
- |-- Check tunnel
- |-- Create coord sys
- |-- QuickGrid
- |-- Meas plane/grid
- |-- TS hidden point (TS)
- |-- Disto (CS20)

---

**Menu tree for GS RTK  
base**

- |-- Base setup
  - | |-- Over known point
  - | |-- Over last setup
  - | |-- Over any point
- |-- Settings
  - | |-- GS base
    - | |-- Satellite tracking
    - | |-- GNSS raw data logging
  - | |-- Connections
    - | |-- Connect to GS base
    - | |-- All other connections
- |-- Switch to rover

---

## Appendix B

## Directory Structure of the Memory Device

### Description

On the data storage device, files are stored in certain directories. The following diagram of the directory structure refers to the data storage devices and the internal memory.

All files are fully compatible with Leica SmartWorx Viva and vice versa, except for the following listed files which are not compatible between the systems:

- Working styles and settings
- System.ram and VivaSystem.zip
- Licence files
- Language files, and
- App files.

### Directory structure

|                    |  |
|--------------------|--|
| -- Code            | <ul style="list-style-type: none"><li>• Codelists, various files</li><li>• Code files for upload or from download from Leica ConX</li></ul>  |
| -- Config          | <ul style="list-style-type: none"><li>• Working style files (*.xfg)</li></ul>  |
| -- RTK_Profile     | <ul style="list-style-type: none"><li>• RTK profile files (*.rpr)</li></ul>  |
| -- Sketch_Template | <ul style="list-style-type: none"><li>• User-defined templates (*.jpg) for sketching</li></ul>   |
| -- UserManagement  | <ul style="list-style-type: none"><li>• Administration settings files (*.usm)</li></ul>  |
| -- Convert         | <ul style="list-style-type: none"><li>• Format files (*.frt)</li><li>• Style sheet (*.xsl)</li><li>• Protected style sheets (*.lss)</li></ul>  |
| -- Data            | <ul style="list-style-type: none"><li>• ASCII (*.txt), Autodesk Point Layout projects (*.zip), custom ASCII file from Leica Geo Office (*.cst), cutsheets (*.txt), DGN (*.dgn), DWG (*.dwg), DXF (*.dxf), IFC (*.ifc), LandXML (*.xml), Terramodel (*.xml), Carlson horizontal (centreline) elements (*.cl), Carlson vertical (profile) elements (*.pro) and Shape files (*.shp, *.shx and *.dbf and all other shape file components), AutoDesk (*.fbk), TDS/Carlson/MicroSurvey (*.rw5), TDS (*.raw), Bentley (*.rwd) for import/export to/from job</li><li>• Downloaded files from BIM 360 Docs, Leica ConX or Bricsys 24/7 which are not a complete job</li><li>• BIM 360 Docs or Leica ConX data for upload</li><li>• Section files for Carlson (*.sct) and ASCII report files for Terramodel (*.txt) for import to job</li><li>• Data files (*.xml) for FTP transfer</li><li>• Data files created from the Disto apps (*.csv, *.html)</li><li>• Report sheets created from apps (*.log)</li></ul> |
| -- Geocom          |  |
| -- Images          |  |

|  |                   |   |
|--|-------------------|---|
|  | -- ATR            | • Image files (*.jpg) taken with Geocom commands using the ATR.   |
|  | -- Overview       | • Image files (*.jpg) taken with Geocom commands using the overview camera.   |
|  | -- Telescope      | • Image files (*.jpg) taken with Geocom commands using the telescope camera.  |
|  | -- GPS            |   |
|  | -- Cscs           | • CSCS field files (*.csc)  |
|  | -- Geoid          | • Geoid field files (*.gem)   |
|  | -- Rinex          | • RINEX files, also downloads from GS18 via Webserver   |
|  | -- ReferenceFrame | • List of default reference frames (REFRASET.dat)   |
|  | -- Map_Images     | • Map background image files (*.jpg, *.jgw, *.archive)<br>*.jpg + *.jgw with same file name = world file<br>*.archive = Leica Captivate format  |
|  | -- Xml            | • Alignment Editor Alignments (*.xml)   |
|  | -- DBX            | • Coordinate system file (Trfset.dat)<br>• Data files created from the Disto apps (*.csv, *.html)<br>• Downloaded BIM 360 Docs or Leica ConX, recognized as DBX file<br>• DTM jobs, various files<br>• BIM 360 Docs or Leica ConX data for upload<br>• Job files (*.dbx) for FTP transfer<br>• Job files for Leica SmartWorx Viva<br>• MDB files downloaded from GS18 via Webserver |
|  | -- Backup         | • Job files as backup. Available on the SD card.  |
|  | -- Job            | • Job files, various files. Jobs are stored in a folder per job.  |
|  | -- Images         | • Image files (*.jpg), stored in a subfolder per job.   |
|  | -- Map files      | • Map-related files (for example *.mpl), stored in a subfolder per job.   |
|  | -- Scans          | • Scan database files (*.sdb files)<br>• Bitmaps of intensity values (*.bmp files)  |
|  | -- Surfaces       | • Surface files (*.dxf)   |
|  | -- Download       | • Various files, downloaded by the FTP data transfer app (*.*)  |
|  | -- GPS            | • Antenna file (List.ant)<br>• GSM/Modem station list (*.fil)<br>• Server list (*.fil)  |
|  | -- Gsi            | • GSI files (*.gsi)<br>• ASCII files for export from job (*.*)  |

|-- System

- Upgrade packages for CS20/TS including firmware, apps, languages, firmware for peripheral devices (\*.fw), on the SD card
  - Special apps for CS20/TS (\*.axx), on the SD card
  - Special apps for CS30/CS35 (\*.dxx), on the SD card
  - Licence file (\*.key), in the internal memory
  - Firmware files for the measurement engine (\*.fw), on the SD card
  - System files (AllObjects.zip)
-

## Appendix C

## Pin Assignments

### C.1

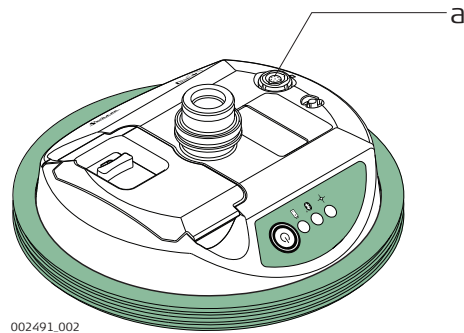
### GS07

#### Description

Some applications require knowledge of the pin assignments for the instrument ports.

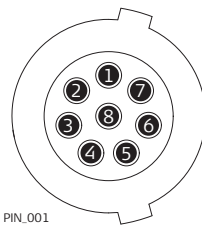
In this chapter, the pin assignments and sockets for the instrument ports are explained.

#### Ports at the instrument underside



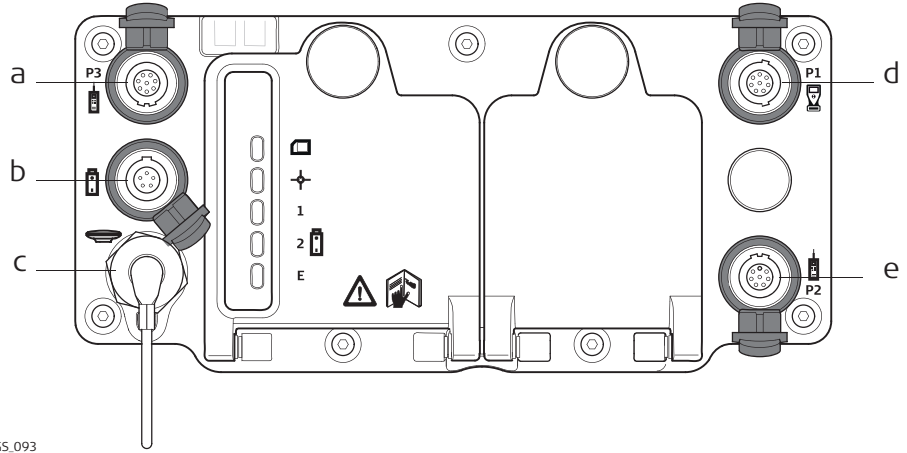
a Lemo port (USB and serial)

#### Pin assignments for 8 pin LEMO-1



| Pin | Signal Name | Function                 | Direction |
|-----|-------------|--------------------------|-----------|
| 1   | USB_D+      | USB data line            | In or out |
| 2   | USB_D-      | USB data line            | In or out |
| 3   | GND         | Signal ground            | -         |
| 4   | RxD         | RS232, receive data      | In        |
| 5   | TxD         | RS232, transmit data     | Out       |
| 6   | NC          | Not connected            | -         |
| 7   | PWR         | Power input, 10.5 V–28 V | In        |
| 8   | AUX_ON      | RS232, manual PWR switch | In        |

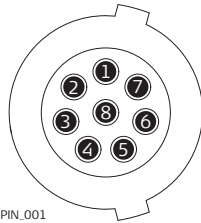
Ports at the instrument front panel



GS.093

- a P3: Power out, data in/out or remote interface in/out. 8 pin LEMO
- b Port PWR: Power in. 5 pin LEMO
- c Port ANT: GNSS antenna in
- d Port P1: Field controller in/out or remote interface in/out. 8 pin LEMO
- e Port P2: Power out, data in/out or remote interface in/out. 8 pin LEMO

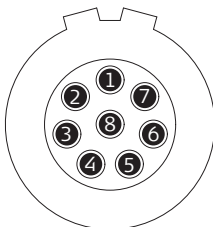
Pin assignments for port P1



PIN.001

| Pin | Signal Name       | Function                      | Direction |
|-----|-------------------|-------------------------------|-----------|
| 1   | USB_D+            | USB data line                 | In or out |
| 2   | USB_D-            | USB data line                 | In or out |
| 3   | GND               | Signal ground                 | -         |
| 4   | RxD               | RS232, receive data           | In        |
| 5   | TxD               | RS232, transmit data          | Out       |
| 6   | ID                | Identification pin            | In or out |
| 7   | PWR               | Power input, 10.5 V-28 V      | In        |
| 8   | TRM_ON/<br>USB_ID | RS232, general-purpose signal | In or out |

Pin assignments for port P2, and port P3

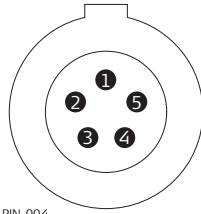


PIN.003



| Pin | Signal Name | Function                     | Direction |
|-----|-------------|------------------------------|-----------|
| 1   | RTS         | RS232, ready to send         | Out       |
| 2   | CTS         | RS232, clear to send         | In        |
| 3   | GND         | Signal ground                | -         |
| 4   | RxD         | RS232, receive data          | In        |
| 5   | TxD         | RS232, transmit data         | Out       |
| 6   | ID          | Identification pin           | In        |
| 7   | GPIO        | RS232, configurable function | In or out |
| 8   | +12 V       | 12 V power supply out        | Out       |

### Pin assignments for port PWR



PIN\_004

| Pin | Signal Name | Function               | Direction |
|-----|-------------|------------------------|-----------|
| 1   | PWR1        | Power input, 11 V-28 V | In        |
| 2   | ID1         | Identification pin     | In        |
| 3   | GND         | Signal ground          | -         |
| 4   | PWR2        | Power input, 11 V-28 V | In        |
| 5   | ID2         | Identification pin     | In        |

## C.3

### GS14/GS16

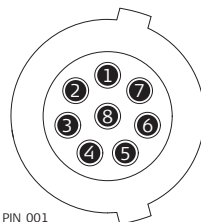
### Ports at the instrument underside



4118\_003

- a QN-connector, only for models with UHF radio
- b Port 1 (USB and serial)

### Pin assignments for port P1



PIN\_001

| Pin | Signal Name | Function                      | Direction |
|-----|-------------|-------------------------------|-----------|
| 1   | USB_D+      | USB data line                 | In or out |
| 2   | USB_D-      | USB data line                 | In or out |
| 3   | GND         | Signal ground                 | -         |
| 4   | RxD         | RS232, receive data           | In        |
| 5   | TxD         | RS232, transmit data          | Out       |
| 6   | ID          | Identification pin            | In or out |
| 7   | PWR         | Power input, 10.5 V-28 V      | In        |
| 8   | GPIO        | RS232, general-purpose signal | In or out |

## C.4

## GS18

### Description

Some applications require knowledge of the pin assignments for the instrument ports.

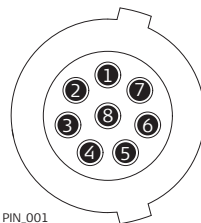
In this chapter, the pin assignments and sockets for the instrument ports are explained.

### Ports at the instrument underside



- a SMB-connector for external UHF antenna, only for models with UHF radio
- b SMB-connector for external LTE antenna
- c Port 1 (Power, USB and serial)

### Pin assignments for port P1



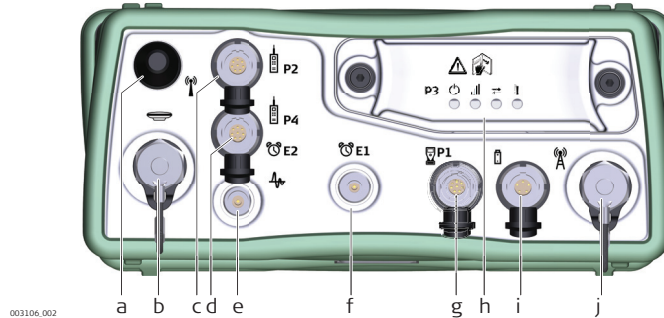
| Pin | Signal Name | Function                 | Direction |
|-----|-------------|--------------------------|-----------|
| 1   | USB_D+      | USB data line            | In or out |
| 2   | USB_D-      | USB data line            | In or out |
| 3   | GND         | Signal ground            | -         |
| 4   | RxD         | RS232, receive data      | In        |
| 5   | TxD         | RS232, transmit data     | Out       |
| 6   | ID          | Identification pin       | In or out |
| 7   | PWR         | Power input, 10.5 V-28 V | In        |

| Pin | Signal Name | Function                      | Direction |
|-----|-------------|-------------------------------|-----------|
| 8   | GPIO        | RS232, general-purpose signal | In or out |

## C.5

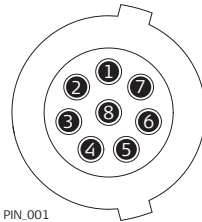
## GS25

### Ports at the instrument back panel



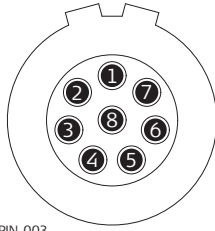
- a Port BT: Bluetooth antenna
- b Port ANT: GNSS antenna in
- c Port P2: Power out, data in/out or remote interface in/out. 8 pin LEMO
- d Port P4 and E2: Serial/Event port. 8 pin LEMO
- e Port PPS: Puls per second output
- f Port E1: Event 1
- g Port P1: CS field controller in/out or remote interface in/out. 8 pin LEMO
- h Port 3: Communication slot-in port and LEDs
- i Port PWR: Power in. 5 pin LEMO
- j Communication Slot-in port, Antenna, TNC

### Pin assignments for port P1



| Pin | Signal Name       | Function                      | Direction |
|-----|-------------------|-------------------------------|-----------|
| 1   | USB_D+            | USB data line                 | In or out |
| 2   | USB_D-            | USB data line                 | In or out |
| 3   | GND               | Signal ground                 | -         |
| 4   | RxD               | RS232, receive data           | In        |
| 5   | TxD               | RS232, transmit data          | Out       |
| 6   | ID                | Identification pin            | In or out |
| 7   | PWR               | Power input, 10.5 V-28 V      | In        |
| 8   | TRM_ON/<br>USB_ID | RS232, general-purpose signal | In or out |

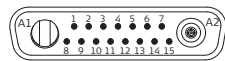
## Pin assignments for port P2



PIN\_003

| Pin | Signal Name | Function                     | Direction |
|-----|-------------|------------------------------|-----------|
| 1   | RTS         | RS232, ready to send         | Out       |
| 2   | CTS         | RS232, clear to send         | In        |
| 3   | GND         | Signal ground                | -         |
| 4   | RxD         | RS232, receive data          | In        |
| 5   | TxD         | RS232, transmit data         | Out       |
| 6   | ID          | Identification pin           | In        |
| 7   | GPIO        | RS232, configurable function | In or out |
| 8   | +12 V       | 12 V power supply out        | Out       |

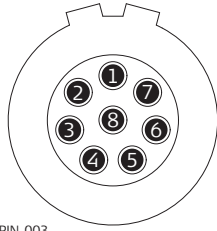
## Pin assignments for port P3



PIN\_005

| Pin | Signal Name | Function                                | Direction |
|-----|-------------|---|-----------|
| 1   | PWR         | 4 V power supply in                     | In        |
| 2   | Tx          | Transmit data                           | In        |
| 3   | Rx          | Receive data                            | Out       |
| 4   | GPO/DCD     | General-purpose out, carrier detect out | Out       |
| 5   | RTS         | Request to send                         | In        |
| 6   | CTS         | Clear to send                           | Out       |
| 7   | GPI/CFG     | General-purpose in, config mode in      | In        |
| 8   | PWR         | 6 V power supply in                     | In        |
| 9   | GPIO        | General-purpose signal                  | In or out |
| 10  | GND         | Signal and chassis ground               | -         |
| 11  | USB+        | USB data line (+)                       | In or out |
| 12  | USB-        | USB data line (-)                       | In or out |
| 13  | GND         | Signal and chassis ground               | -         |
| 14  | ID          | Identification pin                      | In or out |
| 15  | GPIO        | General-purpose signal                  | In or out |
| A1  | NC          | Not used                                | -         |
| A2  | RF1         | Antenna port, radio to antenna          | -         |

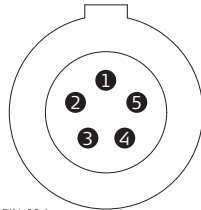
## Pin assignments for port P4/E2



PIN\_003

| Pin | Signal Name      | Function                            | Direction |
|-----|------------------|-------------------------------------|-----------|
| 1   | RTS              | RS232, ready to send                | Out       |
| 2   | CTS              | RS232, clear to send                | In        |
| 3   | GND              | Signal ground                       | -         |
| 4   | RxD              | RS232, receive data                 | In        |
| 5   | TxD              | RS232, transmit data                | Out       |
| 6   | ID               | Identification pin                  | In or out |
| 7   | GPIO/<br>EVT2 IN | RS232, general purpose input/output | In or out |
| 8   | +12 V            | 12 V power supply out               | Out       |

## Pin assignments for port PWR



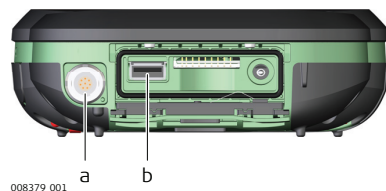
PIN\_004

| Pin | Signal Name | Function               | Direction |
|-----|-------------|------------------------|-----------|
| 1   | PWR1        | Power input, 11 V-28 V | In        |
| 2   | ID1         | Identification pin     | In        |
| 3   | GND         | Signal ground          | -         |
| 4   | PWR2        | Power input, 11 V-28 V | In        |
| 5   | ID2         | Identification pin     | In        |

## C.6

### CS20

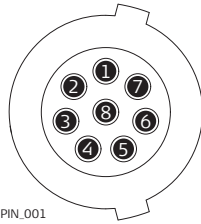
#### Ports at the instrument bottom panel - LEMO connector



008379\_001

- a LEMO port (USB and serial)
- b USB A Host port

## Pin assignments for 8 pin LEMO-1



| Pin | Signal Name | Function                      | Direction |
|-----|-------------|-------------------------------|-----------|
| 1   | USB_D+      | USB data line                 | In or out |
| 2   | USB_D-      | USB data line                 | In or out |
| 3   | GND         | Signal ground                 | -         |
| 4   | RxD         | RS232, receive data           | In        |
| 5   | TxD         | RS232, transmit data          | Out       |
| 6   | ID          | Identification pin            | In or out |
| 7   | PWR         | Power input, 10.5 V-18 V      | In        |
| 8   | GPIO        | RS232, general purpose signal | In or out |

## C.7

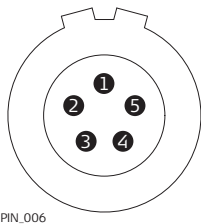
## TS10

### Pin assignments of the 5 pin LEMO-0 port



- a Pin 2: not used
- b Pin 1: Power input
- c Pin 5: TxD  
(RS232, transmit data, Out)
- d Pin 4: RxD  
(RS232, receive data, In)
- e Pin 3: Single ground

### Pin assignments for port P1



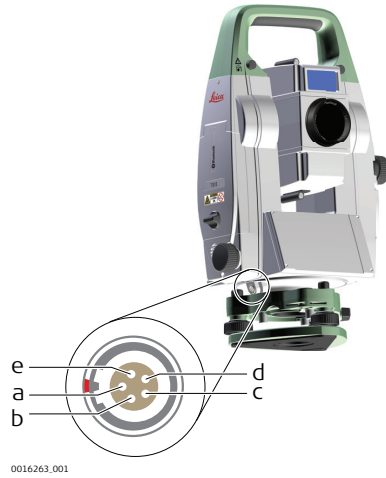
| Pin | Signal Name | Function                                  | Direction |
|-----|-------------|---|-----------|
| 1   | PWR         | Power input, + 12 V nominal (11 V - 16 V) | In        |
| 2   | -           | Not used                                  | -         |
| 3   | GND         | Single ground                             | -         |
| 4   | RxD         | RS232, receive data                       | In        |

| Pin | Signal Name | Function             | Direction |
|-----|-------------|----------------------|-----------|
| 5   | TxD         | RS232, transmit data | Out       |

## C.8

## TS13

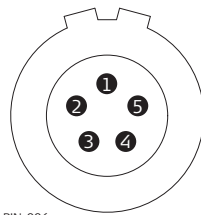
Pin assignments of the 5 pin LEMO-0 port



- a Pin 1: Power input
- b Pin 2: not used
- c Pin 3: Single ground
- d Pin 4: RxD (RS232, receive data, In)
- e Pin 5: TxD (RS232, transmit data, Out)

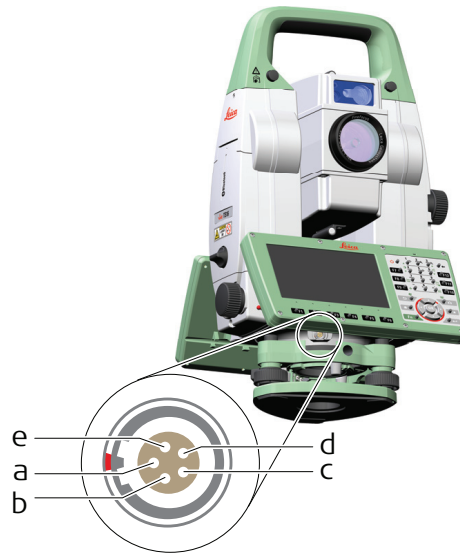
0016263\_001

Pin assignments for port P1



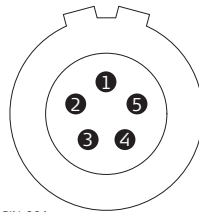
PIN\_006

| Pin | Signal Name | Function                                  | Direction |
|-----|-------------|---|-----------|
| 1   | PWR         | Power input, + 12 V nominal (11 V - 16 V) | In        |
| 2   | -           | Not used                                  | -         |
| 3   | GND         | Single ground                             | -         |
| 4   | RxD         | RS232, receive data                       | In        |
| 5   | TxD         | RS232, transmit data                      | Out       |

Ports at the TS13/  
TS16 instrument

008363\_001

a Port 1

Pin assignments for  
port P1

PIN\_006

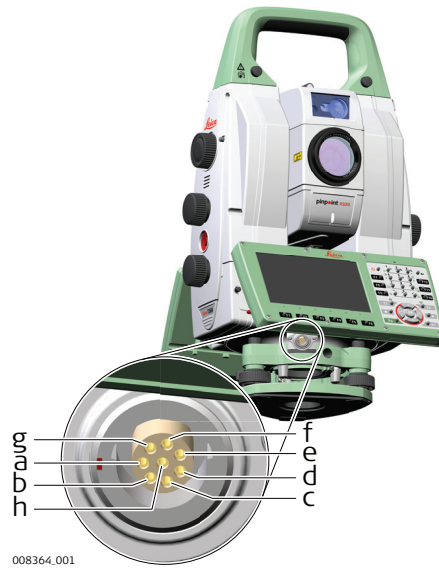
| Pin | Signal Name | Function                                  | Direction |
|-----|-------------|---|-----------|
| 1   | PWR         | Power input, + 12 V nominal (11 V - 16 V) | In        |
| 2   | -           | Not used                                  | -         |
| 3   | GND         | Single ground                             | -         |
| 4   | RxD         | RS232, receive data                       | In        |
| 5   | TxD         | RS232, transmit data                      | Out       |



## C.10

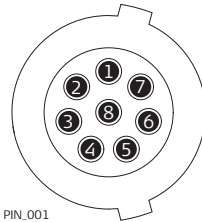
## TS60/MS60/TM60

### Ports at the TS60/ MS60/TM60 instru- ment



- a Pin 1
- b Pin 2
- c Pin 3
- d Pin 4
- e Pin 5
- f Pin 6
- g Pin 7
- h Pin 8

### Pin assignments for 8 pin LEMO-1



PIN\_001

| Pin | Signal Name | Function                                 | Direction |
|-----|-------------|--|-----------|
| 1   | USB_D+      | USB data line                            | In or out |
| 2   | USB_D-      | USB data line                            | In or out |
| 3   | GND         | Signal ground                            | -         |
| 4   | RxD         | RS232, receive data                      | In        |
| 5   | TxD         | RS232, transmit data                     | Out       |
| 6   | ID          | Identification pin                       | In or out |
| 7   | PWR         | Power input, nominal +12 V (11 V - 16 V) | In        |
| 8   | NC          | Not connected                            | -         |

## Appendix D

## Cables

### D.1

### GS Cables

#### Power cables

| Name   | Description   |
|--------|---|
| GEV97  | <ul style="list-style-type: none"><li>Allows GS10 (power port) to be externally powered</li><li>LEMO-1, 5 pin, 0° / LEMO-1, 5 pin, 0°</li><li>1.8 m</li></ul>   |
| GEV71  | <ul style="list-style-type: none"><li>Allows powering of any device from car battery.</li><li>Crocodile clips / LEMO-1, 5 pin, 0° (female)</li><li>4.0 m</li></ul>  |
| GEV219 | <ul style="list-style-type: none"><li>Allows CS20 to be externally powered using the LEMO Port</li><li>Allows GS10/GS14/GS16/GS18 (port 1) to be externally powered</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 0°</li><li>1.8 m</li></ul> |
| GEV276 | <ul style="list-style-type: none"><li>Allows CS20 to be externally powered using the power jack</li><li>Wall adapter / 5.5 mm barrel connector</li><li>1.5 m</li></ul>  |

#### Y cables

| Name   | Description  |
|--------|--|
| GEV205 | <ul style="list-style-type: none"><li>Allows connections between GS10 (port 1), an external radio in GFU housing and the GEB371, with GS10 and a radio being externally powered</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135° (female) / LEMO-1, 5 pin, 0°</li><li>1.8 m</li></ul> |
| GEV215 | <ul style="list-style-type: none"><li>Allows connections between CS20, the GS10 (port 1) and the GEB371, with the GS10 being powered from the GEB371.</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30° / LEMO-1, 5 pin, 0°</li><li>2.0 m</li></ul>                                     |
| GEV243 | <ul style="list-style-type: none"><li>Allows GS10 (power port) to be externally powered from two external batteries</li><li>LEMO-1, 5 pin, 0° / LEMO-1, 5 pin, 0° / LEMO-1, 5 pin, 0°</li><li>2.8 m</li></ul>  |
| GEV261 | <ul style="list-style-type: none"><li>Allows a GS14/GS16/GS18 radio to be programmed by a computer.</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 0° / USB Type A / RS232 serial, 9 pin</li><li>1.8 m</li></ul>   |

#### Radio programming cables

| Name   | Description  |
|--------|--|
| GEV171 | <ul style="list-style-type: none"><li>Allows a radio within a GFU housing to be externally powered and programmed by a computer</li><li>LEMO-1, 8 pin, 135° (female) / RS232 serial, 9 pin / LEMO-1, 5 pin, 0°</li><li>1.8 m</li></ul> |

## Radio cables

| Name   | Description   |
|--------|---|
| GEV232 | <ul style="list-style-type: none"><li>Allows GFU housings to be connected to a GS10 (port 2 and 3)</li><li>LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 30° (female)</li><li>2.8 m</li></ul> |
| GEV233 | <ul style="list-style-type: none"><li>Allows GFU housings to be connected to a GS10 (port 2 and 3)</li><li>LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 30° (female)</li><li>0.8 m</li></ul> |

## Serial data transfer cables

| Name   | Description  |
|--------|--|
| GEV160 | <ul style="list-style-type: none"><li>Allows serial connection between GS10 (port 2 and 3) to a computer to stream NMEA or RTK data</li><li>LEMO-1, 8 pin, 30° / RS232 serial, 9 pin</li><li>2.8 m</li></ul>   |
| GEV162 | <ul style="list-style-type: none"><li>Allows serial connection between GS10 (port 1) to a computer to stream NMEA or RTK data</li><li>Allows serial connection between CS20 (LEMO port) and, for example, a hidden point device, ASCII input device, or computer.</li><li>LEMO-1, 8 pin, 135° / RS232 serial, 9 pin</li><li>2.8 m</li></ul>  |
| GEV163 | <ul style="list-style-type: none"><li>Allows serial connection between CS20 and GS10 port 1. This connection is useful when using third-party software on the CS20 and a cable connection is required to the GS10.</li><li>Allows serial connection between CS20 and GS10 (port 1). This connection is useful when using third-party software on the CS20 and a cable connection is required to the GS10.</li><li>LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135°</li><li>1.8 m</li></ul> |

## USB to serial converter cables

| Name   | Description   |
|--------|---|
| GEV268 | <ul style="list-style-type: none"><li>Allows GS10 (port 2 and 3) to be connected to a computer where a serial connection is required, but no 9 pin RS232 port physically exists on the computer. This cable allows a serial connection through the USB port of the computer to the GS10 hardware.</li><li>LEMO-1, 8 pin, 30° / USB type A</li><li>2.0 m</li></ul>   |
| GEV269 | <ul style="list-style-type: none"><li>Allows CS20 and GS10/GS14/GS16/GS18 (port 1) to be connected to a computer where a serial connection is required, but no 9 pin RS232 port physically exists on the computer. This cable allows a serial connection through the USB port of the computer to the CS20 or GS10/GS14/GS16/GS18 hardware.</li><li>LEMO-1, 8 pin, 135° / USB type A</li><li>2.0 m</li></ul> |

## USB data transfer cables

| Name   | Description  |
|--------|--|
| GEV234 | <ul style="list-style-type: none"><li>Allows a CS20 to connect to a GS10 (port 1). This cable should be used if a cable connection is needed between CS20 and GS10.</li><li>Allows a USB connection between the USB port of a computer and the GS10 (port 1)</li><li>Allows a USB connection between the USB port of a computer and the CS20 LEMO port</li><li>LEMO-1, 8 pin, 135° / USB type A</li><li>1.65 m</li></ul> |
| GEV237 | <ul style="list-style-type: none"><li>Allows a CS20 to connect to a GS10 (port 1). This cable should be used if a cable connection is needed between CS20 and GS10.</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135°</li><li>1.65 m</li></ul>   |

## Antenna cables

| Name   | Description  |
|--------|--|
| GEV108 | <ul style="list-style-type: none"><li>TNC connector / TNC connector</li><li>30 m</li></ul>         |
| GEV119 | <ul style="list-style-type: none"><li>TNC connector / TNC connector</li><li>10 m</li></ul>         |
| GEV120 | <ul style="list-style-type: none"><li>TNC connector / TNC connector</li><li>2.8 m</li></ul>        |
| GEV134 | <ul style="list-style-type: none"><li>TNC connector / TNC connector</li><li>50 m</li></ul>         |
| GEV141 | <ul style="list-style-type: none"><li>TNC connector / TNC connector</li><li>1.2 m</li></ul>        |
| GEV142 | <ul style="list-style-type: none"><li>TNC connector / TNC connector (male)</li><li>1.6 m</li></ul> |
| -      | <ul style="list-style-type: none"><li>TNC connector / TNC connector</li><li>70 m</li></ul>         |

## D.2

### TS Cables

#### Power cables

| Name   | Description   |
|--------|---|
| GEV52  | <ul style="list-style-type: none"><li>Allows TS12/TS15/TS13/TS16 to be externally powered</li><li>LEMO-0, 5 pin, 30° / LEMO-1, 5 pin, 30°</li><li>1.8 m</li></ul>   |
| GEV219 | <ul style="list-style-type: none"><li>Allows CS20 to be externally powered using the LEMO port</li><li>Allows GS10 (port 1) to be externally powered</li><li>Allows MS50/TS50/TM50/TS60/MS60/TM60 to be externally powered</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30°</li><li>1.8 m</li></ul> |

**Radio / Y cables**

| Name   | Description  |
|--------|--|
| GEV186 | <ul style="list-style-type: none"> <li>Allows connections between TS12/TS15/TS13/TS16, an external battery and TCPS</li> <li>LEMO-0, 5 pin, 30° / LEMO-0, 8 pin, 30° / LEMO-1, 5 pin</li> <li>1.8 m</li> </ul>   |
| GEV220 | <ul style="list-style-type: none"> <li>Allows connections between MS50/TS50/TM50/TS60/MS60/TM60, external battery and a computer with 9 pin D-Sub RS232.</li> <li>LEMO-1, 8 pin, 135° / LEMO-1, 5 pin / 9 pin D-Sub RS232</li> <li>1.8 m</li> </ul>                    |
| GEV236 | <ul style="list-style-type: none"> <li>Allows connection between MS50/TS50/TM50/TS60/MS60/TM60, an external battery and TCPS</li> <li>LEMO-1, 8 pin, 15/150° / LEMO-1, 5 pin / LEMO-1, 8 pin, 30°</li> <li>1.8 m</li> </ul>  |
| GEV261 | <ul style="list-style-type: none"> <li>Allows connections between MS50/TS50/TM50/TS60/MS60/TM60, external battery and a computer with either USB or 9 pin D-Sub RS232.</li> <li>LEMO-1, 8 pin, 135° / LEMO-1, 5 pin/ USB / 9 pin D-Sub RS232</li> <li>1.8 m</li> </ul> |

**Serial data transfer cables**

| Name   | Description   |
|--------|---|
| GEV102 | <ul style="list-style-type: none"> <li>Allows serial connection between TS12/TS15/TS13/TS16 and a computer</li> <li>Allows serial connection between TS12/TS15/TS13/TS16 and CS20 (with 9 pin serial CBC02 connector module)</li> <li>LEMO-0, 5 pin, 30° / 9 pin D-Sub RS232</li> <li>2.0 m</li> </ul>  |
| GEV162 | <ul style="list-style-type: none"> <li>Allows serial connection between CS20 and a computer</li> <li>Allows serial connection between MS50/TS50/TM50/TS60/MS60/TM60 and a computer</li> <li>LEMO-1, 8 pin, 135° / 9 pin D-Sub RS232</li> <li>2.8 m</li> </ul>   |
| GEV163 | <ul style="list-style-type: none"> <li>Allows serial connection between CS20 and GS10 port 1. This connection is useful when using third-party software on the CS20 and a cable connection is required to the GS10.</li> <li>Serial data cable for communication between MS50/TS50/TM50/TS60/MS60/TM60 and CS20, connects LEMO 8 pin with LEMO 8 pin.</li> <li>LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135°</li> <li>1.8 m</li> </ul> |
| GEV187 | <ul style="list-style-type: none"> <li>Allows connections between TS10/TS12/TS15/TS13/TS16, an external battery and a computer</li> <li>LEMO-0, 5 pin, 30° / 9 pin D-Sub RS232 / LEMO-1, 5 pin, 30°</li> <li>2.0 m</li> </ul>   |
| GEV217 | <ul style="list-style-type: none"> <li>Allows serial connection between TS12/TS15/TS13/TS16 and CS20</li> <li>LEMO-1, 8 pin, 135° / LEMO-0, 5 pin, 30°</li> <li>1.8 m</li> </ul>  |

## USB to serial converter cables

| Name   | Description  |
|--------|--|
| GEV267 | <ul style="list-style-type: none"><li>Allows TS12/TS15/TS13/TS16 to be connected to a computer where a serial connection is required, but no 9 pin D-Sub RS232 port physically exists on the computer. This cable allows a serial connection through the USB port of the computer.</li><li>LEMO-0, 5 pin, 30° / USB type A</li><li>2.0 m</li></ul> |

## USB data transfer cables

| Name   | Description   |
|--------|---|
| GEV234 | <ul style="list-style-type: none"><li>Allows a USB connection between the USB port of a computer and the CS20 or TM50/TS60/MS60/TM60.</li><li>LEMO-1, 8 pin, 135° / USB type A</li><li>1.65 m</li></ul> |
| GEV237 | <ul style="list-style-type: none"><li>USB data cable for communication between MS50/TS50/TM50/TS60/MS60/TM60 and CS.</li><li>LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135°</li><li>1.65 m</li></ul>         |

## Appendix E NMEA Message Formats

### E.1 Overview

**Description** National Marine Electronics Association is a standard for interfacing marine electronic devices. This chapter describes all NMEA-0183 messages which can be output by the instrument.

#### Access

| Step | Description  |
|------|--|
| 1.   | Select <b>Leica Captivate - Home: Settings\Connections\All other connections\NMEA 1</b> or <b>NMEA 2</b> . |
| 2.   | Press <b>Edit</b> .  |
| 3.   | Check <b>Stream NMEA messages from the GS sensor</b> .   |
| 4.   | Press <b>Messages</b> .  |



A Talker ID appears at the beginning of the header of each NMEA message. The Talker ID can be user defined or standard (based on the NMEA 3.0). The standard is normally GP for GPS but can be changed in **NMEA Output 1** or **NMEA Output 2**.

### E.2 Symbols Used for Describing the NMEA Formats

**Description** NMEA messages consist of various fields. The fields are:

- Header
- Special format fields
- Numeric value fields
- Information fields
- Null fields

Certain symbols are used as identifier for the field types. These symbols are described in this section.

#### Header

| Symbol | Field   | Description   | Example  |
|--------|---------|---|--|
| \$     | -       | Start of sentence   | \$   |
| --ccc  | Address | <ul style="list-style-type: none"><li>• -- = alphanumeric characters identifying the talker</li></ul> Options:<br>GN = <b>Global Navigation Satellite System</b><br>GP = GPS only<br>GL = GLONASS<br>GA = Galileo<br>GB = BeiDou<br>GQ = QZSS | GNGGA<br>GPGGA<br>GLGGA<br>GAGGA<br>GBGGA<br>GQGGA |

| Symbol | Field | Description  | Example |
|--------|-------|--|---------|
|        |       | <ul style="list-style-type: none"> <li>ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message.</li> </ul> |         |

### Special format fields

| Symbol     | Field         | Description  | Example      |
|------------|---------------|--|--------------|
| A          | Status        | <ul style="list-style-type: none"> <li>A = Yes, Data Valid, Warning Flag Clear</li> <li>V = No, Data Invalid, Warning Flag Set</li> </ul>  | V            |
| lll.ll     | Latitude      | <ul style="list-style-type: none"> <li>Degreesminutes.decimal</li> <li>Two fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes.</li> <li>Leading zeros are always included for degrees and minutes to maintain fixed length.</li> </ul>   | 4724.538950  |
| yyyyy.yy   | Longitude     | <ul style="list-style-type: none"> <li>Degreesminutes.decimal</li> <li>Three fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes.</li> <li>Leading zeros are always included for degrees and minutes to maintain fixed length.</li> </ul> | 00937.046785 |
| eeeeee.eee | Grid Easting  | At the most six fixed digits for metres and three fixed digits for decimal fractions of metres.  | 195233.507   |
| nnnnnn.nnn | Grid Northing | At the most six fixed digits for metres and three fixed digits for decimal fractions of metres.  | 127223.793   |
| hhmmss.ss  | Time          | <ul style="list-style-type: none"> <li>hoursminuteseconds.decimal</li> <li>Two fixed digits of hours, two fixed digits of minutes, two fixed digits of seconds and a variable number of digits for decimal fraction of seconds.</li> </ul>   | 115744.00    |



| Symbol             | Field         | Description   | Example |
|--------------------|---------------|---|---------|
|                    |               | <ul style="list-style-type: none"> <li>Leading zeros are always included for hours, minutes and seconds to maintain fixed length.</li> </ul>  |         |
| mmddy              | Date          | <ul style="list-style-type: none"> <li>Monthdayyear - two fixed digits of month, two fixed digits of day, two fixed digits of year.</li> <li>Leading zeros always included for month, day and year to maintain fixed length.</li> </ul>   | 093003  |
| No specific symbol | Defined field | <ul style="list-style-type: none"> <li>Some fields are specified to contain predefined constants, most often alpha characters.</li> <li>Such a field is indicated by the presence of one or more valid characters. Excluded from the list of valid characters are the following that are used to indicate other field types: A, a, c, x, hh, hhmss.ss, lll.ll, yyyyy.yy.</li> </ul> | M       |

#### Numeric value fields

| Symbol | Field            | Description  | Example                   |
|--------|------------------|--|---------------------------|
| x.x    | Variable numbers | <ul style="list-style-type: none"> <li>Integer or floating numeric field</li> <li>Optional leading and trailing zeros. Decimal point and associated decimal-fraction are optional if full resolution is not required.</li> </ul> | 73.10 = 73.1 = 073.1 = 73 |
| hh_    | Fixed HEX field  | Fixed length HEX numbers   | 3F                        |

#### Information fields

| Symbol | Field              | Description   | Example |
|--------|--------------------|---|---------|
| c--c   | Variable text      | Variable length valid character field                           | A       |
| aa_    | Fixed alpha field  | Fixed length field of upper case or lower case alpha characters | N       |
| xx_    | Fixed number field | Fixed length field of numeric characters                        | 1       |

## Null fields

| Symbol    | Field                              | Description                                 | Example |
|-----------|------------------------------------|---|---------|
| No symbol | Information unavailable for output | Null fields do not contain any information. | „       |



Fields are always separated by a comma. Before the Checksum field there is never a comma.



When information for a field is not available, the position in the data string is empty.

## E.3

### GGA - Global Positioning System Fix Data

#### Syntax

```
$--GGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
```

#### Description of fields

| Field     | Description  |
|-----------|--|
| \$--GGA   | Header including Talker ID   |
| hhmmss.ss | UTC time of position   |
| llll.ll   | Latitude (WGS 1984)  |
| a         | Hemisphere, <b>N</b> orth or <b>S</b> outh   |
| yyyy.yy   | Longitude (WGS 1984)   |
| a         | <b>E</b> ast or <b>W</b> est   |
| x         | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Valid fix for GNSS <b>P</b> recise <b>P</b> ositioning <b>S</b> ervice mode, for example WAAS<br>4 = Real-time position, ambiguities fixed |
| xx        | Number of satellites in use. For \$GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.  |
| x.x       | HDOP   |
| x.x       | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.  |
| M         | Units of altitude as fixed text M  |
| x.x       | Geoidal separation in metres. The Geoidal separation is the difference between the WGS 1984 earth ellipsoid surface and mean sea level.  |
| M         | Units of geoidal separation as fixed text M  |
| x.x       | Age of differential GNSS data, empty when DGPS not used  |
| xxxx      | Differential base station ID, 0000 to 1023   |

| Field | Description     |
|-------|-----------------|
| *hh   | Checksum        |
| <CR>  | Carriage Return |
| <LF>  | Line Feed       |

## Examples

### For NMEA v4.0 and v4.1:

#### Standard Talker ID = GPS only

```
$GPGGA,141909.00,4724.5294609,N,00937.0836236,E,1,09,1.0,366.745,M,100.144,M,,*52
```

#### Standard Talker ID = GNSS

```
$GNGGA,142309.00,4724.5296834,N,00937.0832766,E,1,16,0.7,366.740,M,100.144,M,,*4E
```

## E.4

### GGK - Real-Time Position with DOP

#### Syntax

```
$--GGK,hhmmss.ss,mmddy,lll.l,a,yyyyy.yy,a,x,xx,x.x,EHTx.x,M*hh<CR><LF>
```

#### Description of fields

| Field     | Description  |
|-----------|--|
| \$--GGK   | Header including Talker ID   |
| hhmmss.ss | UTC time of position   |
| mmddy     | UTC date   |
| lll.l     | Latitude (WGS 1984)  |
| a         | Hemisphere, <b>N</b> orth or <b>S</b> outh   |
| yyyyy.yy  | Longitude (WGS 1984)   |
| a         | <b>E</b> ast or <b>W</b> est   |
| x         | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |
| xx        | Number of satellites in use. For \$GNGGK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.  |
| x.x       | GDOP   |
| EHT       | Ellipsoidal height   |
| x.x       | Altitude of position marker as local ellipsoidal height. If the local ellipsoidal height is not available, the WGS 1984 ellipsoidal height will be exported.   |
| M         | Units of altitude as fixed text M  |
| *hh       | Checksum   |
| <CR>      | Carriage Return  |

| Field | Description |
|-------|-------------|
| <LF>  | Line Feed   |

## Examples

### For NMEA v4.0 and v4.1:

#### Standard Talker ID = GPS only

\$GPGGK,142804.00,111414,4724.5292267,N,00937.0832394,E,1,09,2.3,EHT4  
66.919,M\*46

#### Standard Talker ID = GNSS

\$GNGGK,142629.00,111414,4724.5295910,N,00937.0831490,E,1,16,1.6,EHT  
467.089,M\*5C

## E.5

### G GK(PT) - Real-Time Position with DOP, Trimble Proprietary

#### Syntax

\$PTNL,GGK,hhmmss.ss,mmddy,llll.ll,a,x,xx,x.x,EHTx.x,M\*hh<CR><LF>

#### Description of fields

| Field     | Description   |
|-----------|---|
| \$PTNL    | \$ = Start of sentence delimiter, talker ID fixed with PTNL   |
| GGK       | GGK sentence formatter  |
| hhmmss.ss | UTC time of position  |
| mmddy     | UTC date  |
| llll.ll   | Latitude (WGS 1984)   |
| a         | Hemisphere, <b>N</b> orth or <b>S</b> outh  |
| yyyyy.yy  | Longitude (WGS 1984)  |
| a         | <b>E</b> ast or <b>W</b> est  |
| x         | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Not existing<br>3 = Real-time position, ambiguities fixed<br>4 = Real-time position, ambiguities not fixed |
| xx        | Number of satellites in use, 00 to 26.  |
| x.x       | PDOP  |
| EHT       | Ellipsoidal height  |
| x.x       | Altitude of position marker as local ellipsoidal height. If the local ellipsoidal height is not available, the WGS 1984 ellipsoidal height will be exported.  |
| M         | Units of altitude as fixed text M   |
| *hh       | Checksum  |
| <CR>      | <b>C</b> arriage <b>R</b> eturn   |
| <LF>      | <b>L</b> ine <b>F</b> eed   |

## Examples

### For NMEA v4.0 and v4.1:

#### Standard Talker ID = GPS only

```
$PTNL,GGK,143504.00,111414,4724.5291450,N,00937.0834387,E,1,10,1.6,E  
HT467.275,M*7C
```

#### Standard Talker ID = GNSS

```
$PTNL,GGK,143619.00,111414,4724.5293608,N,00937.0832640,E,1,17,1.3,E  
HT467.733,M*73
```

## E.6

### GGQ - Real-Time Position with CQ

#### Syntax

```
$--GGQ,hhmmss.ss,mmddy,lll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M*hh<CR><LF>
```

#### Description of fields

| Field     | Description   |
|-----------|---|
| \$--GGQ   | Header including talker ID  |
| hhmmss.ss | UTC time of position  |
| mmddy     | UTC date  |
| lll.ll    | Latitude (WGS 1984)   |
| a         | Hemisphere, <b>N</b> orth or <b>S</b> outh  |
| yyyyy.yy  | Longitude (WGS 1984)  |
| a         | <b>E</b> ast or <b>W</b> est  |
| x         | Position quality indicator<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float                        |
| xx        | Number of satellites in use. For \$GNQQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.  |
| x.x       | Coordinate quality in metres  |
| x.x       | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported. |
| M         | Units of altitude as fixed text M   |
| *hh       | Checksum  |
| <CR>      | <b>C</b> arriage <b>R</b> eturn   |
| <LF>      | <b>L</b> ine <b>F</b> eed   |

## Examples

### For NMEA v4.0:

#### Standard Talker ID = GPS only

```
$GPGGQ,144419.00,111414,4724.5290370,N,00937.0833037,E,1,10,3.894,366.261,M*01
```

#### Standard Talker ID = GNSS

```
$GNGGQ,144054.00,111414,4724.5294512,N,00937.0834677,E,1,21,3.679,366.584,M*12
```

```
$GPGGQ,144054.00,111414,,,,,10,,,*45
```

```
$GLGGQ,144054.00,111414,,,,,07,,,*5F
```

```
$GBGGQ,144054.00,111414,,,,,04,,,*51
```

### For NMEA v4.1:

#### Standard Talker ID = GPS only

```
$GPGGQ,144339.00,111414,4724.5290715,N,00937.0833826,E,1,10,4.060,366.339,M*03
```

#### Standard Talker ID = GNSS

```
$GNGGQ,144224.00,111414,4724.5293821,N,00937.0835717,E,1,22,3.673,366.944,M*12
```



When more than one GNSS is active only \$GNGGQ is output.

## E.7

### GLL - Geographic Position Latitude/Longitude

#### Syntax

```
$--GLL,III.II,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>
```

#### Description of fields

| Field     | Description  |
|-----------|--|
| \$--GLL   | Header including talker ID   |
| III.II    | Latitude (WGS 1984)  |
| a         | Hemisphere, <b>N</b> orth or <b>S</b> outh   |
| yyyyy.yy  | Longitude (WGS 1984)   |
| a         | <b>E</b> ast or <b>W</b> est   |
| hhmmss.ss | UTC time of position   |
| A         | Status<br>A = Data valid<br>V = Data not valid                                       |
| a         | Mode indicator<br>A = Autonomous mode<br>D = Differential mode<br>N = Data not valid |
| *hh       | Checksum   |
| <CR>      | <b>C</b> arriage <b>R</b> eturn  |
| <LF>      | <b>L</b> ine <b>F</b> eed  |



The Mode indicator field supplements the Status field. The Status field is set to A for the Mode indicators A and D. The Status field is set to V for the Mode indicator N.

## Examples

### For NMEA v4.0 and v4.1:

#### Standard Talker ID = GPS only

```
$GPGLL,4724.5289712,N,00937.0834834,E,144659.00,A,A*68
```

#### Standard Talker ID = GNSS

```
$GNGLL,4724.5294325,N,00937.0836915,E,144839.00,A,A*72
```

## E.8

### GNS - GNSS Fix Data

#### Syntax

```
$--GNS,hhmmss.ss,llll.ll,a,yyyyy.yy,a,c--c,xx,x.x,x.x,x.x,x.x,xxxx,h*hh<CR><LF>
```

#### Description of fields

| Field     | Description   |
|-----------|---|
| \$--GNS   | Header including talker ID  |
| hhmmss.ss | UTC time of position  |
| llll.ll   | Latitude (WGS 1984)   |
| a         | Hemisphere, <b>N</b> orth or <b>S</b> outh  |
| yyyyy.yy  | Longitude (WGS 1984)  |
| a         | <b>E</b> ast or <b>W</b> est  |
| c--c      | Four character mode indicator for each GNSS constellation used in the position where the <ul style="list-style-type: none"> <li>• First character is for GPS</li> <li>• Second character is for GLONASS</li> <li>• Third character is for Galileo</li> <li>• Fourth character is for BeiDou</li> </ul> <p>N = Satellite system not used in position fix or fix not valid<br/> P = Precise, for example no deliberate degradation such as SA<br/> A = Autonomous; navigation fix, no real-time fix<br/> D = Differential; real-time position, ambiguities not fixed<br/> R = Real-time kinematic; ambiguities fixed<br/> F = Float real-time kinematic</p> |
| xx        | Number of satellites in use. For \$GNSS messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.  |
| x.x       | HDOP  |
| x.x       | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height is exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height is exported.   |
| x.x       | Geoidal separation in metres  |
| x.x       | Age of differential data  |

| Field | Description  |
|-------|--|
| xxxx  | Differential base station ID, 0000 to 1023   |
| h     | For NMEA v4.1. Navigation Status Indicator<br>S = Safe<br>C = Caution<br>U = Unstable<br>V = Navigation status not valid |
| *hh   | Checksum   |
| <CR>  | Carriage Return  |
| <LF>  | Line Feed  |

## Examples

### For NMEA v4.0:

#### Standard Talker ID = GPS only

```
$GPGNS,150254.00,4724.5290110,N,00937.0837286,E,A,10,0.8,366.282,100.143,,*33GNSS
```

#### Standard Talker ID = GNSS

```
$GNGNS,145309.00,4724.5293077,N,00937.0838953,E,AANA,22,0.5,367.326,100.144,,*64
```

 When more than one GNSS is active only \$GNGNS is output.

### For NMEA v4.1:

#### Standard Talker ID = GPS only

```
$GPGNS,150219.00,4724.5290237,N,00937.0837225,E,A,10,0.8,366.329,100.143,,,V*4FGNSS
```

#### Standard Talker ID = GNSS

```
$GNGNS,145339.00,4724.5292786,N,00937.0838968,E,AANA,22,0.5,367.334,100.143,,,V*19
```

 When more than one GNSS is active only \$GNGNS is output.

## E.9

### GSA - GNSS DOP and Active Satellites


#### Syntax

```
$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,h*hh<CR><LF>
```

#### Description of fields

| Field   | Description  |
|---------|--|
| \$--GSA | Header including talker ID   |
| a       | Mode<br>M = Manual, forced to operate in 2D or 3D mode<br>A = Automatic, allowed to change automatically between 2D and 3D |
| x       | Mode<br>1 = Fix not available<br>2 = 2D  |



| Field   | Description   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|---------|---|--------------------|---------|----------------|--|----------|-----------------|--|----------|-----------|---------|---------|-----------|--|----------|-----------------|--|----------|--------------------|---------|---------|--------------------|--|----------|--------------|--|----------|-----------|--------|---------|-------------------|--|----------|-------------|--|----------|-----------|
|         | 3 = 3D  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| xx      | <p>PRN numbers of the satellites used in the solution.</p> <p>For NMEA v4.0: This field is repeated 12 times.</p> <p>For NMEA v4.1: This field is repeated 16 times.</p> <p> A new GSA message is sent for each GNSS constellation tracked.</p> <p><b>For NMEA v4.0 and v4.1:</b></p> <table> <tr> <td>GPS</td> <td>1 to 32</td> <td>GPS satellites</td> </tr> <tr> <td></td> <td>33 to 64</td> <td>SBAS satellites</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>Undefined</td> </tr> <tr> <td>GLONASS</td> <td>1 to 32</td> <td>Undefined</td> </tr> <tr> <td></td> <td>33 to 64</td> <td>SBAS satellites</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>GLONASS satellites</td> </tr> </table> <p><b>For NMEA v4.1 also:</b></p> <table> <tr> <td>Galileo</td> <td>1 to 36</td> <td>Galileo satellites</td> </tr> <tr> <td></td> <td>37 to 64</td> <td>Galileo SBAS</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>Undefined</td> </tr> <tr> <td>BeiDou</td> <td>1 to 37</td> <td>BeiDou satellites</td> </tr> <tr> <td></td> <td>38 to 64</td> <td>BeiDou SBAS</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>Undefined</td> </tr> </table> | GPS                | 1 to 32 | GPS satellites |  | 33 to 64 | SBAS satellites |  | 65 to 99 | Undefined | GLONASS | 1 to 32 | Undefined |  | 33 to 64 | SBAS satellites |  | 65 to 99 | GLONASS satellites | Galileo | 1 to 36 | Galileo satellites |  | 37 to 64 | Galileo SBAS |  | 65 to 99 | Undefined | BeiDou | 1 to 37 | BeiDou satellites |  | 38 to 64 | BeiDou SBAS |  | 65 to 99 | Undefined |
| GPS     | 1 to 32   | GPS satellites     |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 33 to 64  | SBAS satellites    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99  | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| GLONASS | 1 to 32   | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 33 to 64  | SBAS satellites    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99  | GLONASS satellites |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| Galileo | 1 to 36   | Galileo satellites |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 37 to 64  | Galileo SBAS       |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99  | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| BeiDou  | 1 to 37   | BeiDou satellites  |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 38 to 64  | BeiDou SBAS        |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99  | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| x.x     | PDOP  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| x.x     | HDOP  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| x.x     | VDOP  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| h       | <p>For NMEA v4.1. GNSS System ID</p> <p>1 = GPS</p> <p>2 = GLONASS</p> <p>3 = Galileo</p> <p>4 = BeiDou</p>   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| *hh     | Checksum  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| <CR>    | Carriage Return   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| <LF>    | Line Feed   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |

## Examples

### For NMEA v4.0:

#### Standard Talker ID = GPS only

```
$GPGSA,A,3,01,04,06,09,11,17,20,23,31,,,,,1.5,0.8,1.3*31
```

#### Standard Talker ID = GNSS

```
$GNGSA,A,3,01,04,06,09,11,17,20,23,31,,,,,1.1,0.5,1.0*25
```

```
$GNGSA,A,3,65,71,72,73,74,80,86,87,88,,,,,1.1,0.5,1.0*26
```

For NMEA v4.1:

**Standard Talker ID = GPS only**

\$GPGSA,A,3,01,04,06,09,11,17,20,23,31,,,,,,,,,1.5,0.8,1.3,1\*2C

**Standard Talker ID = GNSS**

\$GNGSA,A,3,01,04,06,09,11,17,20,23,31,,,,,,,,,1.1,0.5,1.0,1\*38

\$GNGSA,A,3,65,71,72,73,74,80,86,87,88,,,,,,,,,1.1,0.5,1.0,2\*38

\$GNGSA,A,3,05,07,10,11,,,,,,,,,,,,,1.1,0.5,1.0,4\*33

**E.10**

**GSV - GNSS Satellites in View**

**Syntax**

\$--GSV,x,x,xx,xx,xx,xxx,xx,.....,h\*hh<CR><LF>

**Description of fields**

| Field   | Description  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|---------|--|--------------------|---------|----------------|--|----------|-----------------|--|----------|-----------|---------|---------|-----------|--|----------|-----------------|--|----------|--------------------|---------|---------|--------------------|--|----------|--------------|--|----------|-----------|--------|---------|-------------------|--|----------|-------------|--|----------|-----------|
| \$--GSV | Header including talker ID   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| x       | Total number of messages, 1 to 9   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| x       | Message number, 1 to 9   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| xx      | Number of theoretically visible satellites according to the current almanac.   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| xx      | PRN numbers of the satellites used in the solution.  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | <table border="0"> <tr> <td>GPS</td> <td>1 to 32</td> <td>GPS satellites</td> </tr> <tr> <td></td> <td>33 to 64</td> <td>SBAS satellites</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>Undefined</td> </tr> <tr> <td>GLONASS</td> <td>1 to 32</td> <td>Undefined</td> </tr> <tr> <td></td> <td>33 to 64</td> <td>SBAS satellites</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>GLONASS satellites</td> </tr> <tr> <td>Galileo</td> <td>1 to 36</td> <td>Galileo satellites</td> </tr> <tr> <td></td> <td>37 to 64</td> <td>Galileo SBAS</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>Undefined</td> </tr> <tr> <td>BeiDou</td> <td>1 to 37</td> <td>BeiDou satellites</td> </tr> <tr> <td></td> <td>38 to 64</td> <td>BeiDou SBAS</td> </tr> <tr> <td></td> <td>65 to 99</td> <td>Undefined</td> </tr> </table> | GPS                | 1 to 32 | GPS satellites |  | 33 to 64 | SBAS satellites |  | 65 to 99 | Undefined | GLONASS | 1 to 32 | Undefined |  | 33 to 64 | SBAS satellites |  | 65 to 99 | GLONASS satellites | Galileo | 1 to 36 | Galileo satellites |  | 37 to 64 | Galileo SBAS |  | 65 to 99 | Undefined | BeiDou | 1 to 37 | BeiDou satellites |  | 38 to 64 | BeiDou SBAS |  | 65 to 99 | Undefined |
| GPS     | 1 to 32  | GPS satellites     |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 33 to 64   | SBAS satellites    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99   | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| GLONASS | 1 to 32  | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 33 to 64   | SBAS satellites    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99   | GLONASS satellites |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| Galileo | 1 to 36  | Galileo satellites |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 37 to 64   | Galileo SBAS       |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99   | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| BeiDou  | 1 to 37  | BeiDou satellites  |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 38 to 64   | BeiDou SBAS        |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 65 to 99   | Undefined          |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| xx      | Elevation in degrees, 90 maximum, empty when not tracking  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| xxx     | Azimuth in degrees true north, 000 to 359, empty when not tracking   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| xx      | <b>Signal to Noise Ration C/No</b> in dB, 00 to 99 of L1 signal, null field when not tracking.   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| ...     | Repeat set PRN / Slot number, elevation, azimuth and SNR up to four times  |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| h       | For NMEA v4.1. Signal ID   |                    |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | <table border="0"> <tr> <td>GPS</td> <td>0</td> <td>All signals</td> </tr> <tr> <td></td> <td>1</td> <td>L1 C/A</td> </tr> <tr> <td></td> <td>2</td> <td>L1 P(Y)</td> </tr> </table>   | GPS                | 0       | All signals    |  | 1        | L1 C/A          |  | 2        | L1 P(Y)   |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
| GPS     | 0  | All signals        |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 1  | L1 C/A             |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |
|         | 2  | L1 P(Y)            |         |                |  |          |                 |  |          |           |         |         |           |  |          |                 |  |          |                    |         |         |                    |  |          |              |  |          |           |        |         |                   |  |          |             |  |          |           |

| Field   | Description        |
|---------|--------------------|
|         | 3 LIM              |
|         | 4 L2 P(Y)          |
|         | 5 L2C-M            |
|         | 6 L2C-L            |
|         | 7 L5-I             |
|         | 8 L5-Q             |
|         | 9-F Reserved       |
|         | 0 All signals      |
| GLONASS | 1 G1 C/A           |
|         | 2 G1 P             |
|         | 3 G2 C/A           |
|         | 4 GLONASS (M) G2 P |
|         | 5-F Reserved       |
| Galileo | 0 All signals      |
|         | 1 E5a              |
|         | 2 E5b              |
|         | 3 E5a+b            |
|         | 4 E6-A             |
|         | 5 E6-BC            |
|         | 6 L1-A             |
|         | 7 L1-BC            |
|         | 8-F Reserved       |
| BeiDou  | 0 All signals      |
|         | 1-F Reserved       |
| *hh     | Checksum           |
| <CR>    | Carriage Return    |
| <LF>    | Line Feed          |



Satellite information can require the transmission of multiple messages, specified by the total number of messages and the message number.



The fields for the PRN / Slot number, Elevation, Azimuth and SNR form one set. A variable number of these sets are allowed up to a maximum of four sets per message.

## Examples

### For NMEA v4.0:

#### Standard Talker ID = GPS only

```
$GPGSV,3,1,09,01,31,151,45,06,37,307,47,09,47,222,49,10,14,279,44*7D
```

```
$GPGSV,3,2,09,17,29,246,47,20,69,081,49,23,79,188,51,31,18,040,41*76
```

```
$GPGSV,3,3,09,32,23,087,42,,,,,,,,,,,,,*49
```

### Standard Talker ID = GNSS

\$GPGSV,3,1,09,01,34,150,47,06,34,308,47,09,44,220,48,10,11,277,43\*7B  
\$GPGSV,3,2,09,17,31,248,49,20,71,076,48,23,76,192,50,31,19,042,42\*7A  
\$GPGSV,3,3,09,32,25,085,40,,,,,,,,,,,,,\*4F  
\$GLGSV,3,1,09,65,24,271,45,71,37,059,47,72,67,329,49,73,31,074,45\*66  
\$GLGSV,3,2,09,74,17,127,44,80,15,022,41,86,12,190,44,87,49,239,48\*66  
\$GLGSV,3,3,09,88,38,314,46,,,,,,,,,,,,,\*53  
\$GBGSV,1,1,04,05,18,123,38,07,23,044,39,10,35,068,45,11,29,224,45\*61

### For NMEA v4.1:

### Standard Talker ID = GPS only

\$GPGSV,3,1,09,01,31,151,46,06,36,307,47,09,46,222,49,10,13,278,44,0\*64  
\$GPGSV,3,2,09,17,29,246,48,20,69,080,49,23,79,189,51,31,18,040,42,0\*66  
\$GPGSV,3,3,09,32,23,087,42,,,,,,,,,,,,,0\*55

### Standard Talker ID = GNSS

\$GPGSV,3,1,09,01,32,151,46,06,35,308,47,09,45,221,49,10,12,278,42,0\*6C  
\$GPGSV,3,2,09,17,30,247,47,20,70,078,49,23,77,191,51,31,19,041,41,0\*6B  
\$GPGSV,3,3,09,32,24,086,41,,,,,,,,,,,,,0\*50  
\$GLGSV,3,1,09,65,25,272,46,71,36,060,47,72,68,333,49,73,31,073,45,0\*73  
\$GLGSV,3,2,09,74,18,126,47,80,15,021,38,86,11,190,45,87,48,238,50,0\*71  
\$GLGSV,3,3,09,88,38,312,46,,,,,,,,,,,,,0\*49  
\$GBGSV,1,1,04,05,18,123,38,07,23,044,40,10,35,067,45,11,28,224,46,0\*7E

## E.11

### LLK - Leica Local Position and GDOP

#### Syntax

\$--LLK,hhmmss.ss,mmddy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M\*hh  
<CR><LF>

#### Description of fields

| Field      | Description  |
|------------|--|
| \$--LLK    | Header including talker ID   |
| hhmmss.ss  | UTC time of position   |
| mmddy      | UTC date   |
| eeeeee.eee | Grid Easting in metres   |
| M          | Units of grid Easting as fixed text M  |
| nnnnnn.nnn | Grid Northing in metres  |
| M          | Units of grid Northing as fixed text M   |
| x          | Position quality<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |

| Field | Description  |
|-------|--|
| xx    | Number of satellites in use. For \$GNLLK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.                      |
| x.x   | GDOP   |
| x.x   | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. |
| M     | Units of altitude as fixed text M  |
| *hh   | Checksum   |
| <CR>  | Carriage Return  |
| <LF>  | Line Feed  |

## Examples

### For NMEA v4.0:

#### Standard Talker ID = GPS only

```
$GPELLK,153254.00,111414,546628.909,M,5250781.888,M,1,09,1.8,366.582,
M*15
```

#### Standard Talker ID = GNSS

```
$GNLLK,153819.00,111414,546629.154,M,5250782.866,M,1,20,1.3,367.427,
M*05
```

```
$GPELLK,153819.00,111414,,,,,09,,, *50
```

```
$GLLLK,153819.00,111414,,,,,07,,, *42
```

```
$GBLLK,153819.00,111414,,,,,04,,, *4C
```

### For NMEA v4.1:

#### Standard Talker ID = GPS only

```
$GPELLK,153254.00,111414,546628.909,M,5250781.888,M,1,09,1.8,366.582,
M*15
```

#### Standard Talker ID = GNSS

```
$GNLLK,153504.00,111414,546629.055,M,5250782.977,M,1,20,1.3,367.607,
M*05
```

 When more than one GNSS is active only \$GNLLK is output.

## E.12

### LLQ - Leica Local Position and Quality

#### Syntax

```
$--LLQ,hhmmss.ss,mmddy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh
<CR><LF>
```

#### Description of fields

| Field      | Description                |
|------------|----------------------------|
| \$--LLQ    | Header including talker ID |
| hhmmss.ss  | UTC time of position       |
| mmddy      | UTC date                   |
| eeeeee.eee | Grid Easting in metres     |

| Field      | Description  |
|------------|--|
| M          | Units of grid Easting as fixed text M  |
| nnnnnn.nnn | Grid Northing in metres  |
| M          | Units of grid Northing as fixed text M   |
| x          | Position quality<br>0 = Fix not available or invalid<br>1 = No real-time position, navigation fix<br>2 = Real-time position, ambiguities not fixed<br>3 = Real-time position, ambiguities fixed<br>5 = Real-time position, float |
| xx         | Number of satellites in use. For \$GNLLQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.  |
| x.x        | Coordinate quality in metres   |
| x.x        | Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported.   |
| M          | Units of altitude as fixed text M  |
| *hh        | Checksum   |
| <CR>       | <b>Carriage Return</b>   |
| <LF>       | <b>Line Feed</b>   |

## Examples

### For NMEA v4.0:

#### Standard Talker ID = GPS only

```
$GPRLLQ,154324.00,111414,546629.232,M,5250781.577,M,1,09,3.876,366.549,M*05
```

#### Standard Talker ID = GNSS

```
$GNLLQ,154119.00,111414,546629.181,M,5250782.747,M,1,20,3.890,367.393,M*1D
```

```
$GPRLLQ,154119.00,111414,,,,,09,,, *44
```

```
$GLLLQ,154119.00,111414,,,,,07,,, *56
```

```
$GBLLQ,154119.00,111414,,,,,04,,, *58
```

### For NMEA v4.1:

#### Standard Talker ID = GPS only

```
$GPRLLQ,154324.00,111414,546629.232,M,5250781.577,M,1,09,3.876,366.549,M*05
```

#### Standard Talker ID = GNSS

```
$GNLLQ,154149.00,111414,546629.191,M,5250782.727,M,1,20,3.880,367.387,M*1B
```



When more than one GNSS is active only \$GNLLQ is output.

## E.13

## RMC - Recommended Minimum Specific GNSS Data

### Syntax

```
$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,*hh<CR><LF>
```

### Description of fields

| Field     | Description  |
|-----------|--|
| \$--RMC   | Header including talker ID   |
| hhmmss.ss | UTC time of position fix   |
| A         | Status<br>A = Data valid<br>V = Navigation instrument warning                        |
| llll.ll   | Latitude (WGS 1984)  |
| a         | Hemisphere, North or South   |
| yyyyy.yy  | Longitude (WGS 1984)   |
| a         | East or West   |
| x.x       | Speed over ground in knots   |
| x.x       | Course over ground in degrees  |
| xxxxxx    | Date: ddmmyy   |
| x.x       | Magnetic variation in degrees  |
| a         | East or West   |
| *hh       | Mode Indicator<br>A = Autonomous mode<br>D = Differential mode<br>N = Data not valid |
| <CR>      | Carriage Return  |
| <LF>      | Line Feed  |

### Examples

#### For NMEA v4.0 and v4.1:

#### Standard Talker ID = GPS only and GNSS

```
$GNRMC,154706.00,A,4724.5288205,N,00937.0842621,E,0.01,144.09,141114,0.00,E,A*10
```

## E.14

## VTG - Course Over Ground and Ground Speed

### Syntax

```
$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>
```

### Description of fields

| Field   | Description  |
|---------|--|
| \$--VTG | Header including talker ID                                 |
| x.x     | Course over ground in degrees true north, 0.0 to 359.9     |
| T       | Fixed text T for true north                                |
| x.x     | Course over ground in degrees magnetic North, 0.0 to 359.9 |
| M       | Fixed text M for magnetic North                            |
| x.x     | Speed over ground in knots                                 |
| N       | Fixed text N for knots                                     |

| Field | Description  |
|-------|--|
| x.x   | Speed over ground in km/h  |
| K     | Fixed text K for km/h  |
| a     | Mode Indicator<br>A = Autonomous mode<br>D = Differential mode<br>N = Data not valid |
| *hh   | Checksum   |
| <CR>  | Carriage Return  |
| <LF>  | Line Feed  |



The Magnetic declination is set in the instrument in **Regional, Angle** page.

## Examples

**For NMEA v4.0 and v4.1:**

**Standard Talker ID = GPS only**

```
$GPVTG,152.3924,T,152.3924,M,0.018,N,0.034,K,A*2D
```

**Standard Talker ID = GNSS**

```
$GNVTG,188.6002,T,188.6002,M,0.009,N,0.016,K,A*33
```

## E.15

### ZDA - Time and Date

#### Syntax

```
$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>
```

#### Description of fields

| Field     | Description                                  |
|-----------|--|
| \$--ZDA   | Header including talker ID                   |
| hhmmss.ss | UTC time                                     |
| xx        | UTC day, 01 to 31                            |
| xx        | UTC month, 01 to 12                          |
| xxxx      | UTC year                                     |
| xx        | Local zone description in hours, 00 to ±13   |
| xx        | Local zone description in minutes, 00 to +59 |
| *hh       | Checksum                                     |
| <CR>      | Carriage Return                              |
| <LF>      | Line Feed                                    |



This message is given high priority and is output as soon as it is created. Latency is therefore reduced to a minimum.

## Examples

**For NMEA v4.0 and v4.1:**

**Standard Talker ID = GPS only and GNSS**

```
$GPZDA,155404.05,14,11,2014,01,00*61
```



## Appendix F

## AT Commands

### AT commands

Hayes Microcomputer Products is a leading manufacturer of modems that has developed a language called the AT command set for controlling digital cellular phones and modems. This AT command set has become the de facto standard.

### List of selected AT commands

The characters in this table are the most commonly used AT commands when configuring a digital cellular phone or modem. Refer to the manual of the used digital cellular phone or modem for information on which AT commands to use.

| AT command                          | Description  |
|-------------------------------------|--|
| ~                                   | Inserts a delay of 1/4 second.   |
| ^#                                  | Inserts the phone number as defined in digital cellular phone connection.  |
| ^^                                  | Inserts character ^.   |
| ^C                                  | Bearer Service: Connection Element.  |
| ^M                                  | Inserts a carriage return and send command.  |
| ^S                                  | Bearer Service: Speed including Protocol and NetDataRate.  |
| AT                                  | Starts a command line to be sent to phone.   |
| AT&F[<value>]                       | Sets the configuration parameters to default values specified by manufacturer of phone.<br><value>: <ul style="list-style-type: none"><li>• 0 = Factory default configuration profile</li></ul>  |
| ATD<number>                         | Starts a call to the phone number given as parameter. If ";" is present, a voice call to the given number is performed.  |
| AT+CBST=[<speed> [,<name> [,<ce>]]] | Sets the bearer service <name> with data rate <speed>, and the connection element <ce> . Refer to the manual of the used digital cellular phone or modem for a list of supported name, speed and connection element values.  |
| AT+CREG=[<mode>]                    | Enables/disables network registration reports depending on the parameter <mode>.   |
| AT+CREG?                            | Reports the <mode> and registration status <stat> of phone.<br><mode>: <ul style="list-style-type: none"><li>• 0 = Disable network registration unsolicited result code</li><li>• 1 = Enable network registration unsolicited result code</li></ul> <stat>: <ul style="list-style-type: none"><li>• 0 = Not registered, ME is not currently searching a new operator to register to</li><li>• 1 = Registered, home network</li><li>• 2 = Not registered, but ME is currently searching a new operator to register to</li><li>• 3 = Registration denied</li><li>• 4 = Unknown</li><li>• 5 = Registered, roaming</li></ul> |

| AT command                                    | Description   |
|---|---|
| AT+COPS=[<mode>[,<format>[,<oper>]][,<AcT>]]] | <p>Forces an attempt to select and register the GSM/UMTS network operator.</p> <p>&lt;mode&gt;:</p> <ul style="list-style-type: none"> <li>• 0 = Automatic choice</li> <li>• 1 = Manual choice</li> </ul> <p>&lt;format&gt;:</p> <ul style="list-style-type: none"> <li>• 0 = Alphanumeric long form</li> <li>• 1 = Short format alphanumeric</li> <li>• 2 = Numeric, 5 digits</li> </ul> <p>&lt;oper&gt;:</p> <ul style="list-style-type: none"> <li>• Network operator in format defined by &lt;format&gt;</li> </ul> <p>&lt;AcT&gt;:</p> <p>Access technology selected:</p> <ul style="list-style-type: none"> <li>• 0 = GSM</li> <li>• 2 = UTRAN</li> </ul> |
| AT+COPS?                                      | Returns the currently registered network operator.  |
| AT+COPS=?                                     | <p>Returns a list of all available network operators in form of: &lt;stat&gt;, long alphanumeric &lt;oper&gt;, short alphanumeric &lt;oper&gt;, numeric &lt;oper&gt;,&lt;AcT&gt;:</p> <p>&lt;stat&gt;:</p> <p>Operator availability:</p> <ul style="list-style-type: none"> <li>• 0 = Unknown</li> <li>• 1 = Available</li> <li>• 2 = Current</li> <li>• 3 = Forbidden</li> </ul> <p>&lt;AcT&gt;:</p> <p>Access technology selected:</p> <ul style="list-style-type: none"> <li>• 0 = GSM</li> <li>• 1 = GSM Compact</li> <li>• 2 = UTRAN</li> </ul>  |
| AT+CPIN=<pin>[,<newpin>]                      | Sends the PIN to the phone.   |
| AT+CPIN?                                      | <p>Returns the status of the PIN request:</p> <ul style="list-style-type: none"> <li>• READY = Phone can be used</li> <li>• SIM PIN = PIN is not set, phone not ready for use.</li> <li>• SIM PUK = PUK is required to use the device</li> <li>• ERROR = No SIM card inserted</li> </ul>  |
| AT+CSQ  | Reports received signal quality indicators in form of: <signal strength><bit error rate>  |
| AT+CSQ=?                                      | Returns the supported ranges.   |
| AT+FLO=<type>                                 | <p>Selects the flow control behaviour of the serial port in both directions.</p> <ul style="list-style-type: none"> <li>• 0 = Flow control None</li> <li>• 1 = Flow control Software (XON-XOFF)</li> <li>• 2 = Flow control Hardware (CTS-RTS)</li> </ul>   |

## Appendix G

## Event Input Notify Message Format

### Description

With GS25, a message can be created. This message provides information about

- the fact that an event was detected by the receiver
- the time when the event was detected.

The message can be in ASCII or in binary format. It is sent to a connected device, for example a PC.

Refer to [19.12 Event input 1/Event input 2](#) for configuring the event input interface.

### Example

```
$PLEIR,HPT,134210000,1203*17
```

### Syntax in ASCII

```
$PLEIR,EIX,sssssssss,ttttttt,nnnn,cccc,dddd*hh<CR><LF>
```

### Description of the fields

| Field     | Description  |
|-----------|--|
| \$PLEIR   | Header   |
| EIX       | Message identifier.<br>X = 1 for port E1<br>X = 2 for port E2  |
| sssssssss | GPS time of week of event in ms  |
| ttttttt   | GPS time of week of event in ns  |
| nnnn      | GPS week number  |
| cccc      | Event count  |
| dddd      | Event pulse count<br>This is the count of all pulses including those violating the specified accuracy limit boundary conditions set in <b>Event Input 1/Event Input 2, Event input</b> page. This allows determination of missed events. |
| *hh       | Checksum   |
| <CR>      | Carriage return  |
| <LF>      | Line feed  |

### Example

```
$PLEIR,EI2,292412000,28932,1203,203,1*70
```

## Appendix H PPS Output Notify Message Format

### Description

With GS25, a message can be created. This message informs about the output of a PPS pulse. The message can be in ASCII or in binary format. It is sent to a connected device, for example a PC.

The message is sent at least 0.5 s before the next pulse. For this reason, notify messages are sent when the PPS output rate is greater than 1 s.

Refer to [19.11 PPS output](#) for configuring the PPS output interface.

### Syntax in binary format

In binary, the notification message format is Leica Binary v2. Documentation for LB2 is available on request from the Leica Geosystems representative.

### Syntax in ASCII

```
$PLEIR,HPT,sssssssss,nnnn*hh<CR><LF>
```

### Description of the fields

| Field     | Description  |
|-----------|--|
| \$PLEIR   | Header   |
| HPT       | Message identifier, <b>H</b> igh <b>P</b> riority <b>T</b> ime |
| sssssssss | GPS time of week of next PPS output in ms                      |
| nnnn      | GPS week number  |
| *hh       | Checksum   |
| <CR>      | Carriage return  |
| <LF>      | Line feed  |

### Example

```
$PLEIR,HPT,134210000,1203*17
```

I.1

A

**A (parameter)**

For horizontal alignments:  
 $A^2 = R * L$   
 R = Radius of the connecting circular curve.  
 L = Length of the spiral.

**Arc**

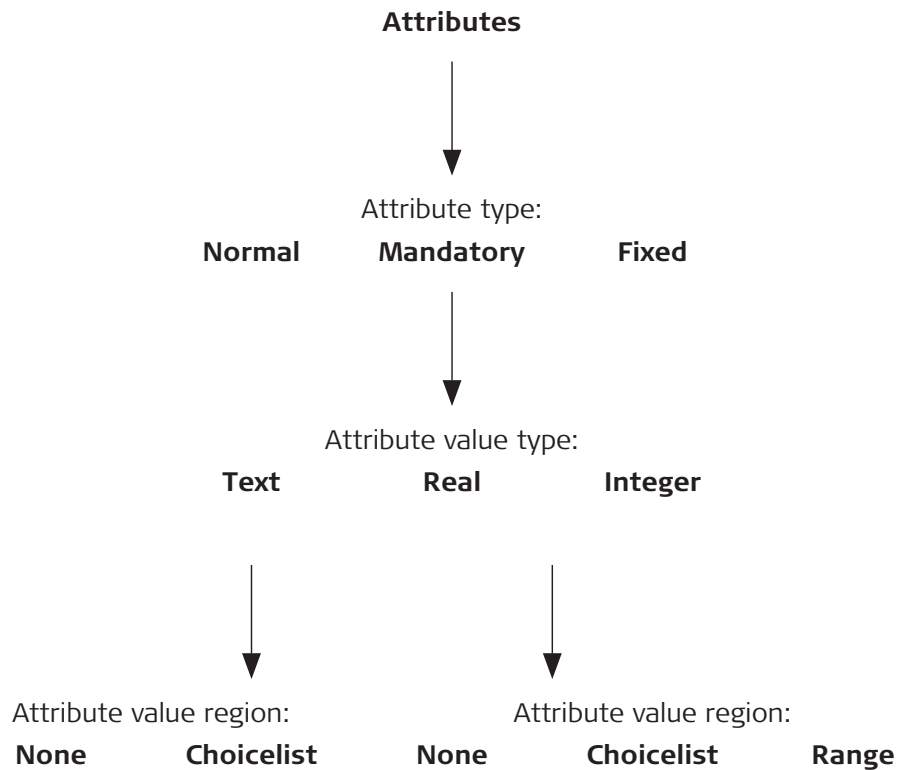
Refer to [Curve](#).

**Attribute**

**Description**

The use of attributes allows additional information to be stored with the code. Up to twenty attributes can be related to one code. Attributes are not compulsory.

**Structure of attributes**



**Example**

| Code  | Attributes | Attribute value type | Attribute value region | Example for the attribute value region |
|-------|------------|----------------------|------------------------|--|
| Birch | Height     | Real                 | Range                  | 0.5-3.0                                |
|       | Condition  | Text                 | Selectable list        | Good, Dead, Damaged                    |
|       | Remark     | Text                 | None                   | -                                      |

## Attribute types

The attribute type defines the input requirements for the attribute.

| Type       | Description  |
|------------|--|
| Normal:    | An input for the attribute is optional. The attribute value can be typed in the field. New attributes with this attribute type can be created in Infinity or on the instrument.  |
| Mandatory: | An input for the attribute is compulsory. The attribute value must be typed in the field. New attributes with this attribute type can be created in Infinity.  |
| Fixed:     | The attribute value is a predefined default which is displayed but cannot be changed in the field. This attribute value is automatically attached to the code. New attributes with this attribute type can be created in Infinity. |

## Attribute value regions

The attribute value region defines if the attribute values must be selected from a predefined list.

| Type             | Description   |
|------------------|---|
| None:            | An input for the attribute must be typed in. New attributes with this attribute value region can be created in Infinity or on the instrument. |
| Range:           | An input for the attribute must fall within a predefined range. New attributes with this attribute value region can be created in Infinity.   |
| Selectable list: | An input for the attribute is selected from a predefined list. New attributes with this attribute value region can be created in Infinity.    |

## Attribute value types

The attribute value type defines which values are accepted as input.

| Type     | Description  |
|----------|--|
| Text:    | Any input for the attribute is interpreted as text. New attributes with this attribute value type can be created in Infinity or on the instrument. |
| Real:    | An input for the attribute must be a real number, for example 1.23. New attributes with this attribute value type can be created in Infinity.      |
| Integer: | An input for the attribute must be an integer number, for example 5. New attributes with this attribute value type can be created in Infinity.     |

## Averaging

Use the **Duplicate points** mode. The mode defines the checks which are performed when more than one set of measured coordinates are recorded for the same point. The settings affect the behaviour of the instrument when editing a point and calculating averages.

## I.2

## B

## I.3

## C

## Chainage equation

Chainage equations define adjustments for the chainage values in the horizontal alignment. These adjustments can be necessary when a horizontal

alignment is modified, by inserting or removing an element, and the chainage values in the horizontal alignment are not recomputed. This situation can occur when editing manually or editing with a program that does not automatically recompute. Chainage equations define leaving a gap or allowing an overlap at certain chainages.

The elements involved in the equations are:

- chainage back
- chainage ahead.

## Class

The class describes the type of coordinate triplet.

### Description of classes

The following table shows the classes in descending hierarchical order.

| Class            | Characteristic     | Description  |
|------------------|--------------------|--|
| <b>Control</b>   | Type               | Control points. Automatically assigned to entered points or manually assigned to calculated points from COGO.  |
|                  | Instrument source  | GS, TS or Infinity   |
|                  | Number of triplets | One  |
| <b>Adjusted</b>  | Type               | Adjusted points using the adjustment program.  |
|                  | Instrument source  | Infinity or Leica Captivate (Measure foresight)  |
|                  | Number of triplets | One  |
| <b>Reference</b> | Type               | <ul style="list-style-type: none"> <li>• Reference point received by a real-time rover</li> <li>• Point set by Setup app.</li> </ul>   |
|                  | Instrument source  | GS, TS or Infinity   |
|                  | Number of triplets | One  |
| <b>Average</b>   | Type               | Averaged point calculated when more than one coordinate triplet of class <b>Measured</b> exists for the same point ID.   |
|                  | Instrument source  | GPS or TS  |
|                  | Number of triplets | One  |
| <b>Measured</b>  | Type               | <ul style="list-style-type: none"> <li>• Measured points differentially corrected using real-time phase, real-time code or post-processing.</li> <li>• Measured points with angles and distances.</li> <li>• Calculated from some apps.</li> </ul> |

| Class            | Characteristic              | Description  |
|------------------|-----------------------------|--|
|                  | Instrument source           | GS, TS or Infinity   |
|                  | Number of triplets          | Multiple. With more than one measured coordinate triplet, the average for the position and the height can be computed. |
| <b>Navigated</b> | Type                        | Navigated points using uncorrected code solutions of a single epoch or SPP positions.                                  |
|                  | Instrument source           | GS   |
|                  | Number of triplets          | Multiple   |
| <b>Estimated</b> | Type                        | Estimated points from Infinity.  |
|                  | Instrument source           | Infinity or Leica Captivate (Create point here)  |
|                  | Possible number of triplets | One  |
| <b>None</b>      | Type                        | Measured points with angles.   |
|                  | Instrument source           | TS   |
|                  | Possible number of triplets | Unlimited  |

## Code

### Description

A code is a description which can be stored with an object or alone.

## Code group

A code group allows codes belonging to the same theme to be grouped. Individual groups can be activated or deactivated. The codes belonging to a deactivated code group cannot be selected from the selectable list for code selection.

## Code types

The code type defines how and for which objects a code can be used.

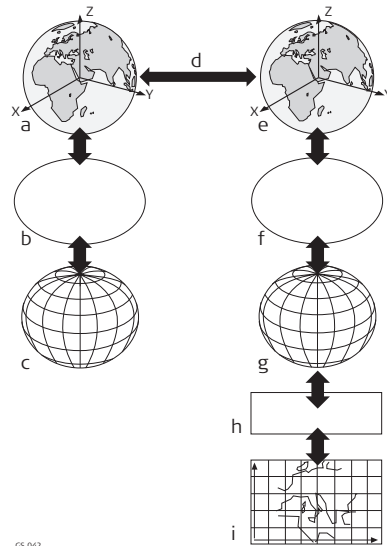
| Type       | Description   |
|------------|---|
| Point code | Object related information recorded together with the current point in the field.   |
| Free code  | Time-related information recorded between points in the field. A time stamp is recorded with each free code. The time stamp defines the chronological order in the export of free codes and points for use in third-party mapping software. |
| Quick code | Quick coding is the storing of an object plus a point or free code using a minimum number of keystrokes.  |

## Coordinate system - elements

The five elements which define a coordinate system are:



- a transformation
- a projection
- an ellipsoid
- a geoid model
- a **C**ountry **S**pecific **C**oordinate **S**ystem model



- a WGS 1984 cartesian: X, Y, Z
- b WGS 1984 ellipsoid
- c WGS 1984 geodetic: Latitude, longitude, ellipsoidal height
- d 7 parameter transformation: dX, dY, dZ, rx, ry, rz, scale
- e Local cartesian: X, Y, Z
- f Local ellipsoid
- g Local geodetic: Latitude, longitude, ellipsoidal height
- h Local projection
- i Local grid: Easting, Northing, orthometric height

All these elements can be specified when creating a coordinate system.

### Coordinate triplet

A measured point consists of three coordinate components - two horizontal components and one vertical component. The generic term for the three coordinate components is coordinate triplet.

Depending on the class, a point ID can contain more than one coordinate triplet of the same and/or of different classes.

### CSCS field file

CSCS field files can be used in the field to convert coordinates directly from WGS 1984 to local grid without the need of transformation parameters.

| Type      | Description  |
|-----------|--|
| Creation  | In Infinity with export onto a data storage device or the internal memory of the instrument. |
| Extension | *.csc  |

### CSCS model


#### Description

Country Specific **C**oordinate **S**ystem models

- are tables of correction values to convert coordinates directly from WGS 1984 to local grid without the need of transformation parameters.
- take the distortions of the mapping system into account.
- are an addition to an already defined coordinate system.

### Types of CSCS models

The correction values of a CSCS model can be applied at different stages in the coordinate conversion process. Depending on this stage, a CSCS model works differently. Three types of CSCS models are supported. Their conversion process is as explained in the following table. Any suitable geoid model can be combined with a geodetic CSCS model.

| Type             | Description  |
|------------------|--|
| <b>Grid</b>      | 1 Determination of preliminary grid coordinates by applying the specified transformation, ellipsoid and map projection.  |
|                  | 2 Determination of the final local grid coordinates by applying a shift in Easting and Northing interpolated in the grid file of the CSCS model.                             |
| <b>Cartesian</b> | 1 Performing the specified transformation.   |
|                  | 2 Determination of local cartesian coordinates by applying a 3D shift interpolated in the grid file of the CSCS model.   |
|                  | 3 Determination of the final local grid coordinates by applying the specified local ellipsoid and map projection.  |
| <b>Geodetic</b>  | 1 Determination of local geodetic coordinates by applying a correction in latitude and longitude interpolated from the file of the CSCS model.                               |
|                  | 2 Determination of the final local grid coordinates by applying the local map projection.  |
|                  |  Using a geodetic CSCS model excludes the use of a transformation in a coordinate system. |

### Coordinate quality for GS

#### Description

The **Coordinate Quality** is

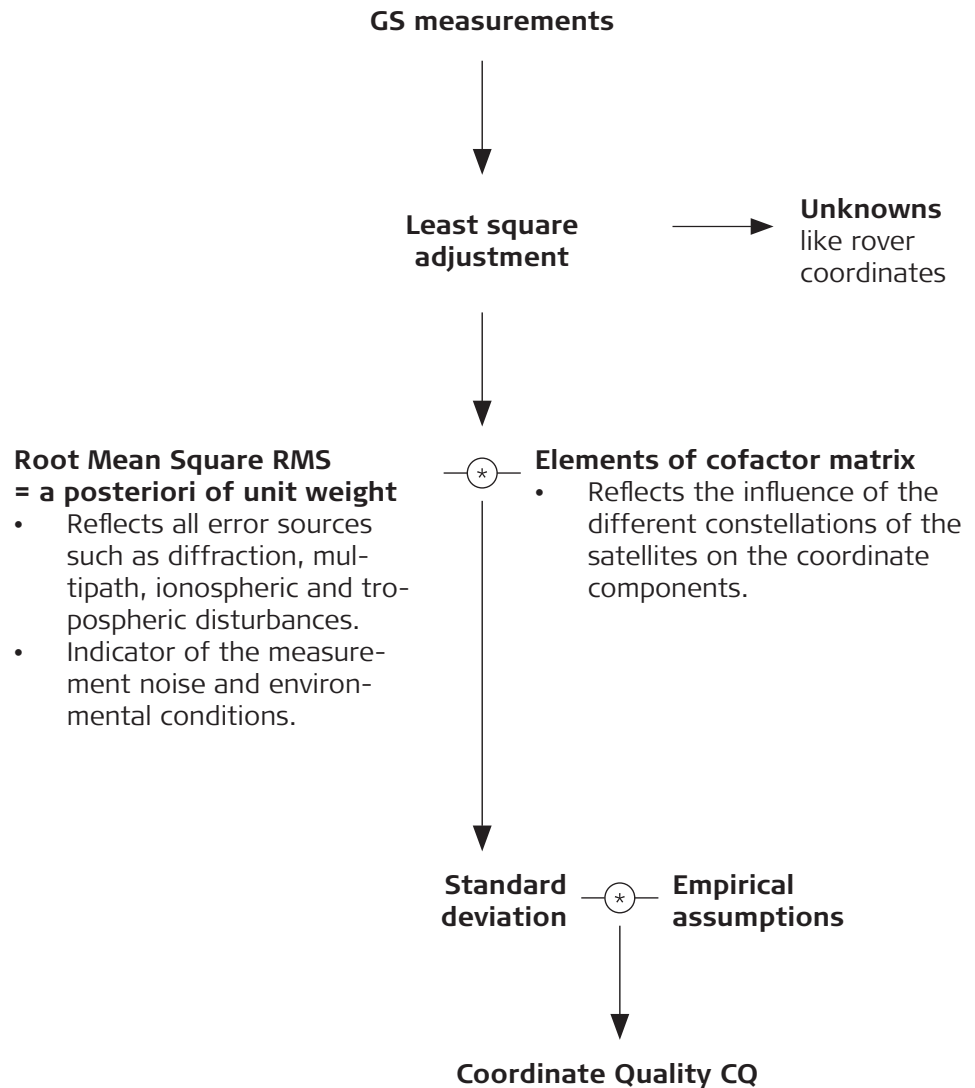
- computed on the rover for code solutions and phase fixed solutions.
- an indicator for the quality of the observations.
- an indicator for the current satellite constellation.
- an indicator for different environmental conditions.
- derived such that there is at least a two third probability that the computed position deviates from the true position by less than the CQ value.
- different from the standard deviation.

#### CQ versus standard deviation

The standard deviation as CQ would often be too optimistic, therefore the computation of the CQ is not based on the basic standard deviation algorithms. There is a 39.3% statistical probability in 2D, that the computed position deviates from the true position, by less than the standard deviation. This probability is not enough for a reliable quality indicator.

This unreliability is true for low redundancy situations such as a constellation of four satellites. In such a case, the RMS converges to zero and the standard deviation would show an unrealistically small value.

### Computation

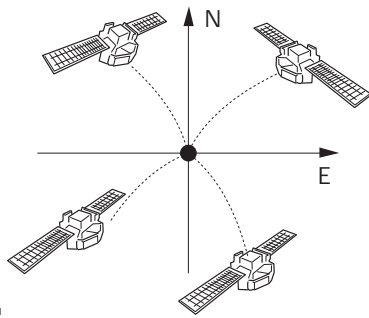


### Range

|                            |                    |
|----------------------------|--------------------|
| For a phase fixed solution | Centimetre level   |
| For a code solution        | From 0.4 m to 5 m. |

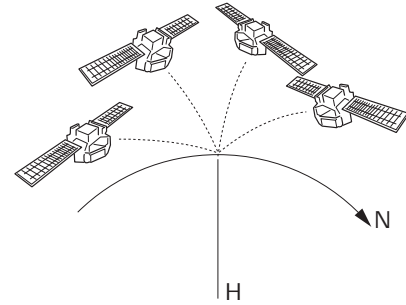
### Position CQ versus height CQ

All GS computed positions are almost twice as accurate in plan than in height. For the position determination, satellites can appear in all four quadrants. For the height determination, satellites can appear in two quadrants. Fewer quadrants weaken the height position compared to the plan position.



GS12\_041

Position determination with satellites appearing in all four quadrants.



Height determination with satellites appearing in two quadrants.

## Coordinate quality for TS

### Description

The Coordinate Quality (CQ) is an indicator for the estimated quality of the point coordinates. The coordinate quality of the measurements is used in point averaging.

| Type      | Description   |
|-----------|---|
| Est 3D CQ | Estimated 3D coordinate quality of computed position.     |
| Est 2D CQ | Estimated plan coordinate quality of computed position.   |
| Est 1D CQ | Estimated height coordinate quality of computed position. |

Vertical angles are always assuming zenith angles and not elevation angles. Standard deviations of circle readings relate to one face measurements.

$$\rho = \frac{200}{\pi}$$

### CQ of TS measurements

Standard deviation of circle reading

$$\sigma_{Hz, V} [\text{rad}] = \frac{\sigma_{Hz, V} [\text{gon}]}{\rho}$$

$\sigma_{Hz, V}$  Standard deviation of circle reading if  $\sigma_{Hz} = \sigma_V$ .  
 $\sigma_{Hz}$ : Standard deviation of horizontal circle reading.  
 $\sigma_V$ : Standard deviation of vertical circle reading.

Standard deviation of distance measurement

$$\sigma_D = c_D + \text{ppm} * D$$

$\sigma_D$  Standard deviation of distance measurement.  
 $c_D$  Constant part of EDM accuracy.  
 ppm ppm part of EDM accuracy.  
 D Slope Distance.

1D estimated coordinate quality

$$1D \text{ CQ} = \sqrt{\sigma_D^2 * \cos^2 V + \sigma_{Hz, V}^2 * D^2 * \sin^2 V}$$

1D CQ Estimated coordinate quality of the height.  
 V Zenith angle.

2D estimated coordinate quality

$$2D \text{ CQ} = \sqrt{\sigma_D^2 * \sin^2 V + \sigma_{Hz, V}^2 * D^2}$$

2D CQ Estimated horizontal coordinate quality.

3D estimated coordinate quality

$$3D \text{ CQ} = \sqrt{\sigma_D^2 + \sigma_{Hz, V}^2 * D^2 * (1 + \sin^2 V)}$$

3D CQ Estimated spatial coordinate quality.

### Working Example 1

|                   |  |
|-------------------|--|
| Instrument:       | TS16   |
| Angular accuracy: | 2" = 6.1728*10 <sup>-4</sup> gon => $\sigma_{Hz, V} = 2" * \sqrt{2}$ |
| EDM accuracy:     | 1 mm + 1.5 ppm for standard mode to reflectors                       |
| Slope distance:   | 150 m  |
| Hz:               | 210 gon  |
| V:                | 83 gon   |

1D CQ = 0.00201 m  $\cong$  2.0 mm  
 2D CQ = 0.00237 m  $\cong$  2.4 mm  
 3D CQ = 0.00311 m  $\cong$  3.1 mm

### Working Example 2

|                   |  |
|-------------------|--|
| Instrument:       | TS16   |
| Angular accuracy: | 2" = 6.1728*10 <sup>-4</sup> gon => $\sigma_{Hz, V} = 2" * \sqrt{2}$ |
| EDM accuracy:     | 1 mm + 1.5 ppm for standard mode to reflectors                       |
| Slope distance:   | 7000 m   |
| Hz:               | 210 gon  |
| V:                | 83 gon   |

1D CQ = 0.09263 m  $\cong$  92.6 mm  
 2D CQ = 0.09663 m  $\cong$  96.6 mm  
 3D CQ = 0.13386 m  $\cong$  133.9 mm

### Working Example 3

|             |      |
|-------------|------|
| Instrument: | TM60 |
|-------------|------|

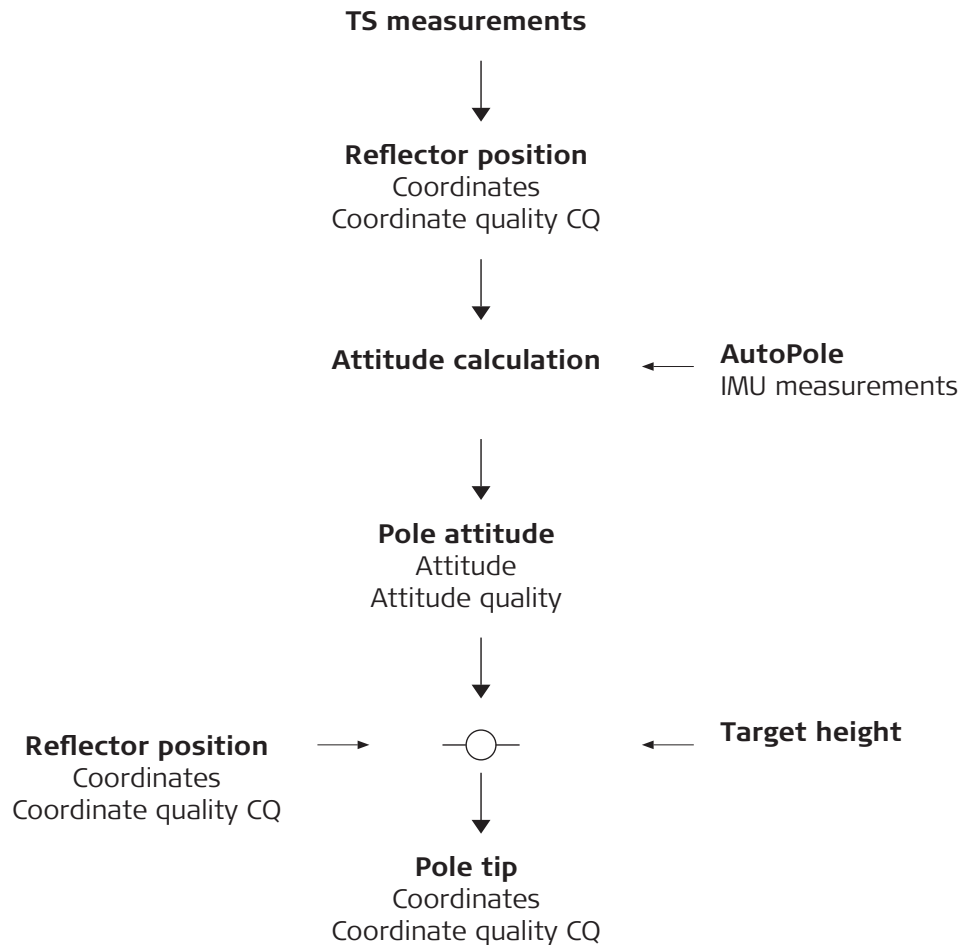
|                                  |  |
|----------------------------------|--|
| Angular accuracy:                | $0.5'' = 1.5432 \times 10^{-4} \text{ gon} \Rightarrow \sigma_{\text{Hz},V} = 0.5'' \times \sqrt{2}$ |
| EDM accuracy:                    | 0.6 mm + 1 ppm for precise mode to reflectors  |
| Slope distance:                  | 150 m  |
| Hz:                              | 210 gon  |
| V:                               | 83 gon   |
| 1D CQ = 0.00053 m $\cong$ 0.5 mm |  |
| 2D CQ = 0.00089 m $\cong$ 0.9 mm |  |
| 3D CQ = 0.00104 m $\cong$ 1.0 mm |  |

#### **Working Example 4**

|                                   |  |
|-----------------------------------|--|
| Instrument:                       | TM60   |
| Angular accuracy:                 | $0.5'' = 1.5432 \times 10^{-4} \text{ gon} \Rightarrow \sigma_{\text{Hz},V} = 0.5'' \times \sqrt{2}$ |
| EDM accuracy:                     | 1 mm + 1 ppm for standard mode to reflectors   |
| Slope distance:                   | 7000 m   |
| Hz:                               | 210 gon  |
| V:                                | 83 gon   |
| 1D CQ = 0.02323 m $\cong$ 23.2 mm |  |
| 2D CQ = 0.02509 m $\cong$ 25.1 mm |  |
| 3D CQ = 0.03420 m $\cong$ 34.2 mm |  |

## CQ of TS measurements with AutoPole

Combining the TS measurements of the reflector with the tilt measurements of the AutoPole results in an overall CQ of the tilt compensated pole tip position.



In this context, the term "attitude" describes the 3D orientation of the pole in a given coordinate system.

Features of the stored coordinate quality of tilt compensated points:

- Indicator for the quality of the pole tip position
- Derived such that there is at least a two third probability that the computed position deviates from the true position by less than the CQ value.
- Different from the standard deviation

CQ versus standard deviation:

The standard deviation as CQ would often be too optimistic. Therefore the computation of the CQ is not based on the basic standard deviation algorithms. There is a 39.3% statistical probability in 2D, that the computed position deviates from the true position, by less than the standard deviation. This probability is not enough for a reliable quality indicator.

## Cross section assignments

One cross section is valid until a new one is defined at a chainage ahead. Cross section definition can be at any chainage. The chainages need not necessarily correspond to chainages where a design element starts or ends.

## Cross section template

A Cross section gives a profile view. It requires vertical alignment or actual elevation on each chainage.

The elements involved are straight elements. The points are called vertices. You can optionally define slopes at the vertices most left and most right.

Points are defined by:

- DH and DV
- DH and slope in percentage
- DH and slope in ratio

## Curve

For horizontal alignments: Circular curve with constant radius.

For vertical alignments: Circular vertical curve with constant radius.

## I.4

## D

## Device

The hardware which is connected to the chosen port.

For GS: Devices are used to transmit and receive real-time data and to communicate with the instrument, for example to download raw observations from a remote location.

For TS: Devices are used to transmit and receive measurement data.

## I.5

## E

## I.6

## F

## I.7

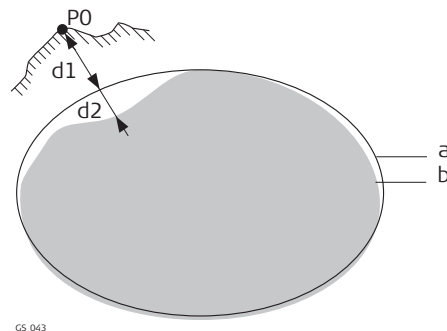
## G

## Geoid model

### Description

GNSS operates on the WGS 1984 ellipsoid and all heights obtained by measuring baselines are ellipsoidal heights. Existing heights are orthometric heights, also called height above the geoid, height above mean sea-level or levelled height. The mean sea level corresponds to a surface known as the geoid. The relation between ellipsoidal height and orthometric height is

$$\text{Orthometric Height} = \text{Ellipsoidal Height} - \text{Geoid Separation } N$$



- a WGS 1984 ellipsoid
- b Geoid
- P0 Measured point
- d1 Ellipsoidal height
- d2 Geoid separation N, is negative when the geoid is below the ellipsoid



## N value and geoid model

The geoid separation (N value) is the distance between the geoid and the reference ellipsoid. It can refer to the WGS 1984 or to the local ellipsoid. It is not a constant except over maybe small flat areas such as 5 km x 5 km. Therefore it is necessary to model the N value to obtain accurate orthometric heights. The modelled N values form a geoid model for an area. With a geoid model attached to a coordinate system, N values for the measured points can be determined. Ellipsoidal heights can be converted to orthometric heights and back.

Geoid models are an approximation of the N value. In terms of accuracy, they can vary considerably and global models in particular should be used with caution. If the accuracy of the geoid model is not known, it can be safer to use local control points with orthometric heights and apply a transformation to approximate the local geoid.

## Geoid field file

The geoid separations in a geoid field file can be used in the field to change between ellipsoidal and orthometric heights.

| Type      | Description  |
|-----------|--|
| Creation  | In Infinity with export onto a data storage device or the internal memory of the instrument. |
| Extension | *.gem  |

## GNSS points

The coordinates of GNSS points are always stored in the WGS 1984 coordinates system. WGS 1984 is a three-dimensional Cartesian coordinate system with the origin at the centre of the Earth. WGS 1984 coordinates are given as X,Y,Z Cartesian coordinates, or latitude, longitude and height (above the WGS 1984 ellipsoid).

GNSS points are stored as class **Measured** or class **Navigated**:

- Class Measured: If there are 5 or more satellites, and the distance to the reference is not too great for the prevailing ionospheric conditions, SmartStation computes a GNSS real-time position. The CQ indicator for this type of point is about 0.01 m to 0.05 m.
- Class Navigated: If the reference stops working, or if the communication link between the reference and SmartStation fails, SmartStation computes a navigation position. The CQ indicator for this type of point is about 3 m to 20 m.

## GNSS surveying techniques

Depending on the surveying task and the instruments being used, certain GNSS surveying techniques are possible. The three existing types of GNSS surveying techniques are:

| GNSS surveying technique | Characteristic | Description  |
|--------------------------|----------------|--|
| Static                   | Way of working | <ul style="list-style-type: none"><li>• Base set up over a point with accurately known coordinates.</li><li>• Rover set up over a point with known or unknown coordinates.</li><li>• Data recorded at both instruments simultaneously at the same data rate, typically 15 s, 30 s or 60 s.</li></ul> |

| <b>GNSS surveying technique</b>  | <b>Characteristic</b> | <b>Description</b>  |
|----------------------------------|-----------------------|---|
|                                  | Use                   | <ul style="list-style-type: none"> <li>Post-processing is compulsory.</li> </ul> For long baselines, geodetic networks, tectonic plate studies.   |
|                                  | Accuracy              | High over long baselines.   |
|                                  | Working speed         | Slow  |
| <b>Post-processed kinematic</b>  | Way of working        | <ul style="list-style-type: none"> <li>Base set up as static over a point with accurately known coordinates.</li> </ul>   |
|                                  | Use                   | <ul style="list-style-type: none"> <li>Rover moves from one point to another. The instrument remains turned on while moving.</li> <li>Static and moving raw observations are collected.</li> <li>Post-processing is compulsory.</li> </ul> For detail surveys and measuring many points in quick succession.  |
|                                  | Accuracy              | High for baselines up to 30 km.   |
|                                  | Working speed         | Efficient for surveying many points that are close together.  |
| <b>Real-time, base and rover</b> | Way of working        | <ul style="list-style-type: none"> <li>Base set up as static over a point with accurately known coordinates in WGS 1984.</li> <li>Rover equipment is set up on a pole and moves from one unknown point to another.</li> <li>A data link, for example a radio or digital cellular phone, transmits satellite data from the base to the rover.</li> <li>Data coming from the base and GNSS signals received on the rover are processed together on the rover as the survey is carried out in real time.</li> <li>Ambiguities are solved, coordinates of the surveyed points are calculated and displayed.</li> <li>apps as on conventional instruments like stakeout or COGO can be performed.</li> <li>Post-processing is optional.</li> </ul> |
|                                  | Use                   | For surveying detail with many points in one area.  |
|                                  | Accuracy              | High for baselines up to 30 km.   |
|                                  | Working speed         | Efficient as the results are generated in the field.  |

Refer to standard surveying literature for more details on GNSS surveying techniques.

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## I.8

## H

### Horizontal Alignment

The horizontal alignment defines the road axis of a project. Horizontal alignments are comprised of the elements:

- straights (tangents)
- curves (arcs)
- spirals (clothoid or cubic parabola)
- blossom curves (element type used for railway track design)

Each element involved is defined by individual horizontal design elements such as chainage, Easting, Northing, radius and parameter A.

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## I.9

## I

### Initialisation

For cm positioning with GNSS, the ambiguities must be fixed. The process of fixing ambiguities is called initialisation. In order to carry out an initialisation, the real-time rover settings must allow for phase fixed solutions. A minimum of five satellites on L1 and L2 is required.

The rover instrument is moved from the beginning of the GNSS operation on, recording data. The trajectory of the moving rover is recorded. Ambiguities are fixed while moving. A new initialisation starts automatically when, after losing the minimum number of required satellites, enough satellites are tracked again.

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### Instrument source

The instrument source describes where the coordinate triplet was measured or entered. The options are GS, TS, Infinity or Level.

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### Interface

The procedures, codes and protocols that enable two entities to interact for an exchange of data. Each interface is given a meaningful display name which enables easy distinction between interfaces.

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## I.10

## J

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## I.11

## K

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## I.12

## L

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## I.13

## M

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## I.14

## N

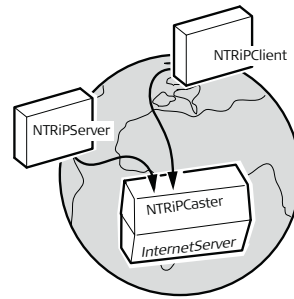
---

### Ntrip

Networked Transport of **R**TCM using **I**nternet **P**rotocol

- is a protocol streaming real-time corrections over the Internet.
- is a generic protocol based on the Hypertext Transfer Protocol HTTP/1.1.
- is used to send differential correction data or other kinds of streaming data to stationary or mobile users over the Internet. This process allows simultaneous computer, laptop, PDA, or instrument connections to a broadcasting host.
- supports wireless Internet access through mobile IP networks like digital cellular phones or modems.

The Ntrip Server could be the GS itself. This setup means the GS is both the Ntrip Source generating the real-time data and also the NTRIP Server transferring this data to the Ntrip Caster.



GS\_044

Ntrip and its role in the Internet

### Ntrip Caster

The Ntrip Caster

- is an Internet server handling various data streams to and from the Ntrip Servers and Ntrip Clients.
- checks the requests from Ntrip Clients and Ntrip Servers to see if they are registered to receive or provide real-time corrections.
- decides whether there is streaming data to be sent or to be received.

### Ntrip Client

The Ntrip Client receives data streams. This setup could be, for example a real-time rover receiving real-time corrections.

In order to receive real-time corrections, the Ntrip Client must first send

- a user ID
- a password
- an identification name, the so-called Mountpoint, from which real-time corrections are to be received

to the Ntrip Caster.

### Ntrip Server

The Ntrip Server transfers data streams.

In order to send real-time corrections, the Ntrip Server must first send

- a password
- an identification name, the so-called Mountpoint, where the real-time corrections come from

to the Ntrip Caster.

Before sending real-time corrections to the Ntrip Caster for the first time, a registration form must be completed. This form is available from the Ntrip Caster administration centre. Refer to the website of the Ntrip Caster administration centre.

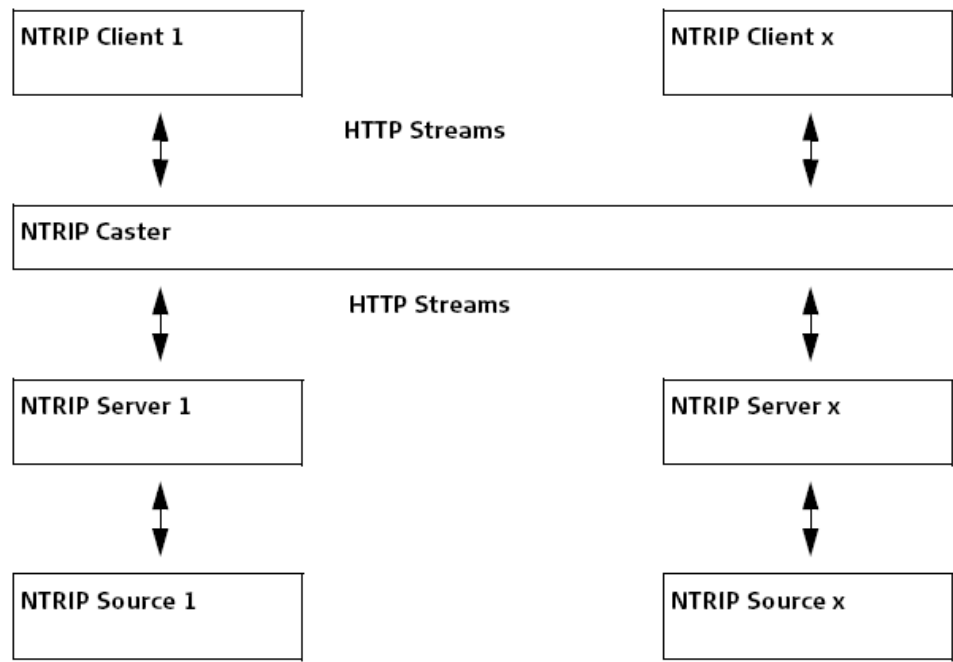
### Ntrip Source

The Ntrip Source generates data streams. This setup could be base sending out real-time corrections.

### Ntrip system components

Ntrip consists of three system components:

- Ntrip Clients
- Ntrip Servers
- Ntrip Caster



**I.15** **O**

**I.16** **P**

**Parabola**

Parabolic vertical curve with constant rate of grade change.  
An asymmetrical parabola uses inconstant rates of change.

**Parameter A**

Refer to [A \(parameter\)](#).

**Port**

A connection through which a separate device can communicate with the instrument.

**I.17** **Q**

**I.18** **R**

**I.19** **S**

**Source**

The source describes the app or functionality that generated a coordinate triplet and the method with which it was created.

| Source                  | Originated from app/functionality             | Instrument source |
|-------------------------|---|-------------------|
| <b>ASCII file</b>       | Import data, ASCII                            | GS or TS          |
| <b>Arc base pt</b>      | Line & arc calculation, base point            | GS or TS          |
| <b>Arc centre point</b> | Line & arc calculation, centre point          | GS or TS          |
| <b>Arc offset pt</b>    | Line & arc calculation, offset point          | GS or TS          |
| <b>Arc segment pt</b>   | Line & arc calculation, segmentation          | GS or TS          |
| <b>Backward brg-dst</b> | Measure hidden point, Back bearing & distance | GS                |

| <b>Source</b>                   | <b>Originated from app/functionality</b>  | <b>Instrument source</b> |
|---------------------------------|---|--------------------------|
| <b>Bearing-Distance</b>         | Measure hidden point, Bearing & distance  | GS                       |
| <b>Distance &amp; offset</b>    | Measure hidden point, Distance & offset   | GS                       |
| <b>COGO Area Div</b>            | Area division   | GS or TS                 |
| <b>COGO Shift/Rtn</b>           | Shift, rotate & scale   | GS or TS                 |
| <b>COGO Brng &amp; distance</b> | Bearing & distance  | GS or TS                 |
| <b>Using 2 bearings</b>         | Measure hidden point, Using 2 bearings  | GS                       |
| <b>Using 2 distances</b>        | Measure hidden point, Using 2 distances   | GS                       |
| <b>GSI file</b>                 | Import data, GSI  | GS or TS                 |
| <b>TPS Hidden Point</b>         | Measure hidden point, auxiliary points  | TS                       |
| <b>Intsct (Brg Brg)</b>         | Intersection, Bearing & bearing   | GS or TS                 |
| <b>Intsct (Brg Dst)</b>         | Intersection, Bearing & distance  | GS or TS                 |
| <b>Intsct (Dst Dst)</b>         | Intersection, Distance & distance   | GS or TS                 |
| <b>Intsct (4 Pts)</b>           | Intersection, Four points   | GS or TS                 |
| <b>LandXML</b>                  | Design to Field in Infinity converting data from LandXML software to be used in the field | Infinity                 |
| <b>Line Base Pt</b>             | Line & arc calculation, base point  | GS or TS                 |
| <b>Line Offset Pt</b>           | Line & arc calculation, offset point  | GS or TS                 |
| <b>Line Segmt Pt</b>            | Line & arc calculation, segmentation  | GS or TS                 |
| <b>None</b>                     | No information on the source is available   | GS or TS                 |
| <b>RefLine (Grid)</b>           | Stake to line, staked out in a defined grid   | GS or TS                 |
| <b>RefLine (Meas)</b>           | Measure to line, measured   | GS or TS                 |
| <b>RefLine (Seg)</b>            | Measure to line/Stake to line, segmented  | GS or TS                 |
| <b>RefLine (Stake)</b>          | Stake to line   | GS or TS                 |
| <b>Ref Plane (Meas)</b>         | Meas plane/grid, measured   | GS or TS                 |
| <b>Ref Plane (Scan)</b>         | Meas plane/grid, scan   | TS                       |
| <b>Road</b>                     | Roads   | GS or TS                 |
| <b>Sets of angles</b>           | Measure sets  | TS                       |
| <b>Setup (known backsight)</b>  | Setup, Known backsight  | TS                       |
| <b>Setup (Ori&amp;Ht)</b>       | Setup, Transfer height  | TS                       |
| <b>Setup (resection)</b>        | Setup, Resection  | TS                       |

| Source                         | Originated from app/functionality                         | Instrument source |
|--------------------------------|---|-------------------|
| <b>Setup (set orientation)</b> | Setup, Set orientation                                    | TS                |
| <b>Srvy Auto Offset</b>        | Measure, auto points, automatically recorded with offsets | GS or TS          |
| <b>Stakeout</b>                | Stake to line   | GS or TS          |
| <b>Measure</b>                 | Measure, measured   | TS                |
| <b>Measure (Auto)</b>          | Measure, auto points, automatically recorded              | TS                |
| <b>Measure (Event)</b>         | Measure, event input                                      | GS                |
| <b>Measure (Instant)</b>       | Measure   | GS                |
| <b>Measure (Rem Pt)</b>        | Measure, remote point                                     | TS                |
| <b>Measure (Static)</b>        | Measure   | GS                |
| <b>Traverse</b>                | Bearing & distance  | TS                |
| <b>Unknown</b>                 | -   | GS or TS          |
| <b>User App</b>                | Customised apps   | GS or TS          |
| <b>User entered</b>            | Manually entered point                                    | GS or TS          |

### Spiral

For horizontal alignments:

Spirals are used to connect straights and curves. A full spiral has an infinite radius at its start or end point whereas a partial has a finite radius at its start and end point.

**In.** Radius at the start point is bigger than at the end point.

**Out.** Radius at the start point is smaller than at the end point.

### Straight

Straight line between two points. Its end point is identical with the beginning of a curve or spiral. The tangent is perpendicular to the radius of the curve.

### Sub class

The sub class describes certain classes in detail. It indicates the status of the position when a coordinate triplet was measured and how the coordinates were determined.

| Sub class                   | Description  | Instrument source |
|-----------------------------|--|-------------------|
| <b>COGO</b>                 | Indirect coordinate determination with app COGO.   | GPS or TS         |
| <b>None</b>                 | Direction is available but no coordinates.<br>Height is available but no position coordinates. | TS<br>Level       |
| <b>TS</b>                   | Measured with distances and angles.  | TS                |
| <b>Fixed (Height)</b>       | Manually entered and fixed in height.  | GPS or TS         |
| <b>Fixed (Position)</b>     | Manually entered and fixed in position.  | GPS or TS         |
| <b>Fixed (Pos &amp; Ht)</b> | Manually entered and fixed in position and height.   | GPS or TS         |

| Sub class               | Description  | Instrument source |
|-------------------------|--|-------------------|
| <b>GNSS code only</b>   | Direct coordinate determination with code solution.  | GPS               |
| <b>GNSS fixed</b>       | Direct coordinate determination with phase fixed solution.                                   | GPS               |
| <b>GNSS float</b>       | Direct coordinate determination using GNSS or with autonomous solution coming from Infinity. | GPS               |
| <b>GPS Hidden Point</b> | Indirect coordinate determination with hidden point measurements.                            | GPS or TS         |

## I.20

## T

### Tangent

Refer to straight.

### TS mode

Current active instrument is TS.

### Transformations

A transformation is the process of converting coordinates from one geodetic datum to another.

#### Requirements

- Transformation parameters.
- In some cases a local ellipsoid.
- In some cases a map projection.
- In some cases a geoid model.

#### Transformation parameters

A transformation consists of shifts, rotations and scale factors, depending on the type of transformation used. Not all these parameters are always required. These parameters can already be known, or can be computed.

#### Description of transformations

- Classic 3D, also called Helmert transformation
- Onestep
- Twostep

| Transformation    | Characteristic        | Description  |
|-------------------|-----------------------|--|
| <b>Classic 3D</b> | Principle             | Transforms coordinates from WGS 1984 cartesian to local cartesian coordinates and vice versa. A map projection can then be applied to obtain grid coordinates. As a similarity transformation, it is the most rigorous transformation type and keeps the full geometrical information. |
|                   | Positions and heights | Positions and heights are linked. The accuracy is fully maintained and does not distort the measurements.  |



| Transformation | Characteristic | Description  |
|----------------|----------------|--|
|                | Use            | When measurements are to be kept homogenous.   |
|                | Requirements   | <ul style="list-style-type: none"> <li>• The positions and heights are known in WGS 1984 and in the local system for at least three points. Four points or more are recommended to obtain higher redundancy.</li> <li>• Parameters of the local ellipsoid.</li> <li>• Parameters of the local map projection, to convert between grid coordinates and geodetic coordinates.</li> <li>• Parameters of the local geoid model, to convert between orthometric and ellipsoidal heights. This information is not compulsory.</li> </ul> |
|                | Area           | Especially wide networks with large height differences. Local grid coordinates must be accurate.   |
|                | Advantage      | <ul style="list-style-type: none"> <li>• Accuracy of the measurements is maintained.</li> <li>• It can be used over any area as long as the local coordinates, including heights, are accurate.</li> </ul>   |
|                | Disadvantage   | <ul style="list-style-type: none"> <li>• The local ellipsoid and map projection must be known for the local grid coordinates.</li> <li>• In order to obtain accurate ellipsoidal heights, the geoid separation at the measured points must be known. This information can be determined from a geoid model.</li> </ul>   |
| <b>Onestep</b> | Principle      | Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure:   |

| Transformation | Characteristic        | Description  |
|----------------|-----------------------|--|
|                |                       | <ol style="list-style-type: none"> <li>1. The WGS 1984 coordinates are projected onto a temporary Transverse Mercator Projection. The central meridian of this projection passes through the centre of gravity of the common control points.</li> <li>2. The results of 1. are preliminary grid coordinates for the WGS 1984 points.</li> <li>3. These preliminary grid coordinates are matched with the local grid control points. The Easting and Northing shifts, the rotation and scale factor between these two sets of points can then be computed. This process is known as a classic 2D transformation.</li> <li>4. The height transformation is a single dimension height approximation.</li> </ol> |
|                | Positions and heights | The position and height transformations are separated.   |
|                | Use                   | <p>When measurements are to be forced to tie in with local existing control. For example:</p> <p>A site where the coordinates of the control points are based on a purely local grid. The coordinate values within this grid are arbitrary and are in no way connected with any ellipsoid or map projection. Obviously a Classic 3D transformation cannot be used here, as cartesian coordinates cannot be calculated from such a grid.</p>  |
|                | Requirements          | <ul style="list-style-type: none"> <li>• The position is known in WGS 1984 and in the local system for at least one point. Three or more points are recommended to obtain redundancy.</li> <li>• Additional height information for one point enables the transformation of heights.</li> <li>• Parameters of the local geoid model. This information is not compulsory.</li> <li>• No parameters of the local ellipsoid.</li> <li>• No parameters of the local map projection.</li> </ul>  |

| Transformation | Characteristic                       | Description   |
|----------------|--------------------------------------|---|
|                | Area                                 | <ul style="list-style-type: none"> <li>Limited to about 10 x 10 km as no projection scale factor is applied and a standard Transverse Mercator Projection is used to compute the preliminary WGS 1984 grid coordinates.</li> <li>For areas without large height differences.</li> </ul>   |
|                | Points and transformation parameters | <p>The transformation parameters determined depend on the number of available points with position information.</p> <ul style="list-style-type: none"> <li>One point: Classic 2D with shift in X and Y.</li> <li>Two points: Classic 2D with shift in X and Y, rotation about Z and scale.</li> <li>More than two points: Classic 2D with shift in X and Y, rotation about Z, scale and residuals.</li> </ul>   |
|                | Points and height transformation     | <p>The type of height transformation performed depends on the number of available points with height information.</p> <ul style="list-style-type: none"> <li>No point: No height transformation.</li> <li>One point: Heights are shifted to fit to the height control point.</li> <li>Two points: Average height shift between the two height control points.</li> <li>Three points: Tilted plane through the three height control points to approximate the local heights.</li> <li>More than three points: Best fitting average plane.</li> </ul> |
|                | Advantage                            | <ul style="list-style-type: none"> <li>Errors in height do not propagate into errors in position since the height and position transformations are separated.</li> <li>If local heights have low accuracy or do not exist, a transformation of position can still be calculated and vice versa.</li> <li>The height points and position points do not have to be the same points.</li> </ul>  |

| Transformation | Characteristic        | Description   |
|----------------|-----------------------|---|
|                | Disadvantage          | <ul style="list-style-type: none"> <li>No parameters of the local ellipsoid and map projection is required.</li> <li>Parameters can be computed with a minimum of points. Care must be taken when computing parameters using just one or two local points, as the parameters calculated are valid in the vicinity of the points used for the transformation.</li> <li>Restriction in the area over which the transformation can be applied. This restriction is because there is no provision for scale factor in the projection.</li> <li>The accuracy in height depends on the undulation of the geoid. The bigger the geoid variations the less accurate the results are.</li> </ul>                                   |
| <b>Twostep</b> | Principle             | <p>Combines the advantages of the Onestep and the Classic 3D transformation. It allows treating position and height separately, but is not restricted to smaller areas. Procedure:</p> <ol style="list-style-type: none"> <li>The WGS 1984 coordinates of the common control points are shifted closely to the local datum using a given Classic 3D pre-transformation. This Classic 3D pre-transformation is typically a rough transformation valid for the country of the local datum.</li> <li>The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points.</li> <li>A 2D transformation is applied, exactly as with the Onestep transformation.</li> </ol> |
|                | Positions and heights | The position and height transformations are separated.  |
|                | Use                   | When measurements are to be forced to tie in with local existing control in areas larger than 10 x 10 km.   |

| Transformation | Characteristic                       | Description  |
|----------------|--------------------------------------|--|
|                | Requirements                         | <ul style="list-style-type: none"> <li>• The position is known in WGS 1984 and in the local system for at least one point. Four points or more are recommended to obtain higher redundancy.</li> <li>• Parameters of the local ellipsoid.</li> <li>• Parameters of the local map projection.</li> <li>• Parameters of a pre-transformation.</li> </ul>   |
|                | Area                                 | Virtually any area as long as the local coordinates are accurate.  |
|                | Points and transformation parameters | Identical with the Onestep transformation.   |
|                | Points and height transformation     | Identical with the Onestep transformation.   |
|                | Advantage                            | <ul style="list-style-type: none"> <li>• Errors in height do not propagate into errors in position since the height and position transformations are separated.</li> <li>• If local heights have low accuracy or do not exist, a transformation of position can still be calculated and vice versa.</li> <li>• The height points and position points do not have to be the same points.</li> <li>• Fits much better over larger areas than a Onestep transformation. Reason:<br/>The first step of a Twostep transformation avoids any distortions because the preliminary grid coordinates are built on a different ellipsoid than the local points. The second step ensures that the influence of the map projection scale factor is taken into account before the final 2D transformation is computed.</li> </ul> |
|                | Disadvantage                         | <ul style="list-style-type: none"> <li>• The local ellipsoid must be known.</li> <li>• The map projection must be known.</li> <li>• A pre-transformation must be known. A null transformation can be used.</li> </ul>  |

| Transformation | Characteristic | Description  |
|----------------|----------------|--|
|                |                | <ul style="list-style-type: none"> <li>In order to obtain accurate ellipsoidal heights, the geoid separation at the measured points must be known. This information can be determined from a geoid model.</li> </ul> |

**I.21**

**U**

**I.22**

**V**

**Vertical alignment**

The vertical alignment gives information about the pattern of heights of the road axis as it is defined in the horizontal alignment.

A vertical alignment is comprised of the elements:

- tangents (straight segments)
- curves
- parabolas.

Each element involved is defined by individual vertical design elements such as chainage, Easting, Northing, radius and parameter P.

**I.23**

**W**

**WGS 1984**

WGS 1984 is the global geocentric datum to which all GNSS positioning information is referred to.

**I.24**

**X**

**I.25**

**Y**

**I.26**

**Z**





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- when it has to be **right**



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