



Leica Viva Series

Technical Reference Manual



Version 1.0
English

- when it has to be **right**

Leica
Geosystems

Introduction

Purchase



Congratulations on the purchase of a Leica SmartWorx Viva instrument.

To use the product in a permitted manner, please refer to the detailed safety directions in the CS10/CS15 User Manual and the GS10/GS15 User Manual.

Product identification

The type and serial number of your product are indicated on the type plate. Enter the type and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorised service workshop.

Type: _____

Serial No.: _____

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.

Trademarks

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 - CompactFlash and CF are trademarks of SanDisk Corporation
 - Bluetooth is a registered trademark of Bluetooth SIG, Inc.
 - SD is a trademark of the SD Card Association
- All other trademarks are the property of their respective owners.

Validity of this manual

- This manual applies to SmartWorx Viva. For the Lite version of SmartWorx Viva, some functionality described in this manual is not available.
- This manual applies to the Leica Viva Series. Differences between GPS and TPS are marked and described.

Available documentation

Name	Description/Format		
CS10/CS15 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.	✓	✓
GS10/GS15 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.	✓	✓

Name	Description/Format		
Viva GNSS Getting Started Guide	Describes the general working of the product in standard use. Intended as a quick reference field guide.	✓	✓
Viva TPS Getting Started Guide	Describes the general working of the product in standard use. Intended as a quick reference field guide.	✓	✓
Viva Series Technical Reference Manual	Overall comprehensive guide to the product and application functions. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists.		✓

Refer to the following resources for all CS10/CS15 documentation/software:

- the SmartWorx Viva DVD
 - <https://myworld.leica-geosystems.com>
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1

1.1



Description

Configurable Keys

Hot Keys

Hot keys are found on the CS15 model only. The CS10 model does not have any hotkeys.

Two levels of hot keys exist:

- The first level is the keys **F7, F8, ..., F12**.
- The second level is the combination of **Fn** and **F7, F8, ..., F12**.

Functionality

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

Use

- The first level is accessed by pressing **F7, F8, ..., F12** directly.
- The second level is accessed by pressing **Fn** first followed by **F7, F8, ..., F12**.
- Hot keys can be pressed at any time. It is possible that a function or application assigned to a hot key cannot be executed in certain situations.

Define hot key step-by-step

This step-by-step description shows how to assign the **Coding & linework settings** screen to the **F7** key and to the first line of the **My GPS Favourites** or **My TPS Favourites** menu.

Step	Description
1.	Select Main Menu: User\Work settings\Hot keys & favourites .
2.	Hot Keys & Favourites For hot keys/Fn hot keys select F7: User - Coding & linework settings . For favourites select 1: User - Coding & linework settings .
3.	OK

Step	Description
4.	OK
5.	Press F7 to access Coding & linework settings. OR GPS Press the favourites key  and 1 to access Coding & linework settings. TPS Press Fn, the favourites key  and 1 to access Coding & linework settings.

1.2

Favourites Key

Description

GPS

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

TPS

- Fn  opens the **My TPS Favourites** menu.
- The  key alone opens **Leica TPS Favourites**.



Functionality of the favourites menu

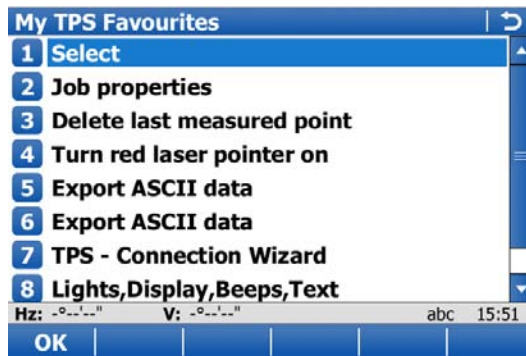
The following chapter is about the **My GPS Favourites** and **My TPS Favourites** menus only. Refer to **Leica TPS Favourites** for more information about **Leica TPS Favourites**.

The **My GPS Favourites** and **My TPS Favourites** menus can be configured to contain the most used functions or applications. The favourites menu cannot be accessed while in a configuration screen. Selecting an option in the menu carries out the function or starts the application assigned to the option.

My favourites menu

The following screen is an example of what a **My GPS Favourites** or **My TPS Favourites** menu can look like. The softkeys and their order is fixed. The functions and applications

which are assigned to the individual places in the menu can differ depending on the configuration.



OK

To execute the selected function.

Fn Quit

To exit the screen.

Define favourites menu step-by-step

Defining the favourites menu is the same process as for defining the hot keys. Refer to "1.1 Hot Keys".

2

2.1

TPS Settings

Leica TPS Favourites

Description

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

This screen displays the possible settings to change to. All possible settings have two states.



Access

Changes made on the **Leica TPS Favourites** screen are stored in the active working style.

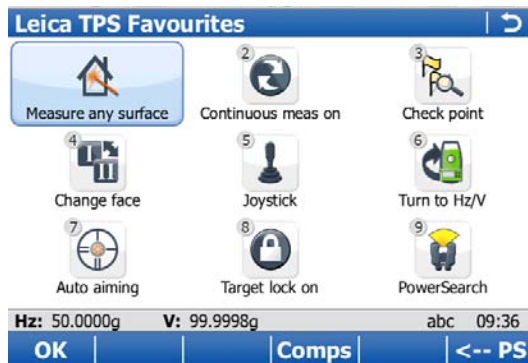
Tap the target aiming icon or select .

Leica TPS Favourites

The appearance of the screen changes, depending on whether the instrument is equipped with motorisation, ATR, reflectorless EDM or PowerSearch.

To change to the displayed setting do one of the following:

- Tap on the icon on the touch screen.
- Highlight a field and press .
- Highlight a field and press .
- Highlight a field and press **OK**.
- Press the number next to the function.



OK

To accept changes and return to **Main Menu**.

Comps

To turn the instrument using compass readings. Refer to **Orientation With Compass**.

Fn Quit

To exit the screen.

Description of options

No.	Icon	Description
1	Measure any surface Measure to prism	To measure to any surface (reflectorless). Automatically sets Target aiming: Manual . To measure to prisms.
2	Continuous meas on Continuous meas off	To set the measure mode to continuous. To set the measure mode to the previous non-continuous mode.
3	Check point	To check a point or the instrument orientation. Refer to Check Point .
4	Change face	To change the face of the telescope.

No.	Icon	Description
5	Joystick	To turn the instrument using the arrow keys. Refer to Joystick .
6	Turn to Hz/V	To turn the instrument to a specific entered position. Refer to Turn Instrument to Hz/V .
7	Auto aiming Manual aiming	To set Target aiming: Automatic . To set Target aiming: Manual .
8	Target lock on Target lock off	To set Target aiming: LOCK . To set Target aiming to the previous non-lock setting.
9	PowerSearch	Prisms are searched for with PowerSearch in the PS window when this icon is used.  If this icon is selected and reflectorless measurements is still set, then this setting is changed to measurements to prisms.

2.2

Check Point

Description

This screen is used to check if a measured point is identical to a point already stored in the job, or if the instruments orientation to a backsight point is still correct.

Access

In **Leica TPS Favourites** click **Check point**.

Check Point

Check Point		↶
Point ID:	1016	✎
Target height:	0.0000	m
Target:	Leica Round Prism	✎
Δ azimuth:	29.6400g	
Δ hz dist:	-----m	
Δ height:	-----m	

Hz: 50.0001g	V: 100.0000g	abc	17:11
Store	Dist		More Last

Store

To store the point and return to **Main Menu**.

Dist

To measure a distance.

More

To display additional information.

Last

To recall the point ID of the last checked point.

Fn Positn

To position to the selected point.

For **Target aiming: Automatic** the instrument does an ATR search.

For **Target aiming: LOCK** the instrument tries to lock on to a prism.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Selectable list	Point ID to be checked. If a stored point was checked, the point ID for that point is remembered and recalled when Last is pressed.
Target height	Editable field	The last used prism height is suggested. An individual prism height can be typed in.
Target	Selectable list	Target names as configured in the Targets screen.
Δ azimuth	Display only	Difference between calculated azimuth and current orientation.
Δ hz dist	Display only	Difference between calculated and current distance.
Δ height	Display only	Difference between calculated and current height.
Current azimuth	Display only	Current orientation.
Horiz distance	Display only	Current distance between station and backsight point.
Height difference	Display only	Current height difference between station and backsight point.
Calc'd azimuth	Display only	Calculated azimuth between station and backsight point.
Calc'd hz dist	Display only	Calculated horizontal distance between station and backsight point.

Field	Option	Description
Calc'd Δheight	Display only	Calculated height difference between station and backsight point.

2.3

Joystick

Description

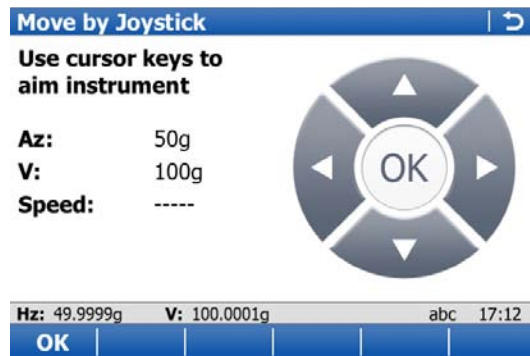
The instrument can be turned using the keyboard arrow keys on the instrument or field controller, or the arrow keys displayed on the touch screen. When this screen is accessed, the EGL is turned on automatically. When leaving the screen, the EGL is turned off.

Access

In **Leica TPS Favourites** click **Joystick**.

Move by Joystick

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.



OK

To return to **Main Menu**.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Speed	-----, Slow , Medium and Fast	Displays the rotating speed of the instrument. Press the same arrow key to change the speed.

2.4

Turn Instrument to Hz/V

Description

This screen is used when the instrument is remote controlled and the telescope is to be turned to a certain direction.

Access

In **Leica TPS Favourites** click **Turn to Hz/V**.

Turn Instrument to Hz/V, Absolute page



Azimuth: g
V angle: g

OK

To return to **Main Menu**. The instrument turns to the prism.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.



Description of fields

Field	Option	Description
Azimuth	Editable field	Oriented horizontal direction for the instrument to turn to.
V angle	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
?Hz	Editable field	Angular difference for the horizontal angle to turn to.
?V	Editable field	Angular difference for the vertical angle to turn to.

Next step

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

For **Target aiming: Automatic** an ATR measurement is performed. If no prism was found, the instrument turns to the position typed in.

For **Target aiming: Lock** the instrument locks on the prism and the LOCK icon is displayed. If no prism was found, the instrument turns to the position typed in.

2.5

Orientation With Compass

Description

Using a conventional magnetic compass while remotely controlling the instrument, it is possible to determine the direction towards which the instrument should turn to perform a target search to locate the prism.

Access

In **Leica TPS Favourites** press **Comps**.



The instrument must be connected to a radio to be remote controlled with the field controller.

Orientation with compass step-by-step

Step	Description
1.	Set up the instrument.
2.	Start the Survey application.
3.	Turn the telescope until Hz: 0.0000 .
4.	Look through the telescope with Hz: 0.0000 to select an object which is easily recognisable.
5.	Standing at the instrument, point the compass to the selected object. Turn the rotating dial until the "N" lines up with the north end of the compass needle.  The compass dial must not be turned once the "N" is lined up with the north end of the compass needle.
6.	Go to the prism. From the prism aim the "N" of the compass towards the instrument. Read the horizontal angle as pointed to by the north end of the compass needle.
7.	In Leica TPS Favourites press Comps .
8.	Orientation With Compass

Step	Description
	Compass reading: The horizontal angle read from the compass while aiming to the instrument. V angle: If the compass works as a clinometer, those values can also be used.  The horizontal and vertical angle reads from the compass are always displayed in degree regardless of the system settings.
9.	OK to return to the survey screen. The instrument turns to the prism. For Target aiming: Automatic an ATR measurement is performed. If no prism was found, the instrument turns to the position typed in. For Target aiming: Lock the instrument locks on the prism and the LOCK icon is displayed. If no prism was found, the instrument turns to the position typed in.

3

Main Menu

3.1

Main Menu Functions

Main Menu



OK

To select the highlighted option and to continue with the subsequent screen.

Fn Mode

To switch between GPS and TPS mode.

Fn Exit

To close Leica SmartWorx Viva software.

Description of the main menu functions

Main menu function	Description	Refer to chapter
Go to Work!	To select and start an application.	"3.2 Go to Work!"
Jobs & Data	To manage jobs and data, as well as import and export. Available for RTK rover and TPS.	"3.3 Jobs & Data"
Instrument	To access settings regarding GPS and instrument connections as well as status information.	"3.4 Instrument"

Main menu function	Description	Refer to chapter
User	To make settings regarding the software and the display as well as other useful tools. Available for RTK rover and TPS.	"3.5 User"

3.2

Go to Work!

Description

The **Go to Work!** drop-down menu contains all loaded applications. Selecting an option in the menu starts the application. Configurations and measurements that can be performed depend on the application.

Go to Work!



OK

To start the highlighted application or to open a submenu.

Next step

Refer to **Applications - General** for information on the applications.

3.3

Jobs & Data

Description

Jobs & Data is available for RTK rover and TPS. It is used to:

- Create a new job.
- Select a job.
- View job properties.
- View and edit data.
- Import data.
- Export and copy data.

Jobs & Data



OK
To select the highlighted option and to continue with the subsequent screen.

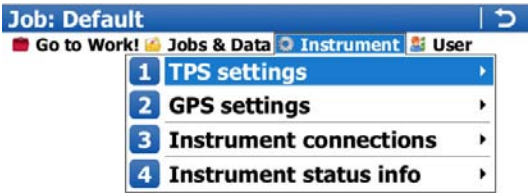
Next step

New job	Refer to chapter 4.2.
View & edit data	Refer to chapter 5.
Job properties	Refer to chapter 4.3.
Choose working job	Refer to chapter 4.4.
Choose control job	Refer to chapter 4.4.
Import data	Refer to chapter 8.
Export & copy data	Refer to chapter 9.

Description

- Instrument** is used to:
- Configure parameters related to the instrument.
 - Configure parameters related to the interfaces.
 - Check status information.

Instrument



OK
To select the highlighted option and to continue with the subsequent screen.

Next step

GPS settings	Refer to chapter 11.
TPS settings	Available for TPS. Refer to chapter 11.
Base settings	Available for RTK base. Refer to chapter 17.
Instrument connections	
• GPS connection	Refer to chapter 11.1.
• TPS connection wizard	Available for TPS. Refer to chapter 11.
• All other connections	Refer to chapter 14.
Base connections	Available for RTK base. Refer to chapter 17.

Instrument status info

Available for RTK rover and TPS. Refer to chapter 17.

Base status info

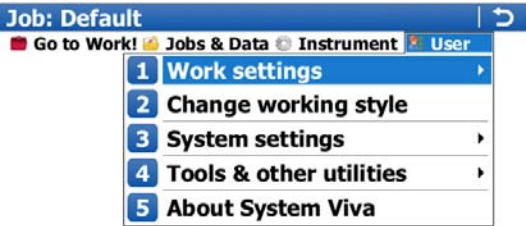
Available for RTK base. Refer to chapter 17.

Description

User is available for RTK rover and TPS. It is used:

- To configure user favourite settings for the survey and the instrument.
- For functionality which is not directly related to surveying data, such as loading firmware or licence keys, format data storage devices and viewing ASCII files.

User



OK

To select the highlighted option and to continue with the subsequent screen.

Next step

Work settings	Refer to chapter 19.
Working style wizard	Refer to chapter 22.
System settings	Refer to chapter 23.
Tools & other utilities	Refer to chapter 24.

4

4.1

Jobs & Data - Jobs

Overview

Description

Jobs

- structure surveying projects.
 - contain all points, lines, areas and codes that are recorded and stored.
 - can be downloaded to LGO for post-processing or for data transfer to a further program.
 - can be uploaded from LGO, for example, for real-time stakeout operations.
 - can be stored on the data storage device or, if fitted, the internal memory.
-

Type of jobs

- Data jobs. Explained in this chapter.
 - DTM files. Refer to "42.6 Staking Out a DTM or Points & DTM".
 - Road alignment files.
-

Default job

A job called **Default** is available on the instrument after: formatting the memory device, inserting a previously formatted data storage device or deleting all jobs from **Job properties**.

Working job

The working job is the one data is stored to. One job is always considered the working job. After formatting the memory device, the job **Default** is used until a user-defined job is created and selected.

When a job becomes the working job, then the sort and filter settings of this job are saved in the SystemRAM. If the data storage device is formatted then these last used sort and filter settings are used for the job **Default**.

4.2

Creating a New Job

Access

Select **Main Menu: Jobs & Data\New job.**

New Job, General

New Job | ↩

General | Codelist | CAD files | Coord system | Averaging

Name:

Description:

Creator:

Device:

3DCQ:---m 2DCQ:---m 1DCQ:---m abc 10:54

Store | **Page**

Store

To store the settings.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	A unique name for the new job. The name can be up to 16 characters long and include spaces. Input required.
Description	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.
Creator	Editable field	The person's name who is creating the job. Input optional.

Field	Option	Description
Device	Selectable list	The device on which the new job will be stored. Depending on the instrument options, this may be a display only field.

Next step

Page changes to the **Codelist** page.

New Job, Codelist page

Description of fields

Field	Option	Description
Codelist	Selectable list	Choosing a codelist copies the codes to the job.

Next step

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

New Job, CAD files page

New Job			↩
General	Codelist	CAD files	Coord system Averaging
File	Size (MB)	Use	
Simple DXF 1.dxf	0.1	No	

Store

To store the settings. Selected and attached CAD files will be available in the job as background maps.

Attach

To attach a CAD file found in the same location to which the new job is to be stored. The setting in the **Use** column will be updated.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

3DCQ:---m	2DCQ:---m	1DCQ:---m	abc	10:13
Store			Attach	Page

Description of columns

Column	Description
File	The name of the CAD files available on the data storage device in the \DATA directory.
Size (MB)	The size of the CAD file in megabytes.
Use	If set to Yes , the file is attached to the job when Store is pressed.

Next step

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

New Job, Coord system page

Description of fields

Field	Option	Description
Coord system	Selectable list	Choosing a coordinate system attaches it to the job. If it is not known which coordinate system to use, select Coord system: WGS 1984 .
All other fields on this screen are display only fields. They depend on the transformation type of the selected coordinate system.		

Next step

GPS Page changes to the **Averaging** page.

TPS Page changes to the **Scale** page.

New Job, Averaging page

In order to check measurements, the same point can be measured more than once. If activated, an average or an absolute difference is calculated.

Description of fields

Field	Option	Description
Mode	Average	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. Computes the average for the position and the height. Points exceeding the defined limits are marked with ! in Edit Point :, Mean page.

Field	Option	Description
	Absolute differences	Computes the absolute differences between two points selected from a list of measured points which are all stored with the same point ID.
	Off	Averaging is turned off. No other fields are available.
Method	Weighted	The method used for computing the average. Available for Mode: Average . Calculates a weighted average
	No weighting	Calculates an arithmetic average.
Points to use	Selectable list	The type of points which will be taken into account for averaging or absolute differences. Available for Mode: Average and Mode: Absolute differences .
Limit in position and Limit in height	Editable field	The acceptable difference for the position and height components. Available for Mode: Average .
From Easting to Cartesian Z	Editable fields	The acceptable absolute differences for each coordinate component. Available for Mode: Absolute differences .

Next step

Store creates a new job.

New Job,
Scale page TPS

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, etc. and the offset from the line of projection. The calculation of the height ppm is derived from the height of the instrument station above the reference datum. Normally this is the height above mean sea level MSL.

Store

To store the settings.

SF/ppm

To change between entering the scale factor or the ppm. Only available for **Compute scale using:SF/GeoPPM**.

ppm=0

To set **Geometric ppm: 0.0**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Compute scale using	Projection & ht info	To enter all values for determining the geometric ppm.
	SF/GeoPPM	To enter only the scale factor or the geometric ppm value.

Field	Option	Description
	Stn & coord system	To automatically calculate the ppm/scale factor from the coordinate system and station position.
Scale at CM	Editable field	The scale at the central meridian. Available for Compute scale using: Projection & ht info
Offset to CM	Editable field	The offset to the central meridian. Available for Compute scale using: Projection & ht info
Map proj ppm	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. Available for Compute scale using: Projection & ht info and Compute scale using: Stn & coord system
Ground height	Editable field	The height of the instrument station above the reference datum. Available for Compute scale using: Projection & ht info
Height ppm	Display only	The height ppm value calculated from the height coordinates of the current station 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 Compute scale using: Projection & ht info and Compute scale using: Stn & coord system

Field	Option	Description
User entered ppm	Editable field	The individual ppm value. Available for Compute scale using: Projection & ht info and Compute scale using: SF/GeoPPM
Geometric ppm	Display only	For Projection & ht info : Geometric ppm = Map proj ppm + User entered ppm + height ppm value calculated from Ground height. For Stn & coord system : Geometric ppm = Map proj ppm + Height ppm.
User entered scale factor	Editable field	The user entered scale factor. Compute scale using: SF/GeoPPM

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 **User entered ppm**.

Individual ppm = $(s-1) \times 10^6$. $s = 1 + \text{ppm} \times 10^{-6}$. The **Geometric ppm** value is calculated with the following:

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

Automatic calculation of the geometric ppm value

When **Compute scale using: Stn & coord system**:

- the ppm values for Map Proj ppm, Height ppm and Geometric ppm are automatically calculated. The coordinates of the current instrument station stored in the internal memory are used, which are based on the currently active coordinate system.
- each time an application is accessed, the geometric ppm value is automatically calculated. The coordinates of the current instrument station 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 will appear, allowing the user to either manually enter the ppm values or accept ppm values of 0.

Next step

Page changes to the **Averaging** page.

4.3

Job Properties and Editing a Job

Description

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

Access

Select **Main Menu: Jobs & Data\Job properties.**

Job Properties:, General page

The fields on this page are identical with the fields in **New Job, General**. Refer to "4.2 Creating a New Job".

The screenshot shows the 'Job Properties: Default' screen with the 'General' tab selected. The fields are as follows:

Name:	Default
Description:	-----
Creator:	-----
Device:	CF card
Size (kB):	55

At the bottom, there is a status bar with the following text: 3DCQ:---m 2DCQ:---m 1DCQ:---m abc 10:13. Below this is a navigation bar with buttons: Store, Data.., and Page.

Store

To store the settings.

Data..

To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are shown on separate pages. Selected sort and filter settings apply.

Page

To change to another page on this screen.

Fn Log..

To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are sorted by time in one list.

Fn Quit

To exit the screen.

Next step

Page changes to the **Codelist** page.

Job Properties:, Codelist page



Store

To store the settings.

Import

To add additional codes from a new codelist to the job. The name of this codelist is copied to the job.

Codes..

To view codes currently stored in the job. Refer to "4.5 Managing Job Codes"

Data..

To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are shown on separate pages. Selected sort and filter settings apply.

Page

To change to another page on this screen.

Fn Log..

To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are sorted by time in one list.

Fn Export

To copy codes from the job to an existing or new codelist.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Codelist	<None>	No codes are stored in the job. This default setting can be changed. Choosing a codelist copies 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 working job is displayed.

Next step

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

**Job Properties: ,
CAD files page**



Store

To store the settings.

Add

To select a CAD file that is added to the job properties. Refer to "4.2 Creating a New Job" for a description of the screen.

Remove

To delete a CAD file from the job properties.

View

To change the setting in the **View** column.

Page

To change to another page on this screen.



Fn Layrs..

To change to the CAD layers screen. In this screen, it is possible to make layers from the CAD file visible or invisible for MapView.

Fn Log..

To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are sorted by time in one list.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Maps	The name of the CAD files that can be used.
View	If set to Yes , the map is visible as background maps in MapView.

Next step

Page changes to the **Coord system** page and the **Averaging** page and for TPS also to the **Scale** page. The functionality on all pages is identical with the creation of a new job. Refer to "4.2 Creating a New Job"

If the coordinate system of the working job is edited, and **Use auto coordinate system** has been selected in the **RTK Rover Wizard**, a message will display requesting confirmation to deactivate auto coordinate system.

4.4

Choosing a Job

Access

- For a working job, where measured points are stored to, select **Main Menu: Jobs & Data\Choose working job.**
- For a control job with control points, select **Main Menu: Jobs & Data\Choose control job.**

Choose working job

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

Choose Working Job (CF card)	
Name	Date
Default	27.04.09

3DCQ:-,---m		2DCQ:-,---m		1DCQ:-,---m		abc		10:15	
OK	New..	Edit..	Delete	Data..	SD card				

OK

To select the highlighted job and to return to the screen from where this screen was accessed.

New..

To create a job. Refer to "4.2 Creating a New Job".

Edit..

To edit the highlighted job. Refer to "4.3 Job Properties and Editing a Job".

Delete

To delete the highlighted job.

CF card, SD card or Intrnl

To change between viewing jobs stored on another data storage device or internal memory.

Description

Available for jobs which have a codelist attached. To view, edit, group and sort all codes currently stored in the job. The functionality of this screen is mainly the same as for **Main Menu: Jobs & Data\New job, Codelist**. For simplicity, the functionality which is different for **Main Menu: Jobs & Data\Job properties, Codelist** is explained here. Refer to "6.4 Managing Codes" for information on **Main Menu: Jobs & Data\New job, Codelist**.

Access step-by-step

Step	Description
1.	Select Main Menu: Jobs & Data\Job properties . OR Select Main Menu: Jobs & Data\Choose working job or Choose control job. Edit.. to access Job Properties: .
2.	Page until the Codelist page is active.
3.	Codes.. to access Job Codes .

Job Codes

Job Codes		
Code	Code description	
a*	a	
bb*	bb	
ccc*	ccc	
d*	d	
ee*	ee	
fff*	fff	
ggg*	ggg	
h*	h	
jj*	jj	
3DCQ:--m	2DCQ:--m	1DCQ:--m abc 10:15
OK	New..	Edit.. More

OK

To return to the previous screen.

New..

To create a new code. Refer to "6.4.2 Creating/Editing a Code".

Info

To edit the highlighted code. Accesses **Edit Code** where new attributes can be added to a code and line styles can be changed.

More

To display information about the code group, the code type, the code description and the quick codes if available.

Fn Group

To access **Code Groups**. To view, create, activate and deactivate code groups. Refer to "6.5 Managing Code Groups".

Fn Sort

To access **Sort Codes**. To sort codes by code name, code description, quick code or last used.

Fn Quit

To exit the screen.

Next step

IF	THEN
the job codes do not need to be changed	OK closes the screen.
a new job code is to be created	New... Refer to "6.4.2 Creating/Editing a Code".
an existing job code is to be edited	highlight the job code and Info .

Edit Code

Edit Code

Code: a

Description: a

Code group: 1

Code type: Point

Linework: None

Mand1

3DCQ:-,---m 2DCQ:-,---m 1DCQ:-,---m abc 10:16

Store **+Attrib**

Store

To store the code including any newly created attributes.

+Attrib

To add a new attribute to a code.

Name or Value

Available for attributes for which an attribute name can be typed in. To highlight 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.

Fn Quit

To exit the screen.

The behaviour of this screen varies with the type of code to be edited. The differences are explained in the table.

Type of code	Description
Point codes and Free codes	New attributes can be added with +Attrib.
Line codes and Area codes	• New attributes can be added with +Attrib. • The line style can be changed. This new line style is stored to the code. It can be decided whether to update the line style of all previously stored lines/areas with this code in this job.

5

5.1

Jobs & Data - Data

Overview

Description

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

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

5.2

Accessing Data Management

Access



Data:
Points page

Select **Main Menu: Jobs & Data\View & edit data.**

The objects listed on the pages belong to the working job. The objects listed and their order depend on the active sort and filter settings. An active filter for a page is indicated by * to the right of the name of the page. Refer to "5.6 Point Sorting and Filters" for information about sort and filter settings.

Data: fixpoint job	
Points *	Lines (0) Areas (0) Map *
Point	Point code
1016	FNCM
1010	FNCM
1011	----
1001	HOUS
2	----
1	----
1020	WTVL
TP001	NATI
Hz: ----g	V: ----g abc 16:31
OK	New.. Edit.. Delete More Page

- OK
- To close the screen and return to the screen from where this screen was accessed.
- New..
- To create a point.
- Edit..
- To edit the highlighted point.
- Delete
- To delete the highlighted point.
- More
- To display information about the codes if stored with any point, the time and the date of when the point was stored, the 3D coordinate quality, the class and the flag for Linework.
- Page
- To change to another page on this screen.
- Fn Log..
- To view points, lines, areas and free codes stored with the job sorted by time. Refer to "5.5 Data Log".

Fn Filter..

To define sort and filter settings. Refer to "5.6 Point Sorting and Filters".

Fn Quit

To exit the screen.

Next step

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

**Data:,
Lines and Areas page**

The explanations given for the softkeys are valid for both pages.

The number in brackets next to the name of the page indicate the number of open lines/areas. Example: Lines (2)/Areas (2) means that two lines/areas are open.

Data: fixpoint job		
Points *	Lines (0)	Areas (0) Map *
Line	Start time	Open
Line0001	14:26:57	No

OK

To close the screen and return to the screen from where this screen was accessed.

New..

To create a line/area. After storing the new line/area, all existing lines and areas which are open are closed. Refer to "5.3.1 Creating a New Point".

Edit..

To edit the highlighted line/area.

Close and Open

To change between the options in the **Open** column of the highlighted line/area. Only available for the current working job.

Hz: ----g		V: ----g		abc 16:31	
OK	New..	Edit..	Open	More	Page

More

To display information about the codes if stored with any line/area, the start time, the end time of when the last point was added to the line/area, the length of the line, the perimeter and the area of the area.

Page

To change to another page on this screen.

Fn Delete

To delete the highlighted line/area.

Fn Filter..

To define sort and filter settings. Refer to "5.6 Point Sorting and Filters".

Fn Quit

To exit the screen.

Description of columns

Column	Description
Line or Area	The listed lines/areas already stored in the working job.
Open	The status of a line/area. • Yes The line/area is open. Measured points are assigned to the line/area. • No The line/area is closed. Measured points are not assigned to the line/area. Close and Open change between the options.

Next step

IF the line/area	THEN
which was last used is to be opened	press a hot key configured to reopen last used line/area. This hot key can be used at any time. Refer to "1.1 Hot Keys" for information on hot keys.
is to be viewed	Page until the Map page is active.

5.3

5.3.1

Point Management

Creating a New Point

Access

In **Data:**, **Points** page, press **New...**

New Point,
Coords page

New Point

Coords

Code

Point ID:

TPS0001

Easting:

m

Northing:

m

Elevation:

m

Hz: -----g

V: -----g

abc

16:31

Store

Coord

Page

- Store

To store the new point entered and all associated information.
- Coord

To view other coordinate properties.
- North or South

Available for local geodetic or WGS 1984 geodetic coordinates when **Local latitude** or **WGS84 latitude** is highlighted. Changes between North and South latitude.
- East or West

Available for local geodetic or WGS 1984 geodetic coordinates when **Local longitude** or **WGS84 longitude** is highlighted. Changes between East and West longitude.
- Page

To change to another page on this screen.
- Fn Ell Ht or Fn Elev

Available for local coordinates. Changes between the ellipsoidal and the orthometric height.

Fn IndivID or Fn Run

For an individual name independent of the ID template or to change back to the next ID from the configured ID template.

Fn Quit

To exit the screen.

Description of fields

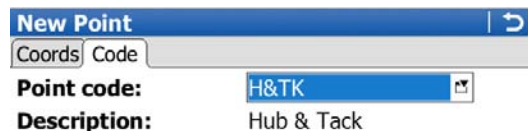
Field	Option	Description
Point ID	Editable field	The name of the new point. The configured point ID template is used. The ID can be changed in the following ways: • To start a new sequence of point IDs, type over the point ID. • For an individual name independent of the ID template Fn IndivID. Fn Run changes back to the next ID from the configured ID template.
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 will be stored as 25 °S, entering -33 °E will be stored as 33 °W.

Next step

Page changes to the **Code** page.

New Point, Code page

The settings for **Code & attributes** in **Main Menu: User\Work settings\Coding & linework** determine the availability of the subsequent fields and softkeys.



Store

To store the new point entered and all associated information.

+Attrib

To create additional attributes for this point code.

Name or Value

Available for attributes for which an attribute name can be typed in. To highlight 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.

Last

To recall the last used attribute values which were stored with this point code.

Default

To recall the default attribute values for the selected code.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point code	Selectable list	When the check box Use a list box to view codes is checked in Coding & Linework Settings : 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	When the check box Use a list box to view codes is not checked in Coding & Linework Settings : Codes for points can be typed in but not selected from a codelist. A check is performed to see if a point code of this name already exists in the job. If so, an information message is displayed. If Suggested attributes: Last used in Coding & Linework Settings , the according attributes are also shown.
Attribute	Editable field	When the check box Use a list box to view codes is checked: Up to 20 attribute values are available. When the check box Use a list box to view codes is not checked: Up to eight attribute values are available.

Next step

Store stores the new point entered and all associated information.



The properties stored with the point are:

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

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 screen opens where they can be corrected.

5.3.2

Editing a Point

Access

In **Data:**, **Points** page highlight a point to be edited. Press **Edit...**

Edit Point: Coords page

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

It is possible to edit the point ID and for points of **Class: Ctrl** and **Class: Est** 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: Ref** cannot be renamed.

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

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

Edit Point: 1016		↻	
Coords	Obs	Code	Annots
Point ID:	1016		
Easting:	764371.8646m		
Northing:	253145.4050m		
Elevation:	400.4962m		
Time:	20:11:55		
Date:	06.03.06		
Hz: ----g V: ----g abc 16:32			
Store	Coord		More Page

Store

To store the changes.

Coord

To view other coordinate properties.

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.

Page

To change to another page on this screen.

Fn Ell Ht or Fn Elev

Available for local coordinates. Changes between the ellipsoidal and the orthometric height. Changing the height type does not edit the point.

Fn Quit

To exit the screen.

Next step

Page changes to the next page.

**Edit Point:,
Obs page**

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

For GPS points

The name of the real-time base station from where the GPS/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 TPS points

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



Changing the reflector height recalculates the point height.

The distance variables **?Hz**, **?V**, **?slope dist** 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.

Next step

Page changes to the next page.

Edit Point:, Code page

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

The point code 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 & Linework Settings**.

Suggested attributes: Last used shows the last used attribute values which are stored for this point code in the active codelist. **Suggested attributes: Default values** 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 screen opens where they can be corrected.

Next step

Page changes to the next page.

Edit Point:, Annots page

Available when the edited point is **Class: Nav** or **Class: Meas** and no offset point.

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

Next step

Page changes to the next page.

**Edit Point:
Mean page**

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

Refer to "5.3.3 Mean Page" for a detailed description.

Description

In order to check measurements, the same point can be measured more than once. These measured points are assigned the class **Meas**. The various measured coordinate triplets for one point can be recorded using the same point ID. If the averaging 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 **Avge**. It is checked if the deviations of each single point are within the limits configured in **Job Properties:, Averaging** page.

After averaging, the **Mean** page becomes available in **Edit Point:** and accessible from the Survey application. Available functionality on the **Mean** page depends on the selected averaging mode.

Averaging

Defining the averaging mode and configuring the limits

The averaging mode and the limits are configured in **Job Properties:, Averaging** page. Refer to "4.3 Job Properties and Editing a Job".

Description of averaging modes

Averaging mode	Description
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 averaging method, the average will be computed weighted or arithmetic (no weighting). The class Avge is assigned to the averaged point.

Averaging mode	Description
	The horizontal and height distances from the measured points to the average are computed and displayed on the Mean page. A check is performed that the differences in position and height, between the averaged point and the point being stored, do not exceed the defined limits.
Absolute differences	What is described for Average also applies for Absolute differences . Additionally, the absolute difference between two points selected from a list of measured points with the same point ID, is checked to be within the defined limits.
Off	Averaging functionality is turned off. With more than one measured coordinate triplet recorded for the same point, no average for the position and the height is computed.

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

Mode: Average or **Mode: Absolute differences** is configured in **Job Properties**., **Averaging** page.

AND

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

Access within data management

Step	Description
1.	In Data :, Points page highlight a point to be edited.
2.	Edit.. to access Edit Point :, Mean page.

Access within Survey

From within the Survey application, the **Mean** page is accessible when the RTK Rover interface is active.

In **Survey**, **Points** page, press **Fn Avg** or **Fn Abs** to access **Edit Point**:, **Mean** page.

Edit Point:,
Mean page

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

Edit Point: 2				
Coords	Code	Mean		
Use	Time	dPos	dHt	!
-----	17:22:47	-----	-----	
Auto	09:48:22	0.0000	0.0000	

Store

To store the changes.

Use

To change between the options in the **Use** column for the highlighted coordinate triplet. To include or exclude this triplet in or from the calculation of the average.

3DCQ:0.382m 2DCQ:0.196m 1DCQ:0.329m abc 09:48

Store | Use | Edit.. | Delete | More | Page

Edit..

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. Codes cannot be changed. The average point has the higher priority. A change in codes must be an overall change for the average point.

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.

Delete

To delete the highlighted coordinate triplet. The average is recomputed.

More

To change between time and date of when the point was stored and the 3D coordinate quality.

Page

To change to another page on this screen.

Fn Diffs

Available for **Mode: Absolute differences** and **Yes** is set in the **Use** column 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 columns

Column	Description
Use	The use of a measured coordinate triplet in the averaging. • Auto The coordinate triplet is included in the averaging computation if within the averaging limit defined in Job Properties::Averaging page. • Yes The coordinate triplet is always included in the averaging computation even if it would fall outside the averaging limit defined in Job Properties::Averaging page. • No The coordinate triplet is never included in the averaging computation. • ----- The coordinate triplet cannot be included in the averaging computation. Automatically set by the system. Use changes between the options.
Time	The time the measured coordinate triplet was stored.
Date	The date the measured coordinate triplet was stored. The format is as defined in Regional Settings, Time page.
dPos	The horizontal distance from the measured coordinate triplet to the average. dPos : ----- indicates unavailable information, for example for a height only point.

Column	Description
dHt	The height distance from the measured coordinate triplet to the average. dHt: ----- indicates unavailable information, for example for a position only point.
!	Available for measured coordinate triplets with Auto or Yes in the Use column if Mode: Average . Indicates an exceeding of the limits.

Next step

Store stores the changes.

5.4

5.4.1

Line/Area Management

Overview

Description

A line/area consists of points and can be created/edited in **Data**:, **Lines** and **Areas** page. The individual points are measured within any application. All points can be used except auxiliary points. Points can be simultaneously assigned to one or more lines and/or areas.

A line/area can have

- a style for display in MapView.
- a code independent of the point code of the points comprising the line/area.



Points are assigned to a line/area when the line/area is open. Refer to "5.2 Accessing Data Management" for information on how to open a line/area.

5.4.2



Creating a New Line/Area

The functionality of all screens and fields are similar for the creation of both lines and areas. The descriptions for lines can be applied for areas.

Access

In **Data**, **Lines** page, press **New...**

New Line, General page

Store

To store the new line entered and all associated information.

Page

To change to another page on this screen.

Fn IndivID or Fn Run

For an individual name independent of the ID template or to change back to the next ID from the configured ID template.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Line ID	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: To start a new sequence of line IDs, type over the line ID.

Field	Option	Description
		For an individual name independent of the ID template Fn IndivID. Fn Run changes back to the next ID from the configured ID template.
Points to store	Selectable list	The type of points which are used to form the line during a survey.
Style	Selectable list	The line style in which lines/areas are represented in MapView and LGO. For Line code: <None> on the Code page a line style can be selected from a selectable list. Otherwise the line style as defined for the selected line code is shown.
Colour	Selectable list	A colour in which the line will be displayed.

Next step

Page changes to the **Code** page.

New Line, Code page

The settings for **Code & attributes** in **Main Menu: User\Work settings\Coding & linework** determine the availability of the subsequent fields and softkeys.



The value for **Start time** with which the line is stored is the time when **Store** was pressed. The same value is assigned to the value for **End time** until a point is added to the line.

The image shows a 'New Line' dialog box with two tabs: 'General' and 'Code'. The 'General' tab is active, showing fields for 'Line code:' (set to '<None>'), 'Description:' (set to '-----'), 'Style:' (a dropdown menu), and 'Colour:' (a black color swatch). Below the dialog box is a data bar with the text '3DCQ:0.372m 2DCQ:0.195m 1DCQ:0.317m abc 09:49'. At the bottom of the data bar is a row of buttons: 'Store', '+Attrib', 'Last', 'Default', and 'Page'.

Store

To store the new line entered and all associated information. Any existing lines and areas which are open are closed.

+Attrib

To create additional attributes for this line code.

Name or Value

Available for attributes for which an attribute name can be typed in. To highlight 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.

Last

To recall the last used attribute values which were stored with this line code.

Default

To recall the default attribute values for the selected code.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Line code	Selectable list	The line code to be stored with the point. When the check box Use a list box to view codes is checked in Coding & Linework Settings: All line codes of the job codelist can be selected. The description of the code is shown as a display only field. The line style is shown as defined for the selected line code. It is the style in which lines/areas are represented in MapView and LGO. For Line code: <None>, it can be changed. The attributes are shown as display only, editable fields or selectable lists depending on their definition.
	Editable field	When the check box Use a list box to view codes is not checked in Coding & Linework Settings: Codes for lines can be typed in but not selected from a codelist. A check is performed to see if a line code of this name already exists in the job. If so, the line style and colour are copied from the existing code and shown as display only. If Suggested attributes: Last used in Coding & Linework Settings, the according attributes are also shown.

Field	Option	Description
Attribute	Editable field	When the check box Use a list box to view codes is checked: up to 20 attribute values are available. When the check box Use a list box to view codes is not checked: up to eight attribute values are available.

Next step

Store stores the new line entered and all associated information.

Creating lines/areas most efficiently

IF the task is to create	THEN
multiple lines/areas with subsequent line/area IDs	use the hot key/favourites menu function Linework - Create new line (quick)/Linework - Create new area (quick) . Pressing the hot key or selecting the function from the  My GPS Favourites menu creates and immediately stores the new line/area. For the line/area ID, the line/area ID template as defined in ID Templates is used. The code and attributes are taken over from the last created line/area.
lines/areas with certain codes	use quick coding. The job codelist must contain quick codes for lines/areas. By tying the quick code a new line/area is created and immediately stored with that line/area code and attributes. For the line/area ID, the line/area ID template as defined in ID Templates is used.

5.4.3



Editing a Line/Area

The functionality of all screens and fields are similar for the creation of both lines and areas. The descriptions for lines can be applied for areas.

Access

In **Data**, **Lines** page, press **Edit...**

Edit Line, General page

Store

To store the changes.

More

To display **End time** and **End date**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Line ID	Editable field	The name of the line can be edited.  A line cannot be renamed to an already existing line ID.
Points to store	Selectable list	The type of points which are used to form the line during a survey can be edited.

Field	Option	Description
Style	Display only	The line style in which lines/areas are represented in MapView and LGO.
Colour	Display only	A colour in which the line will be displayed.
Number of points	Display only	The number of points contained within the line.
Length	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.
Start date and Start time	Display only	The time/date when the line was created.  An edited line retains the creation value for Start time .
End date and End time	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 additional point is added to the line.

Next step

Page changes to the **Points** page.

Edit Line, Points page

All points belonging to the line are listed. The point that was added last to the line is at the top of the list.

Edit Line: Line0001	
General	Points
Point	Point code
TP001	NAIL
TP002	NAIL
TP003	NAIL

3DCQ:0.396m	2DCQ:0.199m	1DCQ:0.342m	abc	09:49	
Store	Add	Edit..	Remov	More	Page

Store

To store the changes.

Add

To add an existing point from the working job to the line. A new point is added above the point which was highlighted when the key was pressed. The value for **End time** on the **General** page changes when a point was added to the line.

Edit..

To edit the highlighted point.

Remov

To remove the highlighted point from the line. The point itself is not deleted.

More

To display information about the point codes if stored with the line, the time and the date of when the line was stored, the 3D coordinate quality, the class and the flag for Linework.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Edit Line, Code page

Next step

Page changes to the **Code** page.

The line code can be edited. All line codes can be selected. For **Line code:None**, the line style can be changed.

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.

Next step

Store stores the changes.

5.5

Data Log

Description

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

Access step-by-step

Access within data management

In **Data**, **Points** page, press **Fn Log..** to access **Data Log**.

Access within job management

In **Job Properties**:, **General** page, press **Fn Log..** to access **Data Log**.

Data Log

In the column **Data record**, all points, lines and areas as well as free codes stored within the working job are displayed. They are always sorted by time with the most recent record at the top. For lines and areas, the value for **Start time** is relevant.

Data Log: fixpoint job					↻
Data record		Record type			
1016	Point			▲	
1011	Point			▬	
1010	Point				
1016	Point				
1011	Point				
1010	Point				
1016	Point				
1016	Point				
1011	Point			▼	
3DCQ:0.426m 2DCQ:0.218m 1DCQ:0.366m abc 09:50					
OK	New..	Edit..	Delete	More	

OK

To close the screen.

New..

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.

Edit..

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 "20.3 Free Coding".

Delete

To delete the highlighted object or free code.

More

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

Fn Quit

To exit the screen.

Next step

OK returns to the screen from where **Data Log** was accessed.

5.6

5.6.1

Point Sorting and Filters

Sorting and Filters for Points, Lines and Areas

Description

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

Three types of filters are available:

Point filter:	An active point filter shows selected points in Data: , Points page.
Line filter:	An active line filter shows selected lines in Data: , Lines page.
Area filter:	An active area filter shows selected areas in Data: , Areas page.



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 job **Default**.

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



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



An active filter for an object is indicated in **Data:** by * located on the right side of the page name.

Access

In **Data:** on the **Points**, **Lines** or **Areas** page, press **Fn Filter..** to access **Sorts & Filters**.

Sorts & Filters, Points page

The available fields on this screen depend on the selected setting for **Filter by**.

OK

To close the screen and return to the screen from where this screen was accessed. The selected sort and filter settings are applied.

Codes..

Available for **Filter by: Point code**. To define the code filters. Refer to "5.6.2 Point, Line and Area Code Filter".

Stake..

To filter points for the Stakeout application. Refer to "5.6.3 Stakeout Filter".

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Sort by	Ascending point ID, Descending point ID, Forward time or Backward time	Always available. The method points are sorted by.
Filter by	No filter	Always available. The method the points are filtered by. Shows all points.

Field	Option	Description
	Highest class	Shows points of highest class.
	Range of point IDs	Shows points with point IDs between the entered start and end ID. The points are left aligned and sorted by the first digit.
	Pt ID wildcard	Shows points with point IDs matching the wildcard.
	Time	Shows points which were recorded within a defined time window.
	Class	Shows points of the selected class.
	Instrument	Shows points originating from the selected instrument or software program type.
	Coordinate type	Shows points of the selected type of coordinates.
	Point code	Shows points with selected codes attached.
	Radius from pt	Shows points within the defined radius from a particular point. The radius is the horizontal distance.
	Individual line	Shows points forming a selected line. This can be useful, for example, during stakeout.
	Individual area	Shows points forming a selected area. This can be useful, for example, during stakeout.
Start ID	Editable field	Available for Filter by: Range of point IDs . The first point to be displayed.

Field	Option	Description
End ID	Editable field	Available for Filter by: Range of point IDs . The last point to be displayed.
Wildcard	Editable field	Available for Filter by: Pt ID wildcard . * and ? are supported. * indicates an undefined number of unknown characters. ? indicates a single unknown character.
Start date	Editable field	Available for Filter by: Time . The date of the first point to be displayed.
Start time	Editable field	Available for Filter by: Time . The time of the first point to be displayed.
End date	Editable field	Available for Filter by: Time . The date of the last point to be displayed.
End time	Editable field	Available for Filter by: Time . The time of the last point to be displayed.
Control (Ctrl), Adjusted (Adj), Reference (Ref), Average (Avge), Measured (Meas), Navigated (Nav), Estimated (Est), None	Show or Hide	Available for Filter by: Class . Defined classes are shown or hidden.
View	Highest triplet	Available for Filter by: Class . The coordinate triplets of the highest class are shown.

Field	Option	Description
	All triplets	All classes for one coordinate triplet are shown.
Instrument	All, TPS, GPS, LEICA Geo Office, Level, Controller, Third party SW or Unknown	Available for Filter by: Instrument . Points originating from this instrument type are shown.
Type	WGS84 only or Local only	Available for Filter by: Coordinate type . Points from the chosen coordinate type are shown.
Point ID	Selectable list	Available for Filter by: Radius from pt . The point to which the radius is applied. Opening the selectable list opens Data: . Refer to "5.2 Accessing Data Management".
Radius	Editable field	Available for Filter by: Radius from pt . The radius of the circle within which the points are shown.
Line ID	Selectable list	Available for Filter by: Individual line . Opening the selectable list opens Data: . Refer to "5.2 Accessing Data Management".
Area ID	Selectable list	Available for Filter by: Individual area . Opening the selectable list opens Data: . Refer to "5.2 Accessing Data Management".

Next step

Page changes to the **Lines** page.

Sorts & Filters, Lines and Areas page

Sorts & Filters

Points Lines Areas

Sort by: Backward end time ▼

Filter by: No filter ▼

3DCQ:0.514m 2DCQ:0.269m 1DCQ:0.438m abc 09:50

OK Page

OK

To close the screen and return to the screen from where this screen was accessed. The selected sort and filter settings are applied.

Codes..

Available for **Filter by: Code / code group**.
To select the line codes to be used.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Sort by	Ascending line ID, Descending line ID, Forward start time, Backward start time, Forward end time, Backward end time	Always available. The method the lines are sorted by.
Filter by	No filter Code / code group	Always available. The method by which the lines are filtered. Shows all lines. Shows lines with selected codes attached.

Next step

OK closes the screen.

5.6.2



Point, Line and Area Code Filter

For each object, a code filter exists. The point, line and area code filters are independent from each other. The functionality is identical. For simplicity, the point code filter is explained.

Access step-by-step

Step	Description
1.	In Sorts & Filters select Filter by: Point code .
2.	Codes.. to access Point Code Filter .

Point Code Filter

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

Point Code Filter				↻
Code	Activated			
H&TK	Yes			▲
NAIL	Yes			≡
CLNE	Yes			
EPAV	Yes			
ESHD	Yes			
TRED	Yes			
FWBD	Yes			
BUSH	Yes			
FHYD	Yes			▼
3DCQ:0.643m 2DCQ:0.330m 1DCQ:0.552m abc 09:51				
OK		Group	Use	None

OK
To close the screen and return to the screen from where this screen was accessed.

Group
To activate and deactivate code groups. Accesses **Code Groups**. Any code group that has been previously deactivated are displayed as deactivated here. Codes belonging to a deactivated code group are not displayed in **Point Code Filter**.

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

Sort Codes.

Fn Quit

To exit the screen.

5.6.3

Stakeout Filter

Description



The settings on this screen define a filter for the Stakeout application. The Stakeout filter can be applied to show points which are already staked or points that are still to be staked.

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

Access

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

Stakeout Filter



View: All points

OK
To close the screen and return to the screen from where this screen was accessed.

Reset
To reset the staked flag for all points of the currently working job.

Fn Quit
To exit the screen.



Description of fields

Field	Option	Description
View	All points	Shows all points.
	Points to stake	Shows points not yet staked out.
	Staked points	Shows points which are already staked out.

6

6.1

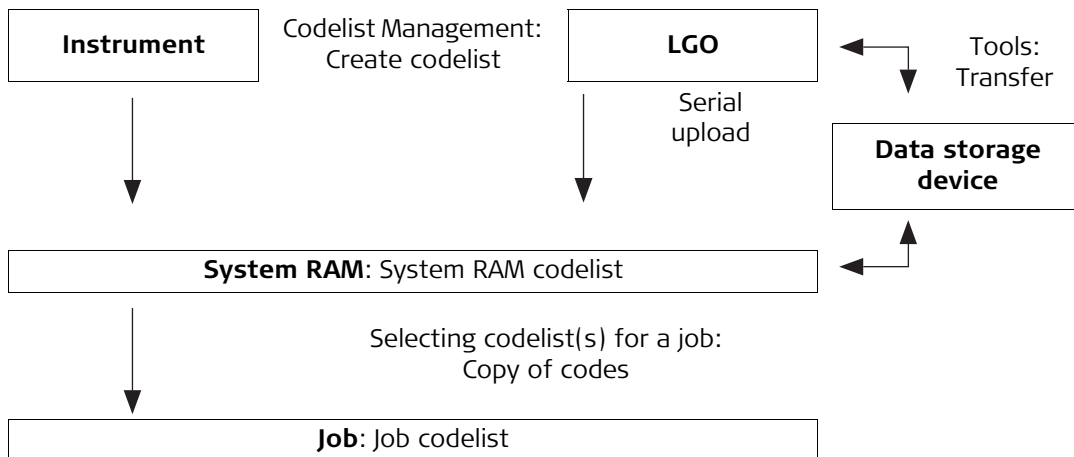


Steps from creating to using a codelist

Codelists

Overview

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



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.

6.2

Accessing Codelist Management

Access

Step	Description
1.	Go to Job Properties: , Codelist page when creating a new job or editing an existing working or control job.
2.	Open the selectable list for Codelist .

Codelists

Listed are all codelists stored in the internal memory.

Codelists	
Name	Date
<None>	-----
123	27.04.09
Qcodes	06.10.04

3DCQ:5.453m	2DCQ:3.239m	1DCQ:4.387m	abc	09:54
OK	New..	Edit..	Delete	More

OK

To return to the screen from where this screen was accessed. The codes from the highlighted codelist are copied to the working job.

New..

To create a codelist. Refer to "6.3 Creating/Editing a Codelist".

Edit..

To edit the highlighted codelist. Refer to "6.3 Creating/Editing a Codelist".

Delete

To delete the highlighted codelist.

More

To display information about the creator and the date of when the codelist was created.

Fn Quit

To exit the screen.

Access

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

New Codelist or Edit Codelist

New Codelist

Name:

Codelist

Description:

Creator:

3DCQ:6.835m2DCQ:3.752m1DCQ:5.713mabc10:40

Store

Codes..

Store

To store the codelist.

Codes..

To access **Codes** where codes can be created, edited or deleted and code groups can be accessed.

Fn Quit

To exit the screen.

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 person's name who is creating the codelist. Input optional.

6.4

6.4.1

Managing Codes

Accessing Codes

Description

Managing codes includes

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

Access step-by-step

Step	Description
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.

The listed codes belong to

the codelist selected from the internal memory when this screen was accessed through

New job \ Codelist

OR

to the job codelist when this screen was accessed through **Job properties \ Codelist**.

The * indicates codes which have attributes attached.

Codes	
Code	Code description
a*	a
bb*	bb
ccc*	ccc
d*	d
ee*	ee
fff*	fff
ggg*	ggg
h*	h
ii*	ii
3DCQ:6.835m 2DCQ:3.752m 1DCQ:5.713m abc 10:41	
OK New.. Edit.. Delete More	

OK

To close the screen and return to the screen from where this screen was accessed.

New..

To create a new code. Refer to "6.4.2 Creating/Editing a Code".

Edit..

To edit the highlighted code. Refer to "6.4.2 Creating/Editing a Code".

Delete

To delete the highlighted code.

More

To display information about the code description, the quick codes if available, the code groups and the code type.

Fn Group

To view, create, delete, activate and deactivate code groups. Refer to "6.5 Managing Code Groups".

Fn Sort

To sort codes by code name, code description, quick code or the last use.

6.4.2

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 application. In this case, the new code is added to the job codelist.

New Code or Edit Code

New Code

Code:

123

Description:

Code group:

1

Code type:

Point

Linework:

None

3DCQ:6.835m	2DCQ:3.752m	1DCQ:5.713m	abc	10:41
Store	+Attrib			

Store

To add the new code and any associated attributes to the codelist in the internal memory.

+Attrib

To add a new editable field for an attribute of attribute type normal and of value type text.

Name or Value

Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and the attribute value to be used as the default attribute value can be typed in.

Fn Quit

To exit the screen.

Field	Option	Description
Code	Editable field	A unique name for the new code. The name can be up to 16 characters long and include spaces. Input required.
Description	Editable field	A detailed description of the code. This description can be, for example, the full designation if Code is an abbreviation. Input optional.
Code group	Selectable list	The code group to which the code is to be assigned.
Code type	Selectable list	Defines the use of the code. It can be used as thematical code for points, lines or areas or as a free code. Makes a code unique. A code can have the same value with different types within the same codelist. For example a code OAK can be of type Point , Line , Area and/or Free .
Linework	Selectable list None	Only available for Code type: Point . To allow a new line or new area to be opened whenever the point code is newly selected. This functionality is also available when creating codelists with LGO Codelist Management. Select this option to disable the functionality. All other code settings on the instrument are not affected when this option is set.

Field	Option	Description
	Begin line	When a point code is newly selected, a new line is opened and the point being stored is added to the line. When the same point code remains selected, a new line is not opened. The point being stored is added to the current line.
	Begin area	The behaviour for opening a new area is the same as the behaviour for opening a new line.
Style	Selectable list	Available for Code type: Line and Code type: Area . The style in which lines/areas are represented in MapView and LGO.
Attribute	Editable field	Up to twenty attributes can be created.  Attributes of attribute type mandatory or fixed and of value type real or integer must be created in LGO .

6.5

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 this screen was accessed through **New job \ Codelist**

OR

to the job codelist when this screen was accessed through **Job properties \ Codelist**.

Codes from currently active code groups are shown.

Code Groups	
Code group	Activated
1	Yes

OK

To close the screen and return to the screen from where this screen was accessed.

New..

To create a new code group. In **New Code Group** type in a unique name for **Name**. **Store** stores the new code group typed in and returns to **Code Groups**.

3DCQ:6.835m 2DCQ:3.752m 1DCQ:5.713m abc 10:42					
OK	New..	Edit..	Delete	Use	None

Edit..

Available for codelists in the internal memory. To edit the highlighted code group. In **Edit Code Group** type in the changes for **Name**. **Store** stores the changes and returns to **Code Groups**.

Use

To activate and deactivate the highlighted code group. Codes belonging to a deactivated code group are not displayed in **Codes**.

None or **All**

To deactivate or activate all code groups.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Code group	The name of the code group.
Activated	Use code group or not. The codes belonging to a deactivated code group cannot be selected from the selectable list for code selection. Use changes between the options.

7

7.1

Coordinate Systems

Overview

Description

A coordinate system

- consists of up to five elements.
 - allows the conversion from WGS 1984 geodetic or cartesian coordinates to, local cartesian, geodetic or grid coordinates and back.
 - can be attached to jobs.
 - can be manually defined.
 - can be computed in the field.
 - can be directly received from a reference network. Refer to "14.7.1 Configuration of a Rover Real-Time Connection".
 - can be downloaded to LGO.
 - can be uploaded from LGO.
-

Using coordinate systems on TPS

Coordinate systems are used on TPS instruments to combine GPS data with TPS data.



[TPS] An attached coordinate system is not used to reduce any measured distance on a TPS instrument.



All GPS 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 screen, but does **not** convert and restore the coordinate values in the database DB-X.



[TPS] Points surveyed with a TPS instrument are always stored in local GRID coordinates regardless of the coordinate system being used.



GPS 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 screen, but does not convert and restore the coordinate values in the database DBX.

One coordinate system can be attached to a job at one time. This coordinate system remains attached to the job unless it is changed.

Default coordinate systems

The default coordinate system is **WGS 1984**. It cannot be deleted. It is not possible to create a coordinate system called **WGS 1984**.

Additional default coordinate systems may be available for certain countries.

Active coordinate system

The active coordinate system is the one attached to the working job. One coordinate system is always considered as the active coordinate system.

Automatic coordinate system

When **Use auto coordinate system** is checked in the **RTK Rover Wizard**, the coordinate system is directly received from the reference network. Refer to "14.7.1 Configuration of a Rover Real-Time Connection".

Coordinate systems when transferring jobs between GPS and TPS

When transferring a job from GPS to TPS, or vice versa, the coordinate system stays attached to the job. It then appears like any other coordinate system on the instrument.

Access

Step	Description
1.	Go to Job Properties :, Coord system page when creating a new job or editing an existing working or control job.
2.	Open the selectable list for Coord system .

Coordinate Systems

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

Coordinate Systems	
Name	Type
CH1903	Classic 3D
None (WGS84)	-----

OK

To select the highlighted coordinate system and to return to the previous screen. With a data storage device inserted, the selected coordinate system will be attached to the working job.

New..

To create a coordinate system manually. Refer to "7.3 Coordinate Systems - Creating and Editing".

Edit..

To edit the highlighted coordinate system. Refer to "7.3 Coordinate Systems - Creating and Editing".

Delete

To delete the highlighted coordinate system. Deletion is not possible if the highlighted coordinate system is active and its source is RTCM.

3DCQ:5.442m	2DCQ:3.220m	1DCQ:4.387m	abc	09:51
OK	New..	Edit..	Delete	More

More

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.

Fn Set-D

Available unless a default coordinate system is highlighted. To turn the highlighted coordinate system into a user defined default coordinate system stored in the instrument.

Fn Default

To recall the deleted default coordinate systems.

Fn Quit

To exit the screen.

7.3

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 "31 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

New Coordinate System

Name:

Transformation:

<None>

Ellipsoid:

Bessel

Projection:

<None>

Geoid model:

<None>

CSCS model:

<None>

3DCQ:5.331m 2DCQ:3.173m 1DCQ:4.285m abc 09:52

Store

Store

To store the coordinate system.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	A unique name for the new coordinate system. The name can be up to 16 characters long and include spaces.
Residuals	1/distance, 1/distance², 1/distance^{3/2}	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. Distribute the residuals of the control points according to the distance between each control point and the newly transformed point.

Field	Option	Description
	Multiquadratic	Distributes the residuals using a multiquadratic interpolation approach.
Transformation	Selectable list	The type of transformation.
Pre Transform	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.
Ellipsoid	Selectable list	Available unless projection Type: Customised . The local coordinates are based on this ellipsoid.
Projection	Selectable list	The map projection.
Geoid model	Selectable list	The geoid model.
CSCS model	Selectable list	The Country Specific Coordinate System model.

7.4

7.4.1



Access step-by-step

Transformations

Transformations

Accessing Transformation Management

Transformations cannot be accessed for coordinate systems with source RTCM. Refer to "Automatic coordinate system".

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

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

Transformations	
Name	Height mode
<None>	-----
granit90-ortho	Orthometric

3DCQ:5.338m	2DCQ:3.181m	1DCQ:4.286m	abc	09:53
OK	New..	Edit..	Delete	More

OK

To select the highlighted transformation and to return to the previous screen.

New..

To create a new transformation. Refer to "7.4.2 Creating/Editing a Transformation".

Edit..

To edit the highlighted transformation. Refer to "7.4.2 Creating/Editing a Transformation".

Delete

To delete the highlighted transformation.

More

To display information about the type of heights computed and the number of control points used for the determination of the transformation.

Fn Set-D

To turn the highlighted transformation into a user-defined default transformation stored in the instrument.

Fn Quit

To exit the screen.

7.4.2



Access

New Transformation or Edit Transformation, General page

Creating/Editing a Transformation

Classic 3D transformations can be created.

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

Store

To store the transformation.

Clear

To set the editable fields to 0. Available on the **Parameters** and the **Advanced** page.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

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

**New Transformation or
Edit Transformation,
Parameters page**

Next step

Page changes to the **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
Height mode	Selectable list	The type of heights to be computed.
Model	Selectable list	The transformation model to be used. For Model: Molodensky-Badakov , additional editable fields are available.

Next step

Store stores the transformation.

7.5

7.5.1



Access step-by-step

Ellipsoids

Accessing Ellipsoid Management

Ellipsoids cannot be accessed for coordinate systems with source RTCM. Refer to "Automatic coordinate system".

Step	Description
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.

Ellipsoids	↩
Name	
Bessel	
None (WGS84)	

OK

To select the highlighted ellipsoid and to return to the previous screen.

New..

To create a new ellipsoid. Refer to "7.5.2 Creating/Editing an Ellipsoid".

Edit..

To edit the highlighted ellipsoid. Refer to "7.5.2 Creating/Editing an Ellipsoid".

Delete

To delete the highlighted ellipsoid.

3DCQ:6.435m	2DCQ:3.493m	1DCQ:5.404m	abc	09:53
OK	New..	Edit..	Delete	

Fn Set-D

To turn the highlighted ellipsoid into a user-defined default ellipsoid stored in the instrument.

Fn Default

To recall the deleted default ellipsoids.

Fn Quit

To exit the screen.

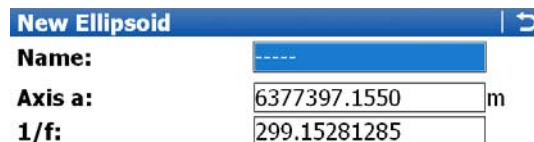
7.5.2

Creating/Editing an Ellipsoid

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

To store the ellipsoid.

Fn Quit

To exit the screen.



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.

7.6

7.6.1



Access step-by-step

Projections

Projections

Accessing Projection Management

Projections cannot be accessed for coordinate systems with source RTCM. Refer to "Automatic coordinate system".

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

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

Projections				
Name	Type			
<None>	-----			
Czech and Slovak	Customised			
DK Bornholm	Customised			
DK Jylland	Customised			
DK S34 Bornholm	Customised			
DK S34 Jylland	Customised			
DK S34 Sjælland	Customised			
DK Sjælland	Customised			
Dutch	Customised			
3DCQ:5.461m	2DCQ:3.248m	1DCQ:4.390m	abc	09:54
OK	New..	Edit..	Delete	

OK

To select the highlighted projection and to return to the previous screen.

New..

To create a new projection. Refer to "7.6.2 Creating/Editing a Projection".

Edit..

To edit the highlighted projection. Refer to "7.6.2 Creating/Editing a Projection".

Delete

To delete the highlighted projection.

Fn Set-D

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.

Fn Quit

To exit the screen.

Description of columns

Column	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.
	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.

Column	Option	Description
	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.
	Cassini	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.
	Polar stereo	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.
	Double stereo	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.
	RSO	Rectified Skewed Orthomorphic. This is a special type of Oblique Mercator projection.

7.6.2

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

New Projection

Name: -----

Type: Transverse Mercator ▾

False easting: 0.0000 m

False northing: 0.0000 m

Latitude of origin: 0°00'00.00000" N

Central meridian: 0°00'00.00000" E

CM scale: 1.000000000000

3DCQ:5.467m 2DCQ:3.253m 1DCQ:4.393m abc 09:54

Store

Store

To store the projection.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	A unique name for the new projection. A name is mandatory, can be up to 16 characters long and include spaces.

Field	Option	Description
Type	Selectable list	The projection type. The setting for determines the availability of the subsequent fields for the parameters of the projection. Refer to "7.6.1 Accessing Projection Management" for a description of the projection types.

7.7

7.7.1

Geoid Models

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 three 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. It is recommended for large geoid field files. This method is explained in this chapter.
 2. The geoid field file is stored in the internal memory of the instrument. It is recommended for large geoid field files. This method is also explained in this chapter.
 3. The geoid field file is transferred to the internal memory and can be used at any time. Refer to "24.1 Transfer user objects" for information on how to transfer geoid field files to the internal memory on the instrument.
-

7.7.2

Accessing Geoid Model Management

Access step-by-step

Step	Description
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.

Geoid Models		↩
File	Source	
<None>	-----	

OK

To select the highlighted geoid model and to return to the previous screen.

CF card

To create a new geoid model. The \DATA\GPS\GEOID directory on the data storage device is automatically scanned for geoid field files. Refer to "7.7.3 Creating a New Geoid Model from the Data Storage Device / Internal Memory".

3DCQ:5.484m	2DCQ:3.266m	1DCQ:4.405m	abc	09:55
OK		Edit..	Delete	Intrnl

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.

Fn Quit

To exit the screen.

7.7.3

Creating 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.

Create geoid model step-by-step

Step	Description
1.	Listed in Geoid Models are all geoid models stored in the internal memory. OR Press CF card 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 LGO.  Existing geoid models are automatically overwritten by new models with the same name.
3.	The creation of a geoid model is finished.

7.8

CSCS Models

Use in the field



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

The creation of CSCS models on the instrument and the functionality of all screens and fields are similar to those for geoid models. Refer to " Requirement".

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

8

8.1

Jobs & Data - Import data

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.

Import formats

Format	Characteristic	Description
ASCII	Import variables	Point ID, grid coordinates, thematical 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
	Specialities	
	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

Format	Characteristic	Description
GSI8 GSI16	Import variables	Point ID (WI 11), local coordinates (WI 81, WI 82, WI 83), thematic codes (WI 71). No free codes, no attributes. Example for GSI8: 110014+00001448 81..01+00001363 82..01-00007748 83..01-00000000 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
	Specialities	
	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.
DXF	No coordinates or heights in file	No import
	No point IDs in file	No import
	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.

Format	Characteristic	Description
	Specialities No coordinates or heights in file	No import

Checks

Points are always imported with the class **Ctrl** and a coordinate quality of -----. Refer to "Appendix H Glossary".

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

8.2

Importing Data in ASCII/GSI Format

Requirements

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



Access

Select **Main Menu: Jobs & Data\Import data\Import ASCII data.**

Import ASCII Data

OK

To import the data.

Config..

To define the format of the data to be imported.

Edit..

To view the file from which data will be imported.

Fn Hts..

To define how heights and the Easting are imported.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
From	Selectable list	Defines from which storage device the data are imported.

Field	Option	Description
Data type to import	Selectable list	Defines if ASCII or GSI data are imported.
From file	Selectable list	For Data type to import: ASCII data : All files in the \DATA directory on the data storage device can be selected. For Data type to import: GSI data : All files with extension *.gsi in the \GSI directory on the data storage device can be selected.
To job	Selectable list	Choosing a job as destination for import makes this job the working job.
Header lines	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.

Next step

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

Configuration

Configuration

Delimiter:

Comma

Point ID position:

1

Easting position:

2

Northing position:

3

Height position:

4

Code position:

None

Example:

P,E,N,H,,,,,,

3DCQ:0.020m

2DCQ:0.012m

1DCQ:0.017m

abc

14:20

OK

Default

OK

To return to the previous screen.

Default

To recall the default import settings.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Delimiter	Selectable list	The separator between the import variables.
Point ID position, Easting position, Northing position, Height position and Code position	Selectable list	Select the positions of the particular variables. An example is shown at the bottom of the screen.
Multi Spaces	Yes	Available for Delimiter: Space . For space delimited data having one space between the variables.

Field	Option	Description
	No	For space delimited data having multiple spaces between the variables.
Number of lines/pt	Selectable list	Available for Delimiter: Line feed . The number of lines used to describe each point.

Next step

Step	Description
1.	OK leads back to Import ASCII Data .
2.	Fn Hts.. to access Define Ht Type & Easting Import .

Configuration (GSI)

Description of fields

Field	Option	Description
Switch WI81/WI82	Yes or No	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.
Definition of feet	Selectable list	The type of feet used in the GSI file.

Next step

Step	Description
1.	OK leads back to Import ASCII Data .
2.	Fn Hts.. to access Define Ht Type & Easting Import .

Define Ht Type & Easting Import

Description of fields

Field	Option	Description
Delimiter	Selectable list	The height type for the imported data.
Multi Spaces	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 Data**.

8.3

Importing Data in DXF Format

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.



Access

Select **Main Menu: Jobs & Data\Import data\Import DXF Data.**

Import DXF Data

Import DXF Data

From: Internal memory

From dxf file:

To job: Default

OK **Config..**

3DCQ:0.020m 2DCQ:0.011m 1DCQ:0.016m abc 14:20

OK

To import the data.

Config..

To define the format of the data to be imported.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
From	Selectable list	Defines from which storage device the data are imported.
From file	Selectable list	All files with extension *.dxf in the \DATA directory on the data storage device can be selected.

Field	Option	Description
To job	Selectable list	Choosing a job as destination for import makes this job the working job.

Next step

Config.. accesses **Configuration**.

Configuration

Description of fields

Field	Option	Description
Block prefix	Editable field	Optional prefix to imported blocks.
Point prefix	Editable field	Optional prefix to imported points.
Line prefix	Editable field	Optional prefix to imported lines.
File units	Selectable list	Choosing the unit for the DXF data to be imported.
Create points at the vertices of lines	Selectable list	Option if points will be created at vertices of the imported line/arc/polyline elements.
Convert white elements	Selectable list	Option if white coloured elements will be converted to black coloured elements.
Height to exclude	Selectable list	Height values inside the DXF file are considered invalid and will not be converted.

Next step

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

9

Jobs & Data - Export & copy data

9.1

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
ASCII	Export variables	Refer to the online help of LGO.
	Format definition	Composed individually as format file using LGO. Refer to the online help of LGO 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.
DXF	Specialities:	
	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.
DXF	Coordinate conversion	All points are converted to local grid position using the coordinate system.

Format	Characteristic	Description
	Height Specialities: Points in file outside of CSCS model Points in file outside of geoid model	Orthometric height and ellipsoidal height are supported. Points outside of CSCS model are not exported. The ellipsoidal height is exported.
LandXML	Coordinate conversion Height Specialities: Points in file outside of CSCS model Points in file outside of geoid model	All points are converted to local grid position using the coordinate system. Orthometric height and ellipsoidal height are supported. LocalGrid position of the points outside of CSCS model is not exported. The ellipsoidal height is exported.
FBK/RAW5/ RAW	Coordinate conversion Height Units	All points are converted to local grid position using the coordinate system. If a geoid model exists, then orthometric height is supported, otherwise ellipsoidal height is exported. Metre, US Ft or Int Feet, Gons, Dec Deg, DMS

9.2

Exporting Data from a Job to a Custom ASCII Format

Description

The settings on this screen 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.

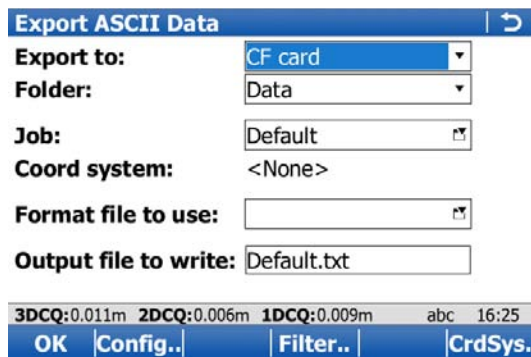
Requirements

At least one format file was created using LGO and transferred to the internal memory.

Access

Select **Main Menu: Jobs & Data\Export & copy data\Export ASCII data.**

Export ASCII Data



OK

To select the highlighted format file.

Config..

To configure the default extension to be used.

Filter..

To define the order in which points, lines and areas are exported as well as which points are exported.

CrdSys.

To update the coordinate system in which the coordinates are exported.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Export to	Selectable list	Defines where the exported data are saved to.  For Export to: Internal memory the data is always exported to the \DATA directory.
Folder	Selectable list	Available for Export to: CF card , Export to: SD card and Export to: USB . The data can be exported to the \DATA, the \GSI or the root directory. Data must be stored to the \GSI directory to be read in a TPS instrument.
Job	Selectable list	To select the job to export.
Coord system	Display only	The coordinate system currently attached to the selected job.
Format file to use	Selectable list	The format files currently available in the internal memory.
Report sheet	Editable field	The name of the file to which the data will be exported.

9.3

Exporting Data in DXF Format

General

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



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

Access

Select **Main Menu: Jobs & Data\Export & copy data\Export DXF Data.**

Export DXF data

OK

To export the data.

Config..

To define what is exported.

Fn Quit

To exit the screen.

Description of fields

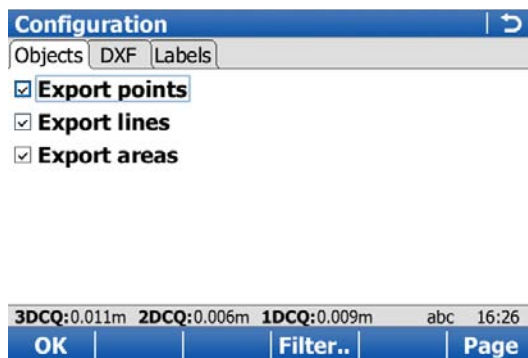
Field	Option	Description
Export to	Selectable list	Defines where the exported data are saved to.
Folder	Selectable list	 The data is always exported to the \DATA directory.

Field	Option	Description
Job	Selectable list	To select the job to export.
Coord system	Display only	The coordinate system currently attached to the selected job.
Report sheet	Editable field	The name of the file to which the data will be exported.

Next step

Config.. goes to **Configuration, Objects** page.

Configuration, Objects page



OK

To export the data.

Filter..

To define the order in which points, lines and areas are exported as well as which points are exported. Refer to "5.6.1 Sorting and Filters for Points, Lines and Areas".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Points	Check box	When this box is checked, points are exported.

**Configuration,
DXF page**

Field	Option	Description
Lines	Check box	When this box is checked, lines are exported.
Areas	Check box	When this box is checked, areas are exported.

Next step

Page changes to the **DXF** page.

Description of fields

Field	Option	Description
Export lines & areas	Selectable list	Defines if lines and areas are exported as Line or Polyline entities.
Export LGO symbols	Editable field	Defines if a block is created for each point with the same icons used in LGO.
Symbol size	Selectable list	Defines the size used for creation of the LGO symbols.
Dimensions	Selectable list	Defines the dimension of the DXF file.
Export to DXF layer	Selectable list	Defines the DXF layer.
Export LGO symbols	Check box	When this box is checked, the relevant symbols for LGO are also exported.

Next step

Page changes to the **Labels** page.

Configuration, Labels page

Label	Export	Layer name
point ID	No	Point ID
coordinates	No	Coordinates
height	No	Height
point code	No	Point Code

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m abc 16:28

OK Edit.. More Page

OK

To accept the settings.

Edit..

To define the colour for each label and also the DXF layer name for user-defined labels.

Page

To change to another page on this screen.

Fn About

To display information about the program name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Label	The name of the label.
Export	Shows if the label is exported or not.
Layer name	The name of the layer that is exported. The information that is exported can be the point ID, the coordinates, the height or the point code.
Colour	The colour of the label.
Decimals	The number of decimals used.

Next step

Edit.. access **Labels**.

The settings on this page define which labels with information (Point ID, Coords, Height and Pt Code) for each point are exported. Each label can be exported as separate layer or in the same layer as the point is exported. Additionally the decimals can be defined for the Coords and Height label.

Labels

Description of fields

Field	Option	Description
First field on screen	Check box	When this box is checked, labels for the point IDs, coordinates, heights or point codes are exported.
Colour	Selectable list	Available when the check box in the first row is checked. Defines the colour for the label.
Layer	Selectable list	When this box is checked, the label is exported as separate layer.
Layer name	Selectable list	Available when Layer is checked. The name of the separate layer.

Next step

OK returns to **Configuration**.

9.4

Exporting Data in LandXML Format

General

Data can be exported to a LandXML file in the \DATA directory of the data storage device or the internal memory.



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

Access

Select **Main Menu: Jobs & Data\Export & copy data\Export LandXML Data.**

Export LandXML Data

Export LandXML Data | ➡

Export to:

Internal memory ▼

Job:

Default 📄

Coord system:

<None>

File name:

Default.xml

- OK
To export the data.
- Config..
To define what is exported.
- Fn Quit
To exit the screen.

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m abc 16:28

OK | Config.. | | |

Description of fields

Field	Option	Description
Export to	Selectable list	Defines where the exported data are saved to.  The data is always exported to the \DATA directory.

Field	Option	Description
Job	Selectable list	To select the job to export.
Coord system	Display only	The coordinate system currently attached to the selected job.
Report sheet	Editable field	The name of the file to which the data will be exported.

Next step

Config.. accesses **Configuration, Export** page.

Configuration, Export page

OK

To return to the previous screen.

Filter..

To set the sort and filter settings for export. Refer to "5.6.1 Sorting and Filters for Points, Lines and Areas".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Points	Check box	When this box is checked, points are exported.

Field	Option	Description
Lines	Check box	When this box is checked, lines are exported.
Areas	Check box	When this box is checked, areas are exported.
TPS measurements	Check box	When this box is checked, TPS observations are exported.
GPS measurements	Check box	When this box is checked, GPS observations are exported.
Codes	Check box	When this box is checked, point codes, line codes and area codes are exported.
Free codes	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.

Next step

Page changes to the **LandXML** page.

Configuration, LandXML page

Description of fields

Field	Option	Description
Dimensions	Selectable list	Defines the dimension of the exported entities.
LandXML version	Selectable list	Defines the LandXML version of the file exported file.

General

Data can be exported to an AutoDesk FBK, TDS RAW, TDS RW5, Carlson RW5 or MicroSurvey RW5 file. The newly created file is stored in the \DATA directory of the data storage device or the internal memory.

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

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

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

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/Area ID

IF you are creating	THEN
Autodesk FBK file	The figure ID follows the user selection as defined in the configuration menu.

IF you are creating	THEN
TDS RW5 file	The line and area IDs are not used when importing data into TDS Foresight.
MicroSurvey RW5 file	The line and area IDs are not used when importing data into MicroSurvey CAD 2005.



Access

Export FBK/RW5/RAW data

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

Select **Main Menu: Jobs & Data\Export & copy data\Export FBK/RW5/RAW data.**

Export FBK/RW5/RAW data | ➔

Export to: CF card ▼

Folder: Data

Job: Default ▢

Coord system: <None>

Data format: Autodesk FBK ▼

File name: Default

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m abc 16:37

OK | Config.. | | | |

OK

To export the data.

Config..

To configure some format-specific options.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Export to	Selectable list	Defines where the exported data are saved to.
Folder	Display only	The data is always exported to the \DATA directory.
Job	Selectable list	To select the job to export.
Coord system	Display only	The coordinate system currently attached to the selected job.
Data format	Autodesk FBK, TDS RW5, TDS RAW, Carlson RW5 or Micro-Survey RW5	Ensure that this field is set properly.
File name	Editable field	Default is the name of the selected Job . It can be changed.  The extension designation (.FBK, .RW5 or .RAW) is added automatically.

Next step

Config.. to access the configuration screen.

Configuration, General page

Description of fields

Field	Option	Description
Use numerical pt ID	Check box	Available unless Data format: TDS RW5 .
Pt ID offset	Editable field	The point IDs are offset by this value.

Field	Option	Description
Use angle right	Check box	Define if angle right values are exported.
Figure ID	Selectable list	Available for Data format: Autodesk FBK . For all other formats, the figure ID is set to point code only automatically.

Next step

Page changes to the **Objects** page.

Configuration, Objects page



OK

To return to **Export FBK/RW5/RAW data**.

All

To check all boxes at once.

Page

To change to another page on this screen.

Fn About

To display information about the application name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the application.

Description of fields

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

Next step

OK returns to **Export FBK/RW5/RAW data**.

9.6

Copy Data Between Jobs

Description



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 **Instrument Flag** is retained.
 - the **Date** and **Time** is retained.
-

Access

Select **Main Menu: Jobs & Data\Export & copy data\Copied data between jobs.**

Copy Data Between Jobs

Copy Data Between Jobs | ➔

From job: Default

Coord system: <None>

To job: Default

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m abc 16:30

OK | Filter.. | Data.. | CrdSys.

OK

To copy a selection of points.

Filter..

To define the point sort and/or point filter settings of points from the job. Refer to "5.6.1 Sorting and Filters for Points, Lines and Areas".

Data..

To view, edit and delete points, lines and areas stored with the job. Points, lines and areas are shown on separate pages. Selected sort and filter settings apply. Refer to "5 Jobs & Data - Data".

CrdSys.

To select a different coordinate system.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
From job	Selectable list	Describes where the points are to be copied from.
Coord system	Display only	The coordinate system which is currently attached to the job.
To job	Selectable list	Describes where the points are to be copied to.

10

10.1

10.1.1

Instrument - TPS settings TPS

Measure mode & target

Measure & Target Settings

Description

The settings on this screen define the active EDM **E**lectronic **D**istance **M**easurement and ATR **A**utomatic **T**arget **R**ecognition settings.



Available options depend on the purchased model, for example with or without ATR.

Access

Select **Main Menu: Instrument\TPS settings\Measure mode & target.**

Measure & Target Settings

Description

- This screen has two pages - the **Survey** page and the **Setup** page.
- The **Survey** page and **Setup** page contain identical fields.
- The settings made in the **Survey** page are used by all applications and all measurements taken outside of the **Setup** application.
- The settings made in the **Setup** page are only used inside the Setup application.
- Any changes made to the **Measure & Target Settings**, for example via icons or hotkeys, while the Setup application is active, only affect the Setup **Measure & Target Settings**.
- Any changes made to the **Measure & Target Settings**, for example via icons or hotkeys, while the Setup application is not active, only affect the Survey **Measure & Target Settings**.
- When entering the Setup application, the Setup **Measure & Target Settings** are active.
- When leaving the Setup application, the Survey **Measure & Target Settings** are active.
- Both Survey and Setup **Measure & Target Settings** are part of the working styles.

Diagram

OK

To accept changes and return to **Main Menu**.

Page

To change to another page on this screen.

Fn Test

To access the **EDM Test Signal/Frequency** screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Measure	Prism	All fields are set to the last used options. The infrared EDM exists for all instrument types and allows to measure the distance to a prism or a tape. For Target aiming: Automatic or Target aiming: Lock this option is automatically set.
	Any surface	To measure without reflector.
Measure mode	Standard	Available for Measure: Prism . Standard single distance measurement.
	Single (fast)	Available only for Measure: Prism . Fast single distance measurement.

Field	Option	Description
	Continuous	Continuous distance measurement.
	Long range (>4km)	Available only for Measure: Any surface . Distance measurement over long distances.
	Single	Available for Measure: Prism . Standard single distance measurement.
Target	Selectable list	Target names as configured in the Targets screen.
Leica constant	Display only	The additive constant as stored for the selected prism in the SmartWorx Viva software.
Absolute constant	Display only	The true additive constant.
Target aiming	Manual	Measurements are done without any automation. ATR search and/or ATR measurement are not performed.
	Automatic	Positioning to static prisms. The ATR sensor is used for measurements to static prisms. If needed an ATR measurement or ATR search is performed after pressing Meas or Dist .
	Lock	Unavailable for SmartStation. The instrument locks onto and follows the moving prism. The ATR sensor is used to follow moving prisms and to find prisms after loss of lock. Depending on Measure single or continuous measurements are performed pressing Meas or Dist .
Visibility	Good	If weather conditions are normal, then select this mode.

Field	Option	Description
	Rain & fog	To increase the instrument measuring ability during suboptimal weather conditions. This mode has a considerable influence on the range (restriction to 100-150 m). This mode is automatically deactivated when the instrument is turned off.
	Rain & fog always	As for Rain & fog , however this mode stays active when the instrument is turned off.
	Sun & reflections	To increase the instrument measuring ability during incident solar radiation and reflections. This mode is automatically deactivated when the instrument is turned off.
	Sun & reflections always	As for Sun & reflections , however this mode stays active when the instrument is turned off.

10.1.2

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 prisms are always available on the instrument:

Product Name	Name in list	Type	Leica constant	Absolute constant
GRZ4, GRZ122	Leica 360° Prism	Prism	+23.1 mm	-11.3 mm
GMP111-0	Leica Mini 0	Prism	0.0 mm	-34.4 mm
GRZ101	Leica Mini 360°	Prism	+30.0 mm	-4.4 mm
GMP101, GMP111	Leica Mini Prism	Prism	+17.5 mm	-16.9 mm
GZM29, GZM30, GZM31, CPR105	Leica Reflective Tape	Tape	+34.4 mm	0.0 mm
GPR1, GPR111, GPR113, GPR121, GPH1P	Leica Round Prism	Prism	0.0 mm	-34.4 mm
-	Reflectorless	RL	+34.4 mm	0.0 mm
MPR122  For Machine Control purposes only!	Leica HDS Target	Prism	+34.4 mm	0.0 mm

Access

Open the selectable list for **Target** in **Measure & Target Settings**.

Targets

Targets			↩
Name	Leica constant	Abs constant	
Leica 360° Prism	23.1mm	-11.3mm	
Leica HDS Target	34.4mm	0.0mm	
Leica Mini 0	0.0mm	-34.4mm	
Leica Mini 360°	30.0mm	-4.4mm	
Leica Mini Prism	17.5mm	-16.9mm	
Leica Reflective Tape	34.4mm	0.0mm	
Leica Round Prism	0.0mm	-34.4mm	
Reflectorless	34.4mm	0.0mm	
Hz: -:--g V: -:--g abc 10:10			
OK	New..	Edit..	Delete More

OK

To select the highlighted target and to return to the previous screen.

New..

To define a new target. Refer to "10.1.3 Creating/Editing a Target".

Edit..

To edit the highlighted target. It is not possible to edit default targets. Refer to "10.1.3 Creating/Editing a Target".

Delete

To delete the highlighted target. It is not possible to delete default targets.

More

To display information about the additive constant, the target type and the creator of the target.

Fn Default

To recall previously deleted default targets and to reset default targets to the default settings. User-defined targets are not affected.

Fn Quit

To exit the screen.

10.1.3

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:	123	
Type:	Prism	
Leica constant:	0.0	mm
Absolute constant:	-34.4	mm
Creator:	-----	

Store

To store the target.

Fn Quit

To exit the screen.

Hz: -----g	V: -----g	abc	10:11
Store			

Description of fields

Field	Option	Description
Name	Editable field	A significant name for the new target.
Type	Prism, Tape or Undefined	The type of target to be defined.
Leica constant	Editable field	The additive constant as stored for the selected prism in the SmartWorx Viva software.

Field	Option	Description
		 An additive constant of 0.0 mm has been defined for the Leica Geosystems standard targets GPR1, GPR111, etc. All entered or selected additive constant values are differences to this 0.0 mm based Leica Geosystems TPS prism system.
Absolute constant	Editable field	The true additive constant. The additive constant is always in mm.  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 TPS prism system. This Leica constant must be entered into the Leica instrument. Formula: True zero constant - 34.4 mm = Leica constant. It is highly recommended to check the additive constant for non-Leica Geosystems prisms on a baseline with an appropriate procedure.
Creator	Editable field	A name of the creator or other comments can be entered.

10.2

Prism search settings

Description

The settings on this screen 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 ATR in the **Fine search window**.
- the behaviour of automatic prism search after the target is lost in lock mode.

Access

Select **Main Menu: Instrument\TPS settings\Prism search settings**.

Prism Search Settings, Target prediction page

Prism Search Settings | ↶

Target prediction | PowerSearch window | Fine search | ◀ ▶

Time limit for predicting target location:

3 s ▼

If no target found after prediction then:

Stop searching ▼

OK

To accept changes and return to **Main Menu**.

Default

To recall the default settings.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Time limit for predicting target location	From 1 s to 5 s	If the target is lost when Target aiming: Lock the path of the prism is predicted for the selected number of seconds.

Field	Option	Description
If no target found after prediction then	Stop searching	Perform no search after prediction.
	Start fine search	Perform search after prediction with ATR in a dynamic Fine search window .
	Start Power-Search	Perform search after prediction with PowerSearch. Activate PowerSearch on the PowerSearch window page.
	Turn to last msd pt	If the target is lost when Target aiming: Lock , 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.

Prism Search Settings, PowerSearch window page

OK

To accept changes and return to **Main Menu**.

New..

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 screen.

Fn Quit

To exit the screen.

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.

Prism Search Settings, Fine search window page

Next step

Page changes to the **Fine search window** page.



**Enter the size of automatic fine target
search window**

Width of Hz search: 4 g

Height of V search: 4 g



OK

To accept changes and return to **Main Menu**.

Default

To recall the default settings.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Width of Hz search	Editable field	Horizontal extent of window.
Height of V search	Editable field	Vertical extent of window.

Next step

Page changes to another page on this screen.

10.3

Atmospheric corrections

Description

The settings on this screen 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 TPS1200+ User Manual for information on calculations.

Access

Select **Main Menu: Instrument\TPS settings\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 | ↩

Atmospheric ppm | Refraction

Temperature: 12.0 °C

Pressure: 1013.3 mbar

Humidity: 60.000 %

Atmospheric ppm: 0.0

Hz: -.-.-g V: -.-.-g abc 10:13

OK | | | | Page

OK

To accept changes and return to **Main Menu**.

Page

To change to another page on this screen.

Fn P<>E

To change **Pressure** to **Elev above MSL** and back.

Fn %<>T'

To change **Humidity** to **Temp wet-bulb** and back.

Fn ppm=0

To set **Atmospheric ppm: 0.0**.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Temperature	Editable field	Sets the temperature.
Pressure or Elev above MSL	Editable field	Sets the atmospheric pressure or the elevation above mean sea level dependent on selection.
Humidity or Temp wet-bulb	Editable field	Sets the relative air humidity or the wet bulb temperature dependent on selection.
Atmospheric ppm	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.

Atmospheric Corrections | ↩

Atmospheric ppm | Refraction

☒ **Use refraction coefficient correction**

Coefficient (k): 0.13

OK

To accept changes and return to **Main Menu**.

Default

To recall the default settings.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Hz: -.-.-g V: -.-.-g abc 10:13

OK | | Default | Page

Description of fields

Field	Option	Description
Use refraction coefficient correction	Check box	If checked, refraction correction is applied to measurements.
Coefficient (k)	Editable field	Refraction coefficient to be used for calculation.

Next step

Page changes to another page.

10.4

Level bubble & compensator

Description

If raw data is to be displayed and recorded, the compensator and the horizontal correction can be deactivated.

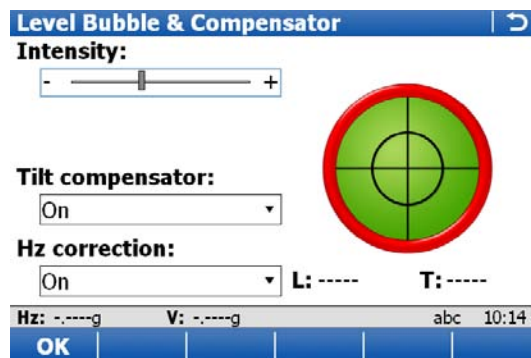
Access

Select **Main Menu: Instrument\TPS settings\Level bubble & compensator**.

OR

Tap  / .

Level Bubble & Compensator



OK

To accept changes and return to **Main Menu**.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Intensity	Scroll bar	To adjust the intensity of the laser plummet.

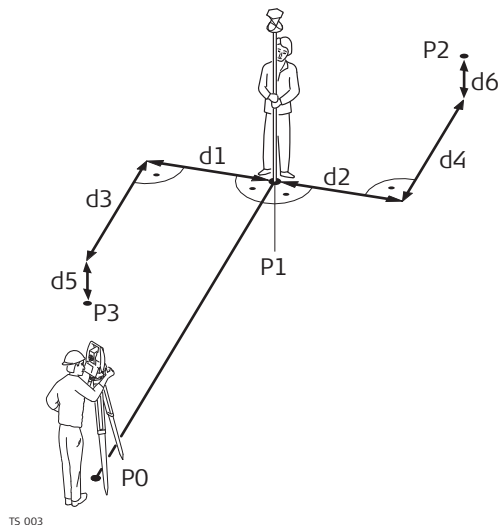
Field	Option	Description
Tilt compensator	On	Vertical angles are relative to plumb line. The horizontal angle is corrected for the transversal tilt errors.
	Off	The correction is turned off temporarily.
	Always off	The mode stays always deactivated.
Hz correction	On	The horizontal angles are corrected for the line of sight and tilting axis.
	Off	The correction is turned off temporarily.
	Always off	The mode stays always deactivated.

Description**Quality control**

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.

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 of the displayed and recorded measurement data is in relation to the offset point.

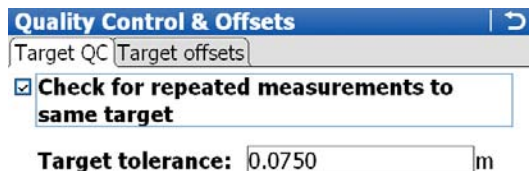


- P0 Station
- P1 Current position
- P2 Offset point
- P3 Offset point
- d1 Offset cross left
- d2 Offset cross right
- d3 Offset length towards instrument
- d4 Offset length away from instrument
- d5 Offset height down
- d6 Offset height up

Access

Select **Main Menu: Instrument\TPS settings\Quality control & offsets.**

Quality Control & Offsets, Target QC page



OK

To accept changes and return to **Main Menu**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.



Description of fields

Field	Option	Description
Check for repeated measurements to same target	Check box	If checked, target checking is activated.
Target tolerance	Editable field	The position tolerance. The units are defined by User\System settings\Regional settings .

Next step

Page changes to the **Target offsets** page.



If configured in a survey screen page, the offset values appear also in the survey screen page in Survey.

Quality Control & Offsets, Target offsets page

Quality Control & Offsets | →

Target QC | Target offsets

Offset mode: Reset after storing ▾

Offset left/right: 0.0000 m

Offset in/out: 0.0000 m

Offset height: 0.0000 m

Hz: -.-.-g V: -.-.-g abc 10:14

OK | | | Offst=0 | Page

OK

To accept changes and return to **Main Menu**.

Offst=0

To set all offsets to 0.000.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

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 Store or Meas .
	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.

10.6

Lights

Description

The settings on this screen allow the lights on the instrument to be configured.

Access

Select **Main Menu: Instrument\TPS settings\Lights**.

Instrument Lights

Instrument Lights | ↶

☐ Use the red laser pointer

☒ Use the instrument guide lights (EGL)
Intensity: - ———— +

☒ Use the reticule light
Intensity: - ———— +

Hz: -.-.-g V: -.-.-g abc 10:15

OK

OK

To accept changes and return to **Main Menu**.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Use the red laser pointer	Check box	If checked, the red laser of the reflectorless EDM is turned on.
Use the instrument guide lights (EGL)	Checkbox	If checked, the Emitting Guide Light (EGL) is turned on. This field is only available if EGL is fitted.

Field	Option	Description
Intensity	From 0 % to 100 %	To adjust the EGL/Laser Guide intensity using the left and right arrow keys.
Use the reticule light	Check box	If checked, the reticule illumination is turned on.
Intensity	From 0 % to 100 %	To adjust the reticule illumination intensity using the left and right arrow keys.

11

11.1

11.1.1

Instrument - GPS settings GPS

RTK rover wizard

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 **Main Menu: Instrument\GPS settings\RTK rover wizard**.



If RTK profiles exist, the wizard starts with the screen shown in this section. Otherwise, the wizard starts the process of creating a new RTK profile. In this case refer to "11.1.2 Creating a New RTK Profile".

RTK rover wizard

RTK Rover Wizard |

The RTK profile wizard allows you to define how RTK corrections are received

☒ **Create a new Profile**

☐ **Load an existing profile**

☐ **Edit an existing profile**

3DCQ:5.328m 2DCQ:3.201m 1DCQ:4.258m abc 09:59

Next | | | | |

Next

To accept changes and to continue with the subsequent screen within the wizard.

Fn Quit

To exit the wizard.

Next step

IF you want to	THEN
create a new set of settings	select Create a new profile , press Next and continue with "11.1.2 Creating a New RTK Profile".
select a different set of settings	select Load an existing profile , press Next and continue with "11.1.3 Loading an Existing RTK Profile".
edit an existing set of settings	select Edit an existing profile , press Next and continue with "11.1.4 Editing an Existing RTK Profile".

11.1.2

RTK rover wizard,
Enter the RTK profile
details

Creating a New RTK Profile

Type in the name and a description for the new set of settings.

The screenshot shows the 'RTK Rover Wizard' interface. At the top, there's a blue header bar with the title 'RTK Rover Wizard' and a refresh icon. Below it, a light blue bar says 'New RTK Profile'. The main area has two labels: 'Name of profile (eg My Radio):' and 'Description:'. The 'Name' label is followed by a text input field containing '123'. The 'Description' label is followed by a text input field containing '-----'.

Next

To accept changes and to continue with the subsequent screen within the wizard.

Back

To return to the previous screen.

Fn Quit

To exit the wizard.

The screenshot shows the bottom status bar of the application. It contains several pieces of information: '3DCQ:5.401m', '2DCQ:3.238m', '1DCQ:4.322m', 'abc', and '09:58'. Below this, there is a blue bar with the word 'Next' in white, followed by four vertical dividers.

11.1.3

RTK rover wizard, Choose an RTK Profile

Loading an Existing RTK Profile

Select an existing RTK profile from the selectable list.



The screenshot shows the 'RTK Rover Wizard' interface. At the top, there's a blue header bar with the title 'RTK Rover Wizard' and a back arrow icon. Below the header, the text 'Choose a RTK Profile' is displayed. Underneath, there's a label 'RTK Profile:' followed by a dropdown menu showing '123'. Below that, the label 'Connection Type:' is followed by the text 'Radio'.

RTK Profile: 123

Connection Type: Radio

Next

To accept changes and to continue with the subsequent screen within the wizard.

Delete

Pressing this key deletes the RTK profile currently shown in the selectable list.

Back

To return to the previous screen.

Fn Quit

To exit the wizard.



The screenshot shows the bottom status bar of the application. It contains several status indicators: '3DCQ:7.391m', '2DCQ:3.946m', '1DCQ:6.249m', 'abc', and '09:59'. Below these indicators is a blue bar with four buttons: 'Finish', 'Delete', and 'Back'.

11.1.4

RTK rover wizard, Choose an RTK Profile

Editing an Existing RTK Profile

Select the RTK profile to be edited from the selectable list.

RTK Rover Wizard | ↻

Choose a RTK Profile 🔍

RTK Profile: 123 ▼

Connection Type: Radio

☐ **Create a Copy**

3DCQ:7.004m 2DCQ:3.745m 1DCQ:5.918m abc 10:01

Next | **Delete** | **Back**

Next

To accept changes and to continue with the subsequent screen within the wizard.

Delete

Pressing this key deletes the RTK profile currently shown in the selectable list.

Back

To return to the previous screen.

Fn Quit

To exit the wizard.

Description of fields

Field	Option	Description
Create a copy	Check box	Creates a copy before the editing process starts.

11.2

Satellite tracking GPS

Description

The settings on this screen define which satellite system, satellites and satellite signals are used by the instrument.

Access

Select **Main Menu: Instrument\GPS settings\Satellite tracking**.

Satellite Tracking Status, Tracking page

Satellite Tracking | ↩

Tracking | Advanced

☒ **GPS L5**

☐ **GLONASS**

☐ **GALILEO**

☐ **COMPASS**

☒ **Show message & audio warning, when loss of lock occurs**

3DCQ:6.926m 2DCQ:3.705m 1DCQ:5.851m abc 10:01

OK | | | | Page

OK

To accept changes.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
GPS L5	Check box	Defines if the GPS L5 signal will be tracked.
GLONASS	Check box	Defines if GLONASS satellite signals are accepted by the instrument when tracking satellites.
GALILEO	Check box	Defines if Galileo satellite signals are accepted by the instrument when tracking satellites.

Field	Option	Description
COMPASS	Check box	Defines if Compass satellite signals are accepted by the instrument when tracking satellites.
Show message & audio warning, when loss of lock occurs	Check box	Activates an acoustic warning signal and a message given by the instrument when satellites are lost.

Next step

Page changes to the **Advanced** page.

Satellite Tracking Status, Advanced page

Satellite Tracking | ↶

Tracking Advanced

Cut-off angle: 10.000°

DOP limit: None ▼

L2C tracking: Automatic ▼

Satellite health: Automatic ▼

3DCQ:6.876m 2DCQ:3.680m 1DCQ:5.809m abc 10:02

OK | | | | Page

OK

To accept changes.

Hlth..

Available for **Satellite health: User defined**.
To configure the satellites used in the survey.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Cut-off angle	Editable field	Sets the elevation in degrees below which satellite signals are not recorded and are not shown to be tracked. Recommended settings: • For real-time: 10°. • For purely post-processing applications: 15°.
DOP limit	None, GDOP, HDOP, PDOP or VDOP	If activated, the limit defined in Limiting value is checked. GPS positions are unavailable when the limit is exceeded.
Limiting value	Editable field	The maximum acceptable DOP value. Available unless DOP limit: None .
Satellite health	Automatic User defined	Sets the satellite tracking behaviour.  This setting is remembered when the instrument is turned off. It is stored as part of the configuration set. Incoming satellite signals are monitored by the instrument. Data from signals which are flagged as unhealthy is not recorded or used for real-time computations. Satellites must manually be included/excluded from data recording and real-time computations with Hlth...

Next step

Hlth.. changes to **Satellite Health**.

Satellite Health

This screen consists of the **GPS** page, **Glonass** page and the **Galileo** page. The explanations given for the softkeys are valid for all pages.

Satellite Health		
GPS	Glonass	Galileo
Satellite	System	User
G01	OK	Auto
G02	N/A	----
G03	OK	Auto
G04	OK	Auto
G05	OK	Auto
G06	OK	Auto
G07	OK	Auto
G08	Unhealthy	Auto
3DCQ:6.818m 2DCQ:3.651m 1DCQ:5.757m abc 10:02		
OK		Use Page

OK

To accept changes and return to the screen from where this screen was accessed.

Use

To change between the options in the column **User**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of columns

Column	Option	Description
Satellite	01 to 32	The Pseudo Random Noise number (GPS, 1 to 32), the Slot ID (GLONASS, 1 to 24) or the Space Vehicle number (Galileo, 1 to 30) of the satellites. There is a prefix G for GPS satellites, a prefix R for GLONASS satellites and a prefix E for Galileo satellites.
System	OK, N/A or Unhealthy	Information on the satellite health taken from the almanac. N/A stands for not available.

Column	Option	Description
User	Bad	Excludes satellite from tracking.
	OK	Includes satellite in tracking.
	Auto	Automatic satellite tracking when satellite is healthy.

Next steps

Step	Description
1.	Page changes to the Glonass page and to the Galileo page, where GLONASS satellites and Galileo satellites used in the survey can be configured.
2.	OK returns to Satellite Tracking Status .
3.	OK returns to Main Menu .

11.3

11.3.1

Antenna heights GPS

Rover Antenna Heights

Access

Select **Main Menu: Instrument\GPS settings\Antenna heights.**

Rover Antenna Heights

Rover Antenna Heights | ➔

Rover antenna:

Vertical offset: 0.3600m

Antenna height when measuring points:
 m

Antenna height when moving:
 m

OK

To return to the Main Menu.

Fn Quit

To exit the screen.

3DCQ:6.830m 2DCQ:3.661m 1DCQ:5.766m abc 10:03

OK

Description of fields

Field	Option	Description
Rover antenna	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 LGO. Open the list to define or edit additional antennas. Refer to "12 Antenna Heights".

Field	Option	Description
Vertical offset	Display only	The vertical antenna offset for the selected antenna.
Antenna height when measuring points	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 applications. The antenna height can still be changed during a survey. The change will not update this default height. The initial value depends on the selected antenna.
Antenna height when moving	Editable field	Sets the default antenna height for auto points and for the moving part of a track when logging raw observations.

11.3.2

Antennas

Description

Listed are antennas in the instrument's System RAM.

Access

Open the selectable list for **Rover antenna** in **Rover Antenna Heights**.

Antennas

Antennas	
Name	Creator
ADVNULLANTENNA	Default
AR25 LEIT	Default
AR25 Pillar	Default
AR25 Tripod	Default
AS05 Pillar	Default
AS05 Pole	Default
AS05 Tripod	Default
AS10 Pillar	Default
AS10 Pole	Default
3DCQ:6.834m 2DCQ:3.665m 1DCQ:5.768m abc 10:03	
OK	New.. Edit.. Delete

OK

To select the highlighted antenna and to return to the previous screen.

New..

To define a new antenna. Refer to "11.3.3 Creating/Editing an Antenna".

Edit..

To edit the highlighted antenna. It is not possible to edit default antennas. Refer to "11.3.3 Creating/Editing an Antenna".

Delete

To delete the highlighted antenna. It is not possible to delete default antennas.

Fn Default

To recall previously deleted default antennas and to reset default antennas to the default settings. User-defined antennas are not affected.

Fn Quit

To exit the screen.

11.3.3

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

New Antenna

General IGS

Name: -----

Hz offset: 0.0000

Vertical offset: 0.3600

L1 phase offset: 0.0000

L2 phase offset: 0.0000

☐ **Copy additional corrections**

3DCQ:6.835m 2DCQ:3.668m 1DCQ:5.768m abc 10:04

Store | **Page**

Store

To store the antenna.

Clear

To set the editable fields to 0. Available on the **Parameters** and the **Advanced** page.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	A unique name for the new antenna.
Hz offset	Editable field	Horizontal offset of measurement reference point.
Vertical offset	Editable field	Vertical offset of measurement reference point.
L1 phase offset	Editable field	Offset of L1 phase centre.
L2 phase offset	Editable field	Offset of L2 phase centre.

Field	Option	Description
Copy additional corrections	Check box	Allows additional corrections to be copied from the antenna which was highlighted before this screen 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
IGS name	Editable field	The International GPS/GNSS Service name of the antenna.
Serial number	Editable field	The serial number of the antenna.
Setup number	Editable field	The setup number of the antenna. Identifies the version number of the current calibration.

Next step

Store stores the new antenna.

Description

The settings on this screen define the limits for coordinate quality accepted for point occupations.

Access

Select **Main Menu: Instrument\GPS settings\Quality control.**

**Quality Control,
General page**

Quality Control | ↩

General | Advanced

☒ **Automatically stop point measurement**

☐ **Automatically store point**

☐ **Check quality before storing**

3DCQ:6.825m 2DCQ:3.665m 1DCQ:5.757m abc 10:04

OK | | | | Page

OK

To accept changes.

Param..

To configure the time interval after which a point occupation can be stopped automatically.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

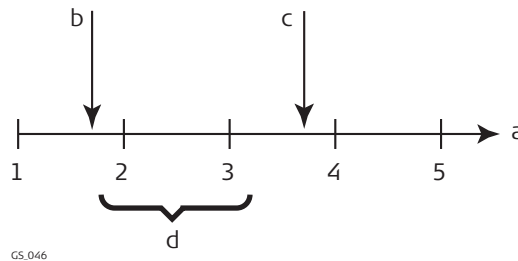
Description of fields

Field	Option	Description
Automatically stop point measurement	Check box	Activates a selectable list for the stop criteria. Stops the measurements automatically when the parameter defined for Stop criteria reaches 100 %.

Field	Option	Description
Stop criteria		Defines the method used for Automatically stop point measurement . The setting determines the computation and value to be shown in the survey screen mask and in the status screen. Parameters for the selected method are defined with Param...
	Accuracy or Positions	Available when working with real-time device. Records observations between pressing Meas and Stop . Recommended for normal real-time applications. Refer to the diagram below.
	Immediately	Records the time tag when Meas 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. Example: Measuring the position of lampposts by driving in a car along the road and pressing Meas when the car is next to the lamppost. Refer to the diagram below.
	Time, Observations or Number of satellites	Available when working without real-time device.
Automatically store point	Check box	Stores points automatically after stopping the point occupation.
Check quality before storing	Check box	If activated, the limit defined in Tolerance is checked before storing a point. A warning signal is given when the limit is exceeded.

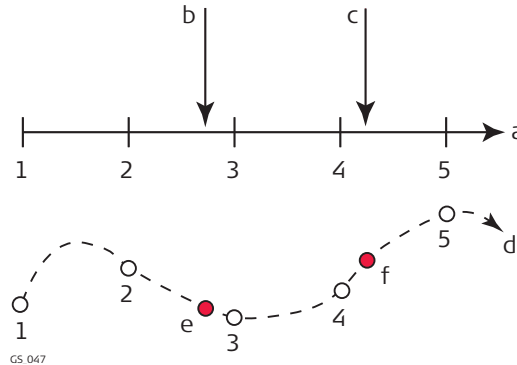
Field	Option	Description
Check	Position only , Height only or Position & height	The type of coordinate quality to be checked before storing a point.
Tolerance	Editable field	The maximum acceptable coordinate quality.

Stop criteria: Accuracy or Positions



- a) Time in epochs
- b) **Meas** pressed
- c) **Stop** pressed
- d) Post-processed coordinates computed by averaging resulting positions of epochs 2 and 3

Stop criteria: Immediately



- a) Time in epochs
- b) **Meas** pressed and point coordinates interpolated based on epochs 2 and 3
- c) **Meas** pressed and point coordinates interpolated based on epochs 4 and 5
- d) Plan view
- e) **Meas** pressed and point coordinates interpolated based on epochs 2 and 3
- f) **Meas** pressed and point coordinates interpolated based on epochs 4 and 5

Next step

IF parameters for Stop criteria	THEN
are not to be configured	Page changes to the Advanced page.
are to be configured	Param.. changes to Parameters for Auto Stop or Real-Time Stop Criteria .

Description of fields

Field	Option	Description
Automatically start measuring point on entering survey	No	Starts point occupation when pressing Meas .
	Yes	Starts point occupation automatically when entering the survey screen. All subsequent points must be occupied by pressing Meas .
	Timed	Starts point occupation automatically at a certain time.

Next step

OK closes the screen.

Parameters for Auto Stop

The parameters shown on this screen depend on the setting for **Stop criteria**.

Parameters for Auto Stop | ↺

Auto STOP/%Indicator based on

Number of obs:

At logging rate: -----s

3DCQ:6.965m	2DCQ:3.768m	1DCQ:5.858m	abc	10:07
OK				

OK

To accept changes.

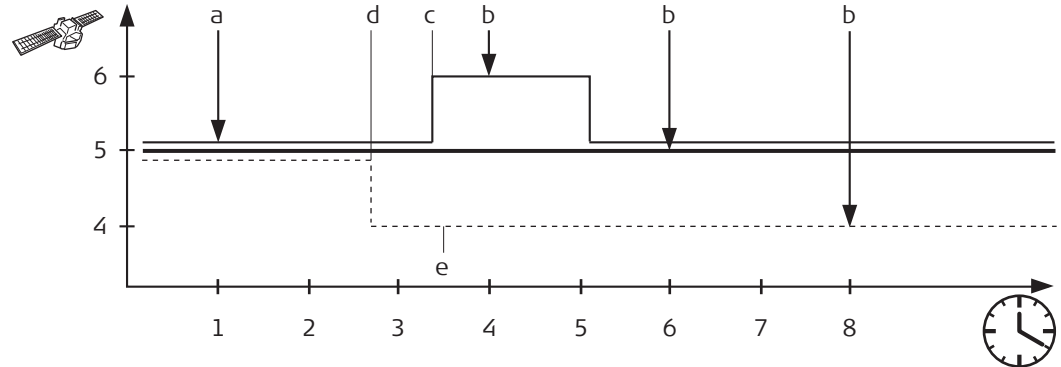
Description of fields

Field	Option	Description
Time at point	Editable fields	Sets the required observation time for each point. Counting time starts when Meas is pressed. The instrument stops measuring when the set length of time is reached.
Number of obs	Editable fields	Sets the required number of observations that are to be recorded at each point. Counting observations starts when Meas is pressed. The instrument stops measuring when the set number of observations is reached.
At logging rate	Display only	Displays the rate at which static raw observations are logged as configured.
8+ satellites for, 7 satellites for, 6 satellites for, 5 satellites for and 4 satellites for	Editable field	Sets the required observation time depending on the number of satellites available. Counting time starts when Meas 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 will be taken into account.

Next step

Step	Description
1.	OK closes the screen.
2.	OK returns to the screen from where Parameters for Auto Stop was accessed.

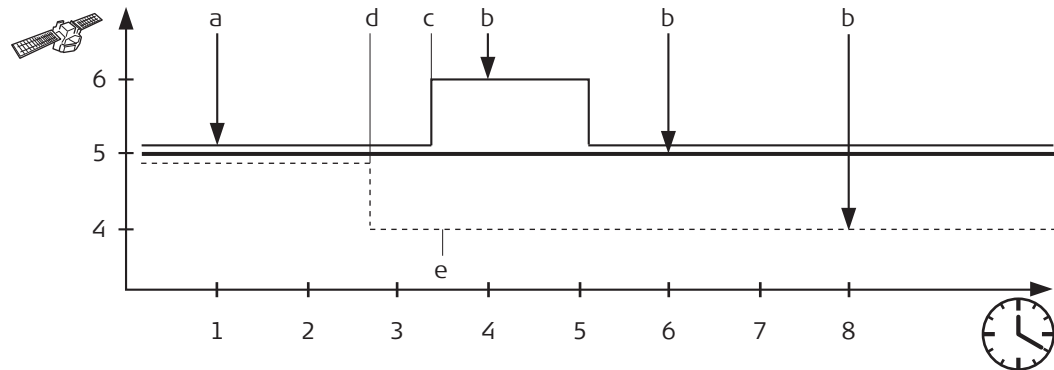
Observation time depending on the number of satellites available



GS 048

- a) **Meas** is pressed. Counting time starts.
- b) Observation is stopped.
- c) 40 % for five 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.**



GS 048

Thin line represents **6 satellites for: 3 min.**

Bold line represents **5 satellites for: 5 min.**

Dashed line represents **4 satellites for: 7 min.**

- a) **Meas** is pressed. Counting time starts.
- b) Observation is stopped.
- c) 40 % for five satellites
- d) 30 % for five satellites
- e) 30 % for four satellites

Real-Time Stop Criteria

The parameters shown on this screen depend on the setting for **Stop criteria**.

Real-Time Stop Criteria

Auto STOP/%Indicator based on

Pos Quality <: 0.0500 m

Ht quality <: 0.0500 m

For a min number of positions

Positions: 5

Position update: 1.000s

OK

To accept changes.

Fn Quit

To exit the screen.

3DCQ:6.991m 2DCQ:3.788m 1DCQ:5.876m abc 10:08

OK

Description of fields

Field	Option	Description
Pos quality better than and Ht quality better than	Editable field	Sets the maximum position and height qualities for each point occupation. Calculating the qualities starts when Meas is pressed. The instrument stops measuring when the position and height qualities are both less than the configured values.
Positions	Editable field	Raw data is logged for a minimum number of positions even when the Pos quality better than and Ht quality better than is already less than the specified maximum.

Field	Option	Description
Position update	Display only	Displays the value for GPS position update rate as configured in Instrument\Instrument status info: Position .
No. of positions	Editable field	Sets the number the positions which must be observed before the instrument stops measuring. Counting the number of positions starts when Meas is pressed.

Next step

OK closes the screen.

11.5

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.

Observations must be logged on all instruments which will be used for post-processing.

The settings on this screen define the logging of raw observations.

Access

To log raw data, a licence key is required. The licence key can only be loaded from an SD card using the Webserver or myWorld@Leica Geosystems.

The licence for raw data logging is required to log GNSS raw data on the GS10/GS15 or on a field controller.

The licence for RINEX logging is required to log RINEX data on the GS10/GS15.

Select **Main Menu: Instrument\GPS settings\Raw data logging**.

Raw data logging settings

Raw Data Logging Settings | ↻

☒ **Log data for post-processing**

Log data to: GS sensor ▼

Logging starts: Only within survey ▼

Log data when: Static ▼

Rate: 0.5s ▼

Data type: Leica format (MDB) ▼

3DCQ:7.017m 2DCQ:3.807m 1DCQ:5.895m abc 10:09

OK

OK

To accept changes.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Log data for post-processing	Check box	Activates raw data logging.
Log data to	Controller or GS sensor	Data can either be logged to the field controller or to the antenna.
Logging starts	Selectable list	Available for Log data to:GS sensor . Data logging can start as soon as the instrument is turned on or only while in the Survey application.
Log data when	Static	Raw observation logging during static intervals when occupying a point. The instrument has to be stationary.

Field	Option	Description
	Static & kinematic	Raw observation logging during static and moving intervals. For post-processed kinematic rover operations.
	Kinematic	Raw observation logging during moving intervals. For post-processed kinematic antenna operations.
Rate	From 0.05s to 300.0s	Rate at which raw observations are logged. Recommendations: • The maximum logging rate using Bluetooth on the field controller is 0.2 s. • For static operations with long baselines and over long time Rate: 15.0s or Rate: 30.0s. • For base stations for post-processed and real-time kinematic rovers, Rate at the base should be the same rate as at the rover. • For initialisation while static and occupying distinct points in kinematic chains Rate between 0.1s and 2.0s.
Data type	Selectable list	Available for Log data to:GS sensor . Data can be logged in the Leica proprietary MDB format or in RINEX.

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 variations.

For most operations, pre-configured standard settings in the instrument can be used. They automatically take the vertical phase centre variations into account.

Vertical or slope height

Only vertical antenna heights measured to the **Mechanical 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.

IF the antenna is	AND the accessories are	AND the setup is	THEN the measurements required are
Leica antenna, for example GS15	standard Leica	tripod	vertical height from height hook
Leica antenna, for example GS15	standard Leica	pole	none. Value is 2.00 m.
Leica antenna, for example GS15	standard Leica	pillar	vertical height to the MRP.
Leica antenna, for example GS15	non-Leica	any	• vertical height to the MRP.

IF the antenna is	AND the accessories are	AND the setup is	THEN the measurements required are
			possibly vertical offset.
non-Leica antenna	standard Leica OR non-Leica	any	- vertical height to the MRP. - possibly vertical offset. - phase centre variations. - horizontal offset if a slope height reading.

Vertical phase centre variations

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 LGO.

The antenna calibrations to determine the phase centre variations were executed by Geo++® GmbH.

12.2

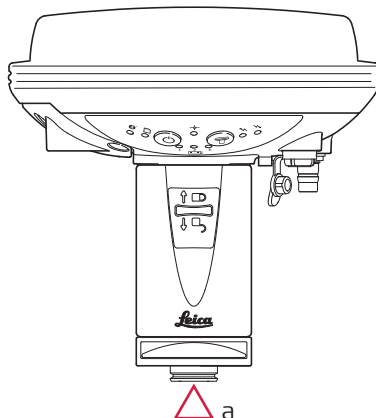
Mechanical Reference Planes, MRP

General

The **Mechanical Reference Plane**

- is where the antenna heights are measured to.
 - is where the phase centre variations refer to.
 - varies for different antennas.
-

GS15

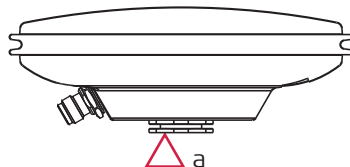


GS_031

- a) The mechanical reference plane is the underside of the threaded metal insert.
-

AX1201/AX1203+ GNSS

GS_032



- a) The mechanical reference plane is the underside of the threaded metal insert.

12.3

12.3.1

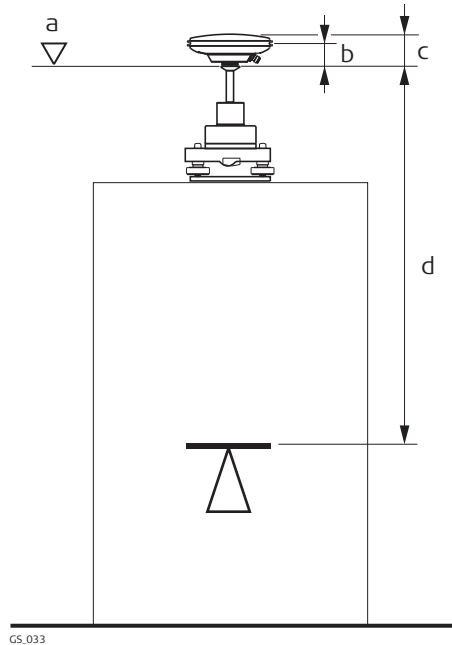


Pillar setup

Determining Antenna Heights

Pillar Setup

- One of the Leica standard antennas is used, for example GS15. All former Leica antenna types are supported.
- Leica standard accessories are used.



- a) Mechanical reference plane
- b) Vertical phase centre offset for L1
- c) Vertical phase centre offset for L2
- d) Vertical height reading

Vertical offset = 0

Vertical height reading

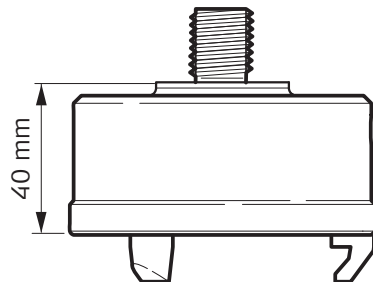
The vertical height reading is the height difference between the pillar benchmark and the mechanical reference plane of the antenna. Normally, it is determined indirectly by levelling.

Determine the antenna height step-by-step

Sometimes, it is difficult to measure to the MRP directly.

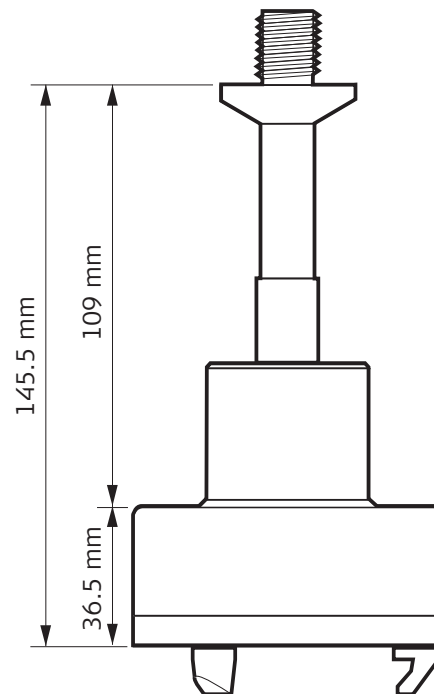
Step	Description
1.	Determine the height difference between the pillar benchmark and a surface on the carrier.
2.	Look up the height difference between this surface on the carrier and where the MRP of the antenna sits on the carrier.
3.	Add the values determined in step 1. and 2., to get the vertical height reading .
4.	For Leica standard antennas plus accessories, the vertical offset is 0.00 m.

Carrier and adapter dimensions



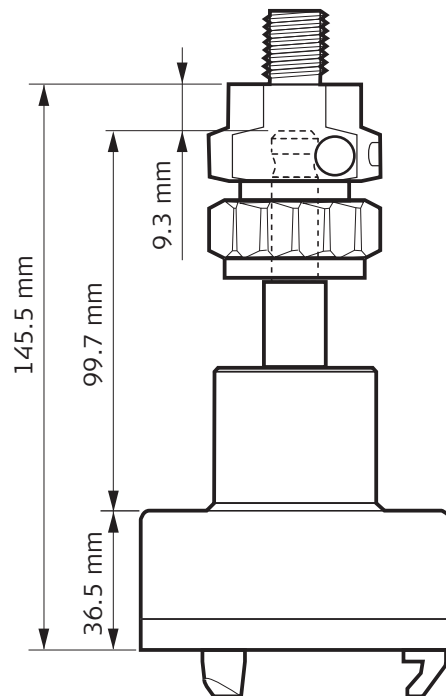
GS_038

GRT247 carrier, preferred for GS15



GS_036

GRT146 carrier.



GS_037

GRT144 carrier with GAD31 screw-to-stub adapter.

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 **Overview** for the vertical phase centre variations.



For carriers other than those carriers 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.

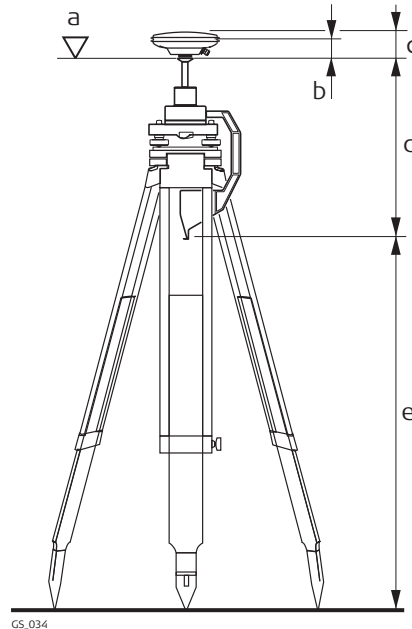
12.3.2



Tripod Setup

- One of the Leica standard antennas is used, for example GS15. All former Leica antenna types are supported.
- Leica standard accessories are used.

Tripod setup



- a) Mechanical reference plane
- 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

Step	Description
1.	Determine the vertical height reading using the height hook.
2.	For Leica standard antennas plus accessories, the vertical offset is 0.36 m.

Next step

- At the beginning of a survey, enter the vertical height reading into the instrument.
- The vertical offset of 0.36 m is stored in the antenna setup record for a tripod setup and will automatically be taken into account. It does not need to be entered.
- Refer to **Overview** for the vertical phase centre variations.



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.

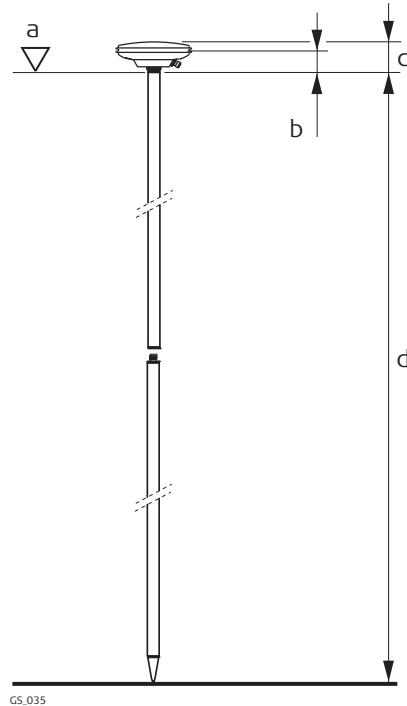
12.3.3



Pole Setup

- One of the Leica standard antennas is used, for example GS15. All former Leica antenna types are supported.
- Leica standard accessories are used.

Pole setup



- a) Mechanical reference plane
- b) Vertical phase centre offset for L1
- c) Vertical phase centre offset for L2
- d) Vertical height reading

Vertical offset = 0

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.

Determine the antenna height step-by-step

Step	Description
1.	The vertical height reading for - the Leica standard pole consisting of an upper and a lower half is 2.00 m. - the Leica standard pole consisting of an upper and a lower half with an additional 1.00 m pole section added is 3.00 m. - the lower half of the pole alone is 1.00 m.
2.	For Leica standard antennas plus accessories, the vertical offset is 0.00 m.

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 **Overview** for the vertical phase centre variations.



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.

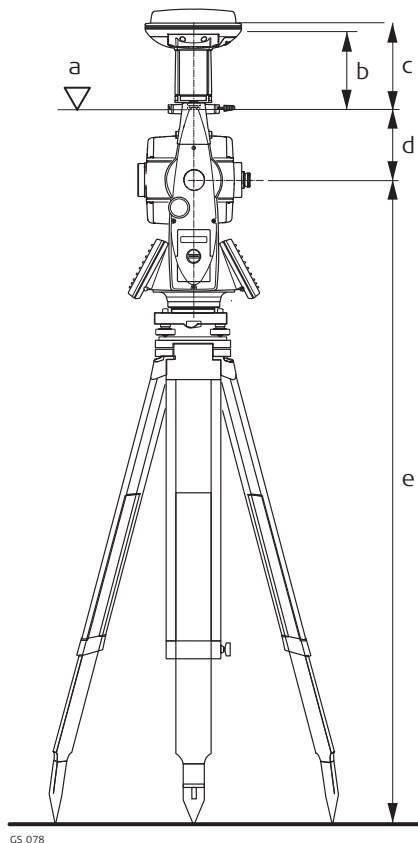
12.4



SmartStation Setup

- A SmartStation setup requires that the user configures **Rover antenna: GS15SmartStn** in **Rover Antenna Heights**. This configuration will ensure the correct vertical offset is applied to the antenna heights.
 - For a SmartStation setup, the antenna height value in the GPS survey screen must equal the value for **Instrument height**. **Instrument height** is seen in the preceding **Set Station Point**.
 - Leica standard accessories are used.
-

SmartStation setup



- a) Mechanical reference plane
- b) Vertical phase centre offset for L1
- c) Vertical phase centre offset for L2
- d) Vertical offset
- e) Instrument height reading

13 Instrument connections - TPS connection wizard TPS

13.1 Starting the TPS Connection Wizard

Description

This chapter explains how the field controller can be connected with a total station using a wizard.

Access

Select **Main Menu: Instrument\Instrument connections\TPS connection wizard**.

TPS Connection Wizard - Step 1

TPS Connection Wizard | ↩

Choose which total station to connect to 🔍

Manufacturer: Leica ▼

Model: TPS1200 ▼

Connect using: Internal radio ▼

Hz: -0.01" V: -0.01" abc 14:51

Next | | | | **Back**

Next

To confirm the settings and to continue to the next screen.

Back

To return to the previous screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Manufacturer	Selectable list	The brand of the instrument.
Model	Selectable list	The instrument model.

Field	Option	Description
Connect using	Cable, Bluetooth or Internal radio	How the instrument is connected. The options available depend on the selection for Model .

Next step

Next changes to the next screen.

IF	THEN
connected via cable	refer to Connection Using Cable .
connected via Bluetooth	refer to Connection Using Bluetooth .
connected via internal radio	refer to Connection Using Internal Radio .

Description

The connection settings must be specified.

TPS Connection Wizard - Step 2

TPS Connection Wizard

Connect cable to total station. Ensure same settings are made on the total station.

Baud rate: 115200

Parity: None

Data bits: 8

Stop bit: 1

Flow control: None

Hz: _O_ _I_ _ _ V: _O_ _I_ _ _ abc 14:52

Next | Default | Back

Next

To confirm the settings and to continue to the next screen.

Default

To return the fields back to their default values.

Back

To return to the previous screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Baud rate	From 1200 to 115200	Frequency of data transfer from instrument to device in bits per second.
Parity	None, Even or Odd	Error checksum at the end of a block of digital data.
Data bits	6, 7 or 8	Number of bits in a block of digital data.
Stop bit	1 or 2	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 screen.

13.3

Connection Using Bluetooth

Description

The screen shown depends on whether a last used Bluetooth ID is available for the chosen instrument model.

TPS Connection Wizard - Step 2

This screen is displayed if the chosen instrument model has a previously used Bluetooth ID already stored.

TPS Connection Wizard | ↩

Currently configured to work with the following total station ✕

Name: BT_Name_1
Bluetooth ID: BT_Address_1

**Press Next to use this total station.
Press Search to find a different total station.**

Hz: 0.0000g V: 0.0000g abc 10:11

Next | **Search** | **Back**

Next

To confirm the settings and to continue to the next screen.

Search

To search for a different total station.

Back

To return to the previous screen.

Fn Quit

To exit the screen.

Next step

Follow the instructions on the screen.

Total Station Connections - Step 2

This screen 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.



Next

To connect to the selected device and continue to the next screen.

Search

To search for a different total station.

Back

To return to the previous screen.

Fn Quit

To exit the screen.

Next step

Follow the instructions on the screen.

13.4

Connection Using Internal Radio

TPS Connection Wizard - Step 2

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 TPS instrument must be set to opposite settings. It is recommended to set the field controller to Remote and TPS instrument to Base .

Next step

Next and follow the instructions on the screen.

14

14.1

Instrument connections - All other connections

Accessing Configuration Connections

Description

The instrument has various connections which can be configured to be used with different ports and devices. The configuration varies depending on the individual application.

Access

For RTK rover and TPS:

- Select **Main Menu: Instrument\Instrument connections\All other connections.**

For RTK base:

- Select **Main Menu: Base connections\Instrument connections\All other connections.**

Connection Settings

The screen gives an overview of all connections with the currently assigned port and device. For an RTK rover, this screen consists of the **CS connections** and the **GS connections** page.

Connection Settings				
CS connections			GS connections	
Connection	Port	Device		
CS Internet	CS Bluetooth 1	Nokia phone		
Total Station	Bluetooth	TPS1200 BT		
GPS Rover	Cable	GS		
ASCII Input	-	-		
GPS Hidden Pt	-	-		
GSI Output	-	-		
Export Job	-	-		
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53				
OK	Edit..	Cntrl..	Page	

OK

To return to the screen from where this screen was accessed.

Edit..

To configure the parameters related to the highlighted connection. Refer to the sections on each individual connection in this chapter.

Cntrl..

Available for certain devices connected to certain connections. To configure additional parameters related to the highlighted device.

Fn Conect and Fn Disco

Available for a real-time connection configured to use an Internet connection. To dial the number of another station configured in the active working style and to hang up again.

Description

The Internet connection

- allows accessing the Internet using the field controller or the instrument plus normally a GPRS device.
- can be used together with the real-time connection to receive real-time data from, for example, an Ntrip Caster via Internet communication.

Refer to "27 NTRIP via Internet" for information about Ntrip.

The settings on this screen define the port and parameters required for accessing the Internet.

Access

For RTK rover:

- In **Connection Settings, CS connections** page, highlight **CS Internet. Edit...**
- In **Connection Settings, GS connections** page, highlight **GS Internet. Edit...**

For RTK base:

- In **Base Connection Settings**, select **GS Internet. Edit...**

For TPS:

- In **Connection Settings**, highlight **CS Internet. Edit...**
-

Internet Connection, Internet page

The screenshot shows the 'Internet Interface' screen with the 'Advanced' tab selected. The 'Use Internet interface on CS' checkbox is checked. The 'Connect using:' dropdown is set to 'CS Bluetooth 1'. The 'Device:' field shows 'Nokia Phone' and the 'Bluetooth ID:' field shows 'BT_Address_1'. The 'Use user ID & password' checkbox is unchecked. At the bottom, there is a status bar with signal strength indicators (3DCQ:5.550m, 2DCQ:3.278m, 1DCQ:4.479m), a function key 'Fn', and the time '09:51'. The bottom navigation bar contains buttons for 'OK', 'Search', 'Devce..', and 'Page'.

OK

To accept changes and return to the screen from where this screen was accessed.

Search

To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available if **CS Bluetooth 1** or **CS Bluetooth 2** are selected.

Devce..

To create, select, edit or delete a device. Refer to "16.2 Accessing Devices / GPRS Internet Devices". Available if the Internet connection is activated.

Page

To change to another page on this screen. Available if the Internet connection is activated.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Use Internet connection on CS or Use Internet connection on GS	Check box	Activates the Internet connection.
Connect using	CS Internal GSM CS RS232 port CS Bluetooth 1 and CS Bluetooth 2 GS Port 1 GS Port 2 GS Port 3	The ports available for connection to the Internet. An internal port in the field controller. This port has a “fixed” device. The RS232 port on the field controller. The Bluetooth ports on the field controller which will be used for the connection functionality. For GS10: The physical port P1 on the box. For GS15: The red LEMO port. For GS10: The physical port P2 on the box. For GS15: The black LEMO port. For GS10: The physical port P3 on the box. For GS15: The port for the slot devices.
Device	Display only	The name of the selected device.
Use user ID & password for Internet connection	Check box	If checked, a user ID and a password can be typed in.

Field	Option	Description
User ID	Editable field	Some providers ask for a user ID to allow connecting to the Internet via GPRS. Contact your provider if a user ID must be used. It is possible to show/hide the User ID.
Password	Editable field	Some providers ask for a password to allow connecting to the Internet via GPRS. Contact your provider if a password is required.

Next step

Page changes to the **Advanced** page.

Internet Connection, Advanced page

Description of fields

Field	Option	Description
Use static IP address	Check box	In order to get access to the Internet, an IP address is required. This IP address identifies the instrument in the Internet. This option should only be checked if a static IP address is available for the instrument. The IP address to get access to the Internet is provided by the network provider permanently. Each time the instrument wants to access the Internet via the device the same IP address identifies the instrument. This behaviour is important if the instrument is used as a TCP/IP server.
IP address	Editable field	Available if Use static IP address is checked. To set the IP address.

Next step

OK returns to the screen from where **Internet Connection** was accessed.

14.3

GPS Rover / Base Sensor GPS

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 **GPS Rover. Edit...**
- Select **Instrument\Instrument connections\GPS connection.**

For RTK base:

- In **Base Connection Settings**, select **Base Sensor. Edit...**
- Select **Instrument\Base connections\Connect to base sensor.**

GPS Connection / Connect to Base Sensor

GPS Connection | ↩

☒ **Use Bluetooth**

Last used rover: BT_Name_1

Bluetooth ID: BT_Address_1

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK | **Search**

OK

To accept changes and return to the screen from where this screen was accessed.

Search

To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available if **Use Bluetooth** is activated.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Use Bluetooth	Check box	Activates the Bluetooth connection.
Last used rover	Display only	Available for RTK rover. The name of the selected Bluetooth device.
Last used base	Display only	Available for RTK base. The name of the selected Bluetooth device.
Bluetooth ID	Display only	The ID of the selected Bluetooth device.

14.4

14.4.1

ASCII Input GPS

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, etc. The ASCII messages are stored as annotations together with the next manually measured point and/or auto point. After receiving the ASCII message, a reply can be sent back to the device as confirmation.

The settings on this screen 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...**

ASCII Input, ASCII input page

ASCII Input

ASCII input | Annotation 1 | Annotation 2 | Annotation 3

☒ **Receive ASCII data via a device**

Connect using: CS RS232 port

Device: TPS1200 Cable

End of message: CR

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK | Device.. | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Device..

Available when **Receive ASCII data via a device** is checked. To create, select, edit or delete a device. Refer to "16.2 Accessing Devices / GPRS Internet Devices".

Page

To change to another page on this screen.

Fn Cmnd..

To configure a message to be sent through the configured port to the device.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Receive ASCII data via a device	Check box	Activates the ASCII input connection.
Connect using	CS Bluetooth 1 and CS Bluetooth 2 CS RS232 port	The Bluetooth ports on the field controller which will be used for the connection functionality. The RS232 port on the field controller.
Device	Display only	The name of the device selected for ASCII input.
End of message	CR, LF or CR/LF	The character to be used to identify the end of the incoming ASCII message.

Next step

Page changes to the **Annotation 1/Annotation 2/Annotation 3/Annotation 4** page.

**ASCII Input,
Annotation 1/Annotation
2/Annotation 3/Annotation 4 page**

Description of fields

Field	Option	Description
Store ASCII data to this annotation	Check box	If checked, ASCII messages are recorded with the selected annotation.
Message desc	Editable field	The description for the ASCII message being received. This description is then displayed in other screens, for example in the status screen.
Message ID	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: ^ To accept strings starting with the subsequent characters. For example, ^1 accepts 12 but not 21. \$ To accept strings ending with the preceding characters. For example, 1\$ accepts 21 but not 12. . To accept any character except newline. [] To accept a set of characters. For example, [0-9] accepts all numbers. Any characters to accept strings that include the characters at any position. For example 1 accepts 1234, 4321 or 2134 but not 2345.
Prefix '@<Desc>@' when writing	Check box	Stores the description in Message desc 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 screen.

14.4.2

Configuration of a Command to the Device

Access

For RTK rover:

- In **ASCII Input**, **ASCII input** page, **Fn Cmnd...**

Send Command to Device



OK

To accept changes and return to the screen from where this screen was accessed.

Send

To send the command to the device.

Fn Quit

To exit the screen.



Description of fields

Field	Option	Description
Command	Editable field	A message to be sent to the device through the configured port when the survey or stakeout application 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.

Description

Hidden point measurement devices are used for measuring to points which cannot be directly measured with GPS, 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 screen define the port, the device and estimated qualities to be used for the hidden point connection.

Access

For RTK rover:

- In **Connection Settings, CS connections** page, highlight **GPS Hidden Pt. Edit...**

Hidden Point Connection
OK

To accept changes and return to the screen from where this screen was accessed.

Offset..

To configure the height and external angle offsets.

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. Refer to "16.2 Accessing Devices / GPRS Internet Devices".

Fn Quit

To exit the screen.

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 CS RS232 port	The Bluetooth ports on the field controller which will be used for the connection functionality. The RS232 port on the field controller.
Device	Display only	The name of the selected hidden point device.
Bluetooth ID	Display only	Available if CS Bluetooth 1 or CS Bluetooth 2 are selected. The Bluetooth ID of the hidden point device.
Default method	Bearing & distance	The method which is suggested first when starting the Survey Hidden Points application. The distance and 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 measured in the direction from the known point to the hidden point.

Field	Option	Description
	Using 2 bearings	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 point.
	Using 2 distances	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.
	Chainage & offset	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.
	Back brng & distance	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.
Set 2DCQ to	Editable field	The estimated value for the position quality assigned to all hidden points. This value must be estimated because hidden point measurement devices do not output position qualities.
Compute height for hidden points	Check box	Select to compute a hidden point with height.

Field	Option	Description
Set 1DCQ to	Editable field	Available when Compute height for hidden points is checked. The estimated value for the height quality assigned to all hidden points.

Next step

IF height and external angle/distance offsets	THEN
are not to be configured	OK closes the screen and returns to the screen from where Hidden Point Connection was accessed.
are to be configured	Offset...

Hidden Point Device Offsets

Hidden Point Device Offsets

Distance offset:

5.500

m

Height offset:

Device height

▼

Device height:

1.941

m

Angle offset:

Permanent

▼

Offset:

20.0000

g

3DCQ:0.009m

2DCQ:0.005m

1DCQ:0.008m

Fn ABC

10:04

OK

OK

To accept changes and to return to **Hidden Point Connection**.

Fn Quit

To exit the screen.

Description of fields

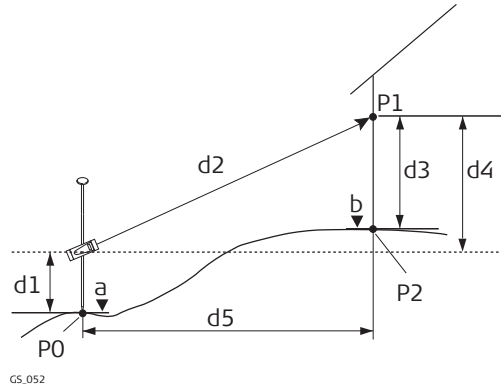
Field	Option	Description
Distance offset	Editable field	The offset is automatically added to the measured distance.
Height offset	None Device height Device & target ht	Available when Compute height for hidden points is checked in Hidden Point Connection. No height offsets are used. The result is the delta height between the centre of the device and the aimed point. 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. When measuring hidden points, the height of the hidden point measurement device as well as the target height can be typed in. This option should be used when the hidden point cannot be directly measured with a hidden point device, but a target point can be used to calculate the position.
Device height	Editable field	The height of the hidden point measurement device. This height is the distance from the ground to the centre of the device.
Target height	Editable field	The distance from the hidden point to the aimed point.

Field	Option	Description
Angle offset		Sets the default method for entering an angle offset. EAO is an offset angle between the North of the device being used and WGS 1984 geodetic North. EAOs are applied when measuring hidden points using a device capable of measuring azimuths.
	None	No EAO value is applied to the azimuth measurement received from the hidden point measurement device.
	Permanent	Applies a default value for the offset angle. The value is changeable.
	New for each point	Offset angle values must be entered for each new hidden point.
Offset	Editable field	Available for Angle offset: Permanent . The default value for the offset angle.

Next step

Step	Description
1.	OK returns to Hidden Point Connection .
2.	OK returns to the screen from where Hidden Point Connection was accessed.

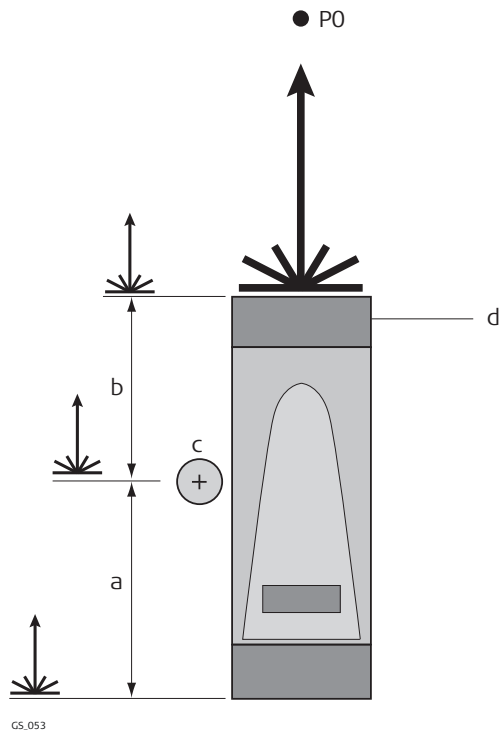
Diagram



- 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



GS_053

- a) Negative **Distance offset**
- b) Positive **Distance offset**
- c) Pole
- d) DISTO
- P0 Hidden point

Description

The Export Job connection allows data from a job to be exported from the instrument to another instrument.
The settings on this screen define the port and the device to which the data will be exported.

Access

For RTK rover:

- In **Connection Settings**, **CS connections** page, highlight **Export Job. Edit...**

For TPS:

- In **Connection Settings** highlight **Export Job. Edit...**

Export Job Connection

Export Job Interface | ↩

☒ **Export job to external device**

Connect using: CS RS232 port ▼

Device: TPS1200 Cable

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK | | | Device..

OK

To accept changes and return to the screen from where this screen was accessed.

Search

Available when **CS Bluetooth 1** or **CS Bluetooth 2** are 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. Refer to "16.2 Accessing Devices / GPRS Internet Devices".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Export job to external device	Check box	Activates the connection.
Connect using	CS Bluetooth 1 and CS Bluetooth 2 CS RS232 port	The Bluetooth ports on the field controller which will be used for the connection functionality. The RS232 port on the field controller.
Device	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.
Job Number	Selectable list	Available if the Device is a Leica instrument. Select a job number to assign to the job.
Name	Editable field	Available if the Device is a Leica instrument. The name of the job.

14.7

14.7.1

RTK Rover GPS

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 screen depend on the selected settings.

RTK Rover Settings | ↩

General | RTK base | RTK network | Advanced

☒ **Receive RTK data**

Connect using: GS Port 3

RTK device: Satel 3AS

☐ **Use external antenna on GS15**

RTK data format: Leica

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK | Device.. | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Search

Available when connecting via Bluetooth. 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. Refer to "16.2 Accessing Devices / GPRS Internet Devices".

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Receive RTK data	Check box	If checked, the rover real-time connection is activated.
Connect using	CS Internal GSM CS RS232 port CS Bluetooth 1 and CS Bluetooth 2 CS Internet 1, CS Internet 1 and CS Internet 3 GS Port 1 GS Port 2 GS Port 3 GS Internet 1, GS Internet 2 and GS Internet 3	An internal port in the field controller. This port has a “fixed” device. The RS232 port on the field controller. The Bluetooth ports on the field controller which will be used for the connection functionality. The Internet ports on the field controller. If these ports are not assigned to a specific connection, then these ports are additional remote ports. For GS10: The physical port P1 on the box. For GS15: The red LEMO port. For GS10: The physical port P2 on the box. For GS15: The black LEMO port. For GS10: The physical port P3 on the box. For GS15: The slot for a device. The Internet ports on the GS10 or GS15. If these ports are not assigned to a specific connection, then these ports are additional remote ports.
Device	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.

Field	Option	Description
RTK data format	Leica	The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. This format is recommended when working exclusively with Leica instruments.
	Leica 4G	The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2 and Galileo E1/E5a/E5b/Alt-BOC. This format is recommended when working exclusively with Leica instruments.
	CMR/CMR+	CMR and CMR+ are compacted formats used to broadcast data for third-party instruments.
	RTCM 18,19 v2	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 will be resolved at the rover. Accuracy at the rover: 1 - 5 cm rms after a successful ambiguity resolution.
	RTCM v3	Use RTCM when rover units from a different manufacturer are to be used. Message according to RTCM version 3. A new standard format for transmission of Global Navigation Satellite System correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. Message types for real-time GNSS operation: • 1001: L1-only GPS real-time observables

Field	Option	Description
		• 1002: Extended L1-only GPS real-time observables • 1003: L1 & L2 GPS real-time observables • 1004: Extended L1 & L2 GPS real-time observables • 1005: Stationary real-time base station Antenna Reference Point • 1006: Stationary real-time base station ARP with antenna height • 1007: Antenna descriptor • 1008: Antenna descriptor and serial number • 1009: L1-only GLONASS real-time observables • 1010: Extended L1-only GLONASS real-time observables • 1011: L1 & L2 GLONASS real-time observables • 1012: Extended L1 & L2 GLONASS real-time observables Network RTK Messages according to Master-Auxiliary Concept:

Field	Option	Description
	RTCM 1,2 v2	• 1014: Network Auxiliary Station Data message. 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. • 1015: Ionospheric Correction Differences message • 1016: Geometric Correction Differences message • 1029: Unicode Text String message • 1033: Receiver and Antenna Descriptor message 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. Accuracy at the rover: • For L1-only: 0.25 - 1 m rms. • For L1 and L2: 1 - 5 cm rms after a successful ambiguity resolution. Message according to RTCM version 2.x. Differential and delta differential GPS corrections. Message 3 is also generated. Use for DGPS applications. Accuracy at the rover: 0.25 - 1 m rms.

Field	Option	Description
	RTCM 9,2 v2	Message according to RTCM version 2.x. GPS partial correction set and delta differential GPS corrections. Message 3 is also generated. Use for DGPS applications with a slow data channel in the presence of interference. Accuracy at the rover: 0.25 - 1 m rms.
	RTCM 20,21 v2	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 - 5 cm rms after a successful ambiguity resolution.
	RTCM 1,2,18,19 v2	Available for RTK base. Message according to RTCM version 2.x. Combination of RTCM 1,2 v2 and RTCM 18,19 v2 .
	RTCM 1,2,20,21 v2	Available for RTK base. Message according to RTCM version 2.x. Combination of RTCM 1,2 v2 and RTCM 20,21 v2 .
	The availability of the following options, depends on the selection made for SBAS tracking on the Advanced page.	
	Automatic SBAS	SBAS satellites will be tracked and the SBAS service used will be automatically selected.
	WAAS	Wide Area Augmentation System satellites will be tracked.
	WAAS (test)	To track Wide Area Augmentation System satellites while the system is still in test mode.

Field	Option	Description
	EGNOS	European G eostationary N avigation O verlay S ystem satellites will be tracked.
	EGNOS (test)	To track European G eostationary N avigation O verlay S ystem satellites while the system is still in test mode.
	MSAS	M TSAT S atellite-based A ugmentation S ystem where MTSAT stands for M ulti-functional T ransport S ATel-lite
	GAGAN	G PS A ided G eo A ugmentation N avigation satellites will be tracked.
RTCM version	1.x, 2.1, 2.2 or 2.3	Available when the selected RTK data format is an RTCM version 2 format. The same version must be used at the reference and the rover.
Bits per byte	6 or 8	Defines the number of bits/byte in the RTCM message being received.
Use auto coordinate system	Check box	Available for RTK data format: RTCM v3 . To set an RTCM coordinate system received by a reference network as active coordinate system.
Receive RTK network information	Check box	Available for RTK data format: RTCM v3 . Activates an info message (RTCM message 1029).
Behaviour	Selectable list Log only	Available for RTK data format: RTCM v3 . The info message will only be logged to a text file.

Field	Option	Description
	Show only	The info message will only be shown by the instrument.
	Show & log	The info message will be shown by the instrument and logged to a text file.

Next step

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

RTK Rover Settings, RTK base page

Description of fields

Field	Option	Description
Sensor at base	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 Leica , Leica 4G , CMR/CMR+ and RTCM v3 contain this information. These corrections are important when a System300 instrument or an instrument from a different manufacturer is used as reference.
Antenna at base	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 Leica , Leica 4G , CMR/CMR+ and RTCM v3 contain this information.

Field	Option	Description
		 If the reference data is corrected by absolute antenna calibration values and a Leica standard antenna is being used on the rover, select ADVNULLANTENNA as base antenna.
RTK base is sending unique ID	Check box	If checked, an ID can be typed in.
RTK base ID	Editable field From 0 to 31 From 0 to 1023 From 0 to 4095	The special ID of the base station from which real-time data is to be received. The allowed minimum and maximum values vary. For RTK data format: Leica and RTK data format: CMR/CMR+ . For RTCM version: 2.x . For RTK data format: Leica 4G and RTK data format: RTCM v3 .

Next step

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

RTK Rover Settings, RTK network page

OK

To accept changes and return to the screen from where this screen was accessed.

Fn GGA..

To activate the sending of a GGA message for RTK network applications. Refer to "14.7.3 Configuration of GGA Message Sending for Reference Network Applications".

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Use RTK network	Check box	If checked, an RTK network can be used.
Network type		Defines the type of reference network to be used. Refer to Leica GNSS Spider documentation for more detailed descriptions.

Field	Option	Description
	Nearest	The rover sends its position via NMEA GGA message to Leica GNSS Spider. From this position, Leica GNSS Spider 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. If this option is selected, an NMEA GGA message must be activated using Fn GGA...
	i-MAX	individualised Master-AuXiliary corrections. The rover sends its position via NMEA GGA message to Leica GNSS Spider where the Master-Auxiliary corrections are calculated. The corrections are also individualised by Leica GNSS Spider, which means it determines the best suitable corrections for that rover. If this option is selected, an NMEA GGA message can be activated using Fn GGA...
	MAX	Master-AuXiliary corrections The rover typically does not send its position to Leica GNSS Spider. Leica GNSS Spider 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 RTCM v3 with message types 1015/1016. If this option is selected, an NMEA GGA message can be activated using Fn GGA...

Field	Option	Description
	VRS	V irtual R eference S tation. If this option is selected, an NMEA GGA message must be activated using Fn GGA... Refer to "14.7.3 Configuration of GGA Message Sending for Reference Network Applications".
	FKP	Area correction parameters. Derived from German: F lächen K orrektur P arameter
Send user ID	Check box	Activates the sending of a Leica proprietary NMEA message defining the user.
User ID 1 and User ID 2	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
Use prediction	Check box	To activate and deactivate the prediction of real-time observations between the data rate of the base. Available unless RTK data format: RTCM 1,2 v2 or RTK data format: RTCM 9,2 v2 .
Use height filter	Check box	To activate and deactivate the height filter for height smoothing.

Field	Option	Description
Glonass mode	Automatic	The instrument decides automatically if GLONASS observations are fixed or not (only GLONASS instruments).
	Glonass fix	The GLONASS observations are fixed in an RTK solution.
	Glonass float	The GLONASS observations are not fixed in an RTK solution.
SBAS tracking	Automatic SBAS WAAS WAAS (test) EGNOS	Allows a Space-Based Augmentation System to be configured to provide additional corrections in conjunction with GPS signals. Also commonly referred to as Satellite-Based Augmentation System, 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. Automatic SBAS SBAS satellites will be tracked and the SBAS service used will be automatically selected. WAAS Wide Area Augmentation System satellites will be tracked. WAAS (test) To track Wide Area Augmentation System satellites while the system is still in test mode. EGNOS European Geostationary Navigation Overlay System satellites will be tracked.

Field	Option	Description
	EGNOS (test)	To track E uropean G eostationary N avigation O verlay S ystem satellites while the system is still in test mode.
	MSAS	M TSAT S atellite-based A ugmentation S ystem where MTSAT stands for M ulti-functional T ransport S ATellite
	GAGAN	G PS A ided G eo A ugmentation N avigation satellites will be tracked.

Next step

Page changes to another page on this screen.

Prediction

The following provides additional information on the prediction of real-time positions between the data rate of the base.

Access

In **RTK Rover Settings, Advanced** page.

Description

Prediction is the interpolation of real-time corrections between those corrections regularly transmitted by a reference at a defined data rate.

Advantages in using prediction

- Computation of real-time positions on the rover is independent from the transmission rate of the data from the base station.
- Positions computed with prediction have a reduced latency of around 20 ms.

Recommended settings for using prediction

The slower the data rate the more important it is to activate prediction.

Height smoothing

The following provides additional information on the height filter for height smoothing.

Access

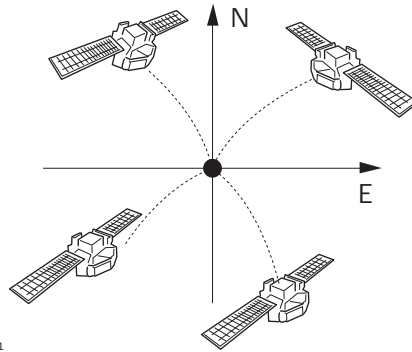
In **RTK Rover Settings, Advanced** page.

Description

Height smoothing is a filter applied to all heights measured in the WGS84 or a local coordinate system or output via NMEA. The filter defaults are best suited for high dynamic variations in height up to 1 m/s as carried out by graders.

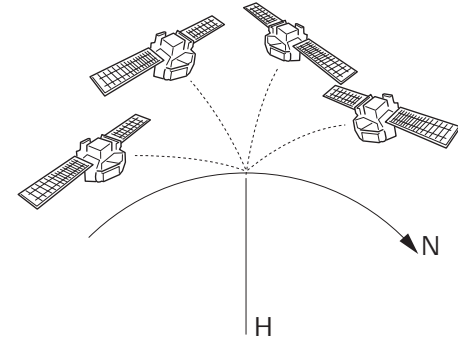
Height Smoothing with high dynamic GPS operations

All GPS 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. Having fewer quadrants, weakens the height position compared to the plan position.



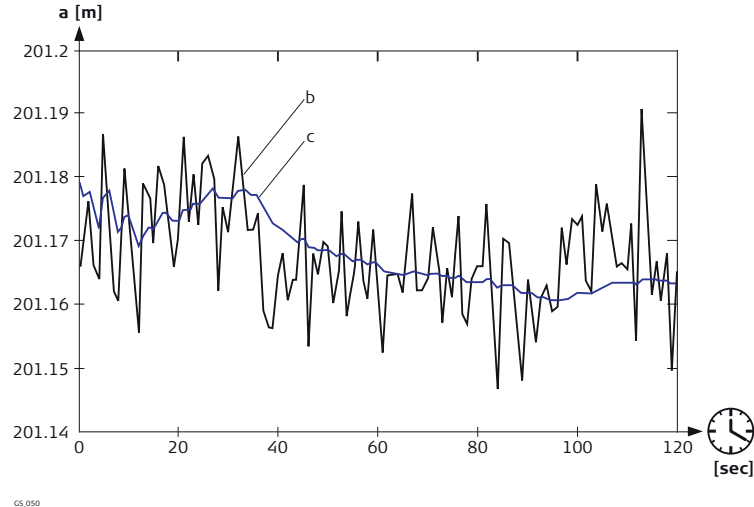
GS12_041

Position determination with satellites appearing in all four quadrants.



Height determination with satellites appearing in two quadrants.

In high dynamic GPS operations, this fact results in height variations of a few centimetres as shown in the blue curve in the following diagram. Some GPS monitoring applications require a stabilised height. By applying the filter, the height variations are smoothed and most of the noise in the height component is eliminated.



- a) Height
- b) Height variations
- c) Smoothed height

14.7.2

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 being 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 survey. This switch allows maximum productivity and minimal costs with real-time GPS.

Field procedure step-by-step

Step	Description
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.
9.	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.

14.7.3

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 "F.3 GGA - Global Positioning System Fix Data" for information on GGA message format.

Access step-by-step

In **RTK Rover Settings**, **RTK network** page, press **Fn GGA...**

Send GGA NMEA

Send GGA NMEA	
GGA position:	From job
Point ID:	101
Easting:	-5.000m
Northing:	8.000m
Elevation:	7.000m

3DCQ:0.009m	2DCQ:0.005m	1DCQ:0.008m	Fn abc	09:53
OK	Coord			

OK

To accept changes and return to the screen from where this screen was accessed.

Coord

Available for **GGA position: From job** and **GGA position: LAST/HERE Posn.** To view other coordinate types. Local coordinates are available when a local coordinate system is active.

Last

Available for **GGA position: LAST/HERE Posn.** 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.

Here

Available for **GGA position: LAST/HERE Posn.** To use the coordinates of the current navigation position in the GGA message.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height. Available for local coordinates.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
GGA position	Automatic	The current rover position is sent to the reference network. The position is updated and sent every five seconds.
	From job	A point from the working job can be selected in Point ID . The position of this point is sent to the reference network every five seconds.
	LAST/HERE Posn	The position last used in a reference network application or the current navigation position can be selected using Last or Here . The selected position is sent every five seconds.
	None	No GGA message is sent to the reference network.
Point ID	Selectable list	Available for GGA position: From job . The coordinates of this point are sent out in the GGA message.

14.8

14.8.1

Base RTK 1 / Base RTK 2 GPS

Configuration of a Reference Real-Time Connection

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 (RTK1)/RTK base settings (RTK2), General page

The available fields and pages on this screen depend on the selected settings.

OK

To accept changes and return to the screen from where this screen was accessed.

Device..

Available for **Connect using: GS Port 1/GS Port 2/GS Port 3**. To create, select, edit or delete a device. Refer to "16.2 Accessing Devices / GPRS Internet Devices".

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Transmit RTK base info	Check box	Activates the base real-time connection.
Connect using	GS Port 1	For GS10: The physical port P1 on the box. For GS15: The red LEMO port.
	GS Port 2	For GS10: The physical port P2 on the box. For GS15: The black LEMO port.
	GS Port 3	For GS10: The physical port P3 on the box. For GS15: The slot for a device.
	GS Internet 1, GS Internet 2 and GS Internet 3	The internet ports on the GS10 or GS15. If these ports are not assigned to a specific connection, then these ports are additional remote ports.
Device	Display only	The device currently assigned to the selected port within the active working style.
RTK data format	Leica, Leica 4G, CMR/CMR+, RTCM 18,19 v2, RTCM v3, RTCM 1,2 v2, RTCM 9,2 v2, RTCM 20,21 v2, RTCM 1,2,18,19 v2	Refer to "14.7.1 Configuration of a Rover Real-Time Connection" for information about these real-time data formats.

Field	Option	Description
RTCM version	1.x, 2.1, 2.2 or 2.3	Available when the selected RTK data format is an RTCM version 2 format. The same version must be used at the reference and the rover.
Use external antenna on GS15	Check box	Available for Connect using: GS Port 3 . Allows external radio / GSM antenna on the GS15 to be used for slot devices.

Next step

Page changes to the **Data rates** page.

Description

For all real-time data formats, parts of the message can be output at different rates. The settings on this screen define the output rates for the various parts of the selected real-time data format. The available fields on this screen depend on the selected setting for **RTK data format** in **RTK base settings (RTK1)/RTK base settings (RTK2)**.

Description of fields

Field	Option	Description
RTK data format	Display only	The selected data format.
Data	From 0.1s to 60.0s	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
	From 0 to 1023	For any RTCM version 2 format.
	From 0 to 4095	For Leica 4G and RTCM v3 .

Next step

Page changes to the **Time slicing** page.

RTK base settings
(RTK1)/RTK base
settings (RTK2),
Time slicing page

Description of fields

Field	Option	Description
Use time slicing	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.
Total base stations being used	2, 3 or 4	The number of base stations in use from where real-time messages are sent.
Time slot for this base	2, 3 or 4 The contents of the selectable list depend on the settings for Total base stations being used .	The time slot represents the actual time delay. The number of possible time slots is the number of base stations in use. The time delay equals 1 s divided by the total number of base stations. If two base stations are used, the time delay is 0.50 s. Therefore, the time slots are at 0.00 s and at 0.50 s. With three base stations, the time delay is 0.33 s. The time slots are at 0.00 s, 0.33 s and 0.66 s.

Next step

Page changes to another page on this screen.

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 "Appendix F NMEA Message Formats" for a comprehensive description of each NMEA message.

The settings on this screen 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 screens for the configuration 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...**

NMEA Output 1

NMEA Output 1

☒ **Stream NMEA messages from the GS**

Connect using: GS Port 1

Device: RS232

☐ **Use a defined talker ID**

Messages (coordinates are computed using the coord system on the GS)

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK **Mesgs** **Devce..**

OK

To accept changes and return to the screen from where this screen was accessed.

Mesgs

To configure what NMEA messages are output, the rates and the output timing method. Refer to paragraph "NMEA Messages".

Devce..

To create, select, edit or delete a device.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Stream NMEA messages from the GS	Check box	Activates the output of NMEA.
Connect using	GS Port 1	For GS10: The physical port P1 on the box. For GS15: The red LEMO port.
	GS Port 2	For GS10: The physical port P2 on the box. For GS15: The black LEMO port.
	GS Port 3	For GS10: The physical port P3 on the box. For GS15: The slot for a device.

Field	Option	Description
	GS BT	The Bluetooth port on the GS10/GS15.
Device	Display only	Usually, RS232 is used to transfer NMEA messages.
Use a defined talker ID	Check box	When this box is checked, a user-defined talker ID can be typed in. Otherwise, the NMEA Talker ID based on the NMEA standards v3.0 is used (default GP for GPS.)
Talker ID	Editable field	Available when Use a defined talker ID is checked. Appears at the beginning of each NMEA message.
Messages (coordinates are computed using the coord system on the GS sensor)	Display only	The NMEA messages currently selected for output.

Next step

IF NMEA messages	THEN
are not configured	OK closes the screen.
are to be configured	Mesgs.

NMEA Messages

This screen shows the messages that can be output, which messages are currently output, the output rates and the output timing method.

NMEA Messages			
Message	Use	Rate	Output
GGA	Yes	1.00	Epoch
GGK	Yes	1.00	Epoch
GGK_PT	Yes	1.00	Epoch
GGQ	Yes	1.00	Epoch
GLL	Yes	1.00	Epoch
GNS	Yes	1.00	Epoch
GSA	Yes	1.00	Epoch
GSV	Yes	1.00	Epoch
ILK	Yes	1.00	Epoch
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53			
OK		Edit..	None Use

OK

To accept changes and return to the screen from where this screen was accessed.

Edit..

To configure how the currently highlighted message is output. Refer to paragraph "NMEA Message to Send".

All and None

To activate and deactivate the output for all messages.

Use

To activate and deactivate the output for the highlighted message.

Fn Quit

To exit the screen.

Next step

IF an NMEA message	THEN
is not to be configured	OK closes the screen.
is to be configured	highlight the message and Edit...

NMEA Message to Send

NMEA Message to Send
↩

☒ **Stream the GKG message**

Output: At each epoch

Output Delay: 0.0 sec

Rate: 1.0s

☒ **Monitor CQ values**

CQ Control: Pos Only

Maximum CQ: 0.050 m

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK

OK

To accept changes and return to the screen from where this screen was accessed.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Stream the NMEA message	Check box	When this box is checked, the selected NMEA message is output.
Output	At each epoch	The NMEA message is created at the exact epoch of the screen update rate. It is sent out in the time interval as defined in Rate . With Output Delay , the output can also be delayed by a time after this epoch. Refer to paragraph "Diagram".
	Immediately	The NMEA message is created as soon as the information is available. It is sent out in the time interval as defined in Rate .
	On Point Stored	The NMEA message is sent on point storage.

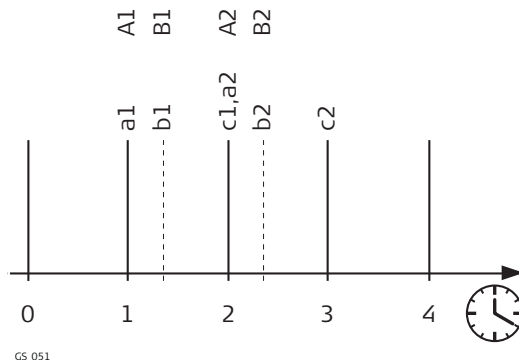
Field	Option	Description
		 If the time interval defined in Rate is shorter than the epochs of the screen update, then the internal computation of positions is changed to allow the specified rate of NMEA positions. The screen update remains unchanged.
Output Delay	Editable field	Available for Output: At each epoch. Delays the output of the NMEA message. The delay is applied from the epoch as defined in Rate. The time of delay can be a value up to Rate. This option is required if two or more instruments are being used to monitor the position of an object. The position of each instrument is being output as NMEA message back to a control station. If all instruments sent their position message at the same time, as would be the case with Output: Immediately, then the control station may not be able to cope with all the positional data messages. In this case, the output of the second instrument could be delayed. The control station would then receive the message from each instrument at a slightly different time.
Point Type	All points	Available for Output: On Point Stored. Defines the type of points for which the NMEA message is sent. The NMEA message is sent when any type of point is stored.

Field	Option	Description
	Occupy Pts Only	The NMEA message is sent when a manually measured point is stored.
	Auto pts only	The NMEA message is sent when auto points are stored.
Rate	From 0.05s to 3600.0s	Available unless Output: On Point Stored . Defines the time intervals at which the NMEA messages are created.
Monitor CQ values	Check box	When this box is checked the CQ control can be defined.
CQ Control	Position only , Height only or Position & height	Available when Monitor CQ values 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 Maximum CQ , then NMEA messages are not output,
Maximum CQ	Editable field	Available when Monitor CQ values is checked. The limit for the coordinate quality up to which NMEA messages are output.

Next step

Step	Description
1.	OK returns to NMEA Messages .
2.	OK returns to the screen from where NMEA Messages .

Diagram



For **Output: At each epoch** with **Rate: 1.0s**

- a1 Data 1 available
- b1 NMEA message for data 1 composed
- c1 NMEA message for data 1 sent
- a2 Data 2 available
- b2 NMEA message for data 2 composed
- c2 NMEA message for data 2 sent

For **Output: Immediately** with **Rate: 1.0s**

- A1 Data 1 available
- B1 NMEA message for data 1 composed and sent
- A2 Data 2 available
- B2 NMEA message for data 2 composed and sent

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 LGO through a serial port on the computer. The CS does not need to be removed from the instrument.

The settings on this screen 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 "24.3 Load licence keys" for information on how to type in the licence key. The corresponding LB2 commands are also protected. If these OWI commands have been activated by a licence key, it is indicated in **User About Leica Viva, Instrument** page.

• 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...**

Remote (OWI) Connections

Remote (OWI) Interfaces			
Port	Connection	Device	
GS Port 1	Remote (OWI)	RS232	
GS Port 2	NMEA 2	-	
GS Port 3	RTK Rover	Satel 3AS	
GS BT	Remote (OWI)	-	

3DCQ:0.009m	2DCQ:0.005m	1DCQ:0.008m	Fn abc	09:53
OK			Cntrl..	Device..

OK

To accept changes and return to the screen from where this screen was accessed.

Cntrl..

To configure additional parameters.

Device..

Available unless an internet connection is used. To create, select, edit or delete a device. Refer to "16.2 Accessing Devices / GPRS Internet Devices".

Use

Available unless a connection is **NMEA 1**, **NMEA 2** or **Remote (OWI)**. To use the highlighted connection by **Remote (OWI)**.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Port	The physical port on the instrument which will be used for the connection functionality.
Connection	The connection configured for the ports. Any port which is not configured is automatically assigned the remote connection.

Column	Description
Device	The hardware connected to the chosen port.

14.11

Total Station TPS

Description

The settings on this screen define the communication of the field controller with total stations, for example TPS1200, TS09 / TS06 / TS02 and third-party instruments.

Access

For TPS:

- In **Connection Settings** highlight **Total Station. Edit...**

Total Station Connections

Total Station Connections		↩
Manufacturer:	Leica	▼
Model:	TPS1200	▼
Connect using:	Bluetooth	▼
Name:	TPS1200	
Bluetooth ID:	15894650	

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Fn abc 09:48				
OK			Search	

OK

To accept changes and return to the screen from where this screen was accessed.

Search

To search for all available Bluetooth devices. If more than one Bluetooth device is found a list of available devices is provided. Available if **Connect using: Bluetooth** is selected.

Cntrl..

Available for certain devices connected to certain connections. To configure additional parameters, for example changing the radio channel.

Default

To return the fields back to their default values.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Manufacturer	Selectable list	The brand of the instrument.
Model	Selectable list	The instrument model.
Connect using	Cable, Bluetooth, Internal radio or External radio	How the instrument is connected. The options available depend on the selection for Model . The availability of the other fields depends on the selection made here.
Baud rate	From 1200 to 115200	Frequency of data transfer from instrument to device in bits per second.
Parity	None, Even or Odd	Error checksum at the end of a block of digital data.
Data bits	6, 7 or 8	Number of bits in a block of digital data.
Stop bit	1 or 2	Number of bits at the end of a block of digital data.
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.

Description

Each time a measured point is stored to the working job, GSI data is streamed through the configured port of the field controller.

Access

In **Connection Settings** highlight **GSI Output**. **Edit...**

GSI Output Connection

GSI Output Interface | ↩

☒ **Output GSI data to device**

Connect using: CS Bluetooth 1 ▼

Device: Nokia phone

Bluetooth ID: BT_Address_1

GSI Format: GSI8 polar & crtsn ▼

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK | Search | Device..

OK

To accept changes and return to the screen from where this screen was accessed.

Search

Available when **CS Bluetooth 1** or **CS Bluetooth 2** are 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.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Output GSI data to device	Check box	Activates the connection.
Connect using	CS RS232 port	The RS232 port on the field controller.

Field	Option	Description
	CS Bluetooth 1 and CS Bluetooth 2	The Bluetooth ports on the field controller which will be used.
Device	Display only	The device currently assigned to the selected port.
GSI Format	GSI8 polar & crtsn GSI16 polar GSI16 cartesian Pt,N,E,Ht,Date Pt,E,N,Ht,Date Pseudo NMEA GGA GSI8 polar GSI16 polar 2	GSI Polar and Cartesian (8 data characters) (Point ID, Hz, V, SlopeDist, PPM, E, N, Elev.) GSI Polar (16 data characters) (Point ID, Hz, V, SlopeDist, PPM, reflector height) GSI Cartesian (16 data characters) (E, N, Elev, Reflector Height) Coordinate data (Northing BEFORE Easting) Coordinate data (Easting BEFORE Northing) Based on NMEA (N ational M arine E lectronics A ssociation), which is a standard for interfacing marine electronic devices. GSI Polar (8 data characters) (Point ID, Hz, V, SlopeDist, PPM) GSI Polar (16 data characters) (Point ID, Hz, V, SlopeDist, PPM)
Use RS232 GSI protocol	Check box	A protocol defines if the system expects a handshake or no handshake.

Field	Option	Description
		If checked, a handshake is required. A data block is sent out from the instrument and a receipt confirmation is expected. This handshake requires that GeoCom Mode is activated.

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

Type	GSI8 Polar&Cart	GSI16 Polar	GSI16 Cartesian
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+0000000001338465022.002+00000000005371500	
*110002+000000000PNC0056	21.002+0000000001280253022.002+00000000005255000	
*110003+000000000PNC0057	21.002+0000000001122236022.002+00000000005433800	
*110004+000000000PNC0058	21.002+0000000001057355022.002+00000000005817600	
*110005+000000000PNC0059	21.002+0000000000998361022.002+00000000005171400	

GSI Word information

Pos.	Name	Description of values	Applicable for
1-2	Word Index (WI)		
3	No significance	∴ No information.	WI 11, WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87
4	Automatic index information	∴ No information. 0: Tilt compensator: Off 3: Tilt compensator: On	WI 21, WI 22
5	Input mode	∴ No information. 0: Measured values transferred from instrument 1: Manual input from keyboard 2: Measured value, H_z correction: Off. 3: Measured value, H_z correction: On. 4: Result calculated from functions	WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87
6	Units	∴ No information. 0: Distance: Metre (m) , last digit 1 / 1000 m 1: Distance: US ft (ft) last digit 1 / 1000 ft 2: Angle: 400 gon 3: Angle: 360° dec 4: Angle: 360°''' 5: Angle: 6400 mil 6: Distance: Metre (m) , last digit 1 / 10000 m 7: Distance: US ft (ft) last digit 1 / 10000 ft	WI 21, WI 22, WI 31, WI 81, WI 82, WI 83, WI 87

Pos.	Name	Description of values	Applicable for
7	Sign	+: Positive value -: Negative value	WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87
8-15 8-23	Data	Data includes a sequence of 8 (16) numerical or alphanumerical characters.  Certain data blocks are allowed to carry more than one value for example ppm/mm. This data is automatically transferred with the according sign before each single value.	WI 11, WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87
16 24	Separating character	: Blank	WI 11, WI 21, WI 22, WI 31, WI 51, WI 81, WI 82, WI 83, WI 87

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 Settings**.

Field	Description
Point ID	Text describing the point identification
Northing	The Northing coordinate.
Easting	The Easting coordinate.
Elevation	The height coordinate.

Field	Description
Date	The measurement/origination date.
Time	The measurement/origination time.
< 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 (**N**ational **M**arine **E**lectronics **A**ssociation), 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.

Field	Description
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 Regional Settings .
Height Geoid	Fixed number (0.0)
Height units	Fixed text (M)
Time since last DGPS update	Fixed number (0.0)
DGPS Base station ID	Fixed number (0.0001)
Checksum	Fixed number (*99)
<CR/LF>	Carriage Return Line Feed

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.

15

Instrument connections - All other connections, Cntrl.. Key

15.1

Digital Cellular Phones

15.1.1

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 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.

Technologies

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

Global System for Mobile Communications 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.

15.1.2

Configuring a GSM Connection

Access

For RTK rover and TPS:

- In **Connection Settings**, highlight a connection which has a digital cellular phone of GSM technology attached. **Cntrl...**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a digital cellular phone of GSM technology attached. **Cntrl...**

GSM Dial-Up Connection, Dial-up details page

The screenshot shows the 'GSM Dial-Up Connection' screen with the 'Dial-up details' tab selected. The fields are as follows:

GSM device:	Manufact ModelId
Dial-up connection:	My Dial-up Stn
Number:	+41987654321
Protocol:	Analog

At the bottom, there is a status bar showing '3DCQ:0.011m 2DCQ:0.005m 1DCQ:0.009m Fn abc 09:53' and a navigation bar with buttons: OK, Near, and Page.

OK

To accept changes and return to the screen from where this screen 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 **Dial-up Connection List**. Coordinates of these stations must be known.

Page

To change to another page on this screen. Available if the Internet connection is activated.

Fn Cmd..

To send AT commands to the digital cellular phone.

Fn Clear

Available on the **Sim codes** page. To set the additional editable fields to 0.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
GSM device	Display only	Available for RTK rover and TPS. The type of digital cellular phone highlighted when this screen was accessed.
Dial-up connection	Selectable list	Available for RTK rover and TPS. The digital cellular phone base station to be dialled. Opening the selectable list accesses Dial-up Connection List where new base stations can be created and existing base stations can be selected or edited. Refer to "15.7 Configuring the Stations to Dial".
Number	Display only	Available for RTK rover and TPS. The number of the digital cellular phone at the selected Dial-up connection as configured in Dial-up Connection List .
Protocol	Display only	Available for RTK rover and TPS. The configured protocol of the digital cellular phone at the selected Dial-up connection as configured in Dial-up Connection List .

Field	Option	Description
APN	Editable field	Available for RTK base with Internet capable devices. The Access Point Name of a server from the network provider, which allows access to data services. Contact your provider to get the correct APN.

Next step

Page changes to the **Sim codes** page.

GSM Dial-Up Connection,
Sim codes page

Description of fields

Field	Option	Description
PIN code	Editable field	To enter the Personal Identification Number of the SIM card.
PUK code	Editable field	If the PIN is locked for any reason, for example the wrong PIN was entered, input the Personal UnblockKey code for access to the PIN.

Next step

Page changes to the **Advanced** page.

GSM Dial-Up Connection,
Advanced page

Description of fields

Field	Option	Description
Network data rate		The network baud rate.

Field	Option	Description
	Selectable list	For digital cellular phones of GSM technology that do not support autobauding choose the baud rate from the selectable list.
	Autobauding	Select this option for an automatic search of the network baud rate.
Use transparent mode	Check box	Define if the digital cellular phone uses Radio channel Protocol. Check for digital cellular phones that do use transparent mode. Uncheck for digital cellular phones that use RLP. Check with the network provider if the digital cellular phone uses transparent mode or not.
Manually select cellphone network	Check box	To select a network provider from a list. This function is helpful when working close to borders. By default, the strongest network is used. Using this option, a network other than the strongest can be selected. Press Search for a list of all available networks.

Next step

Page changes to another page on this screen.

15.1.3

Configuring a CDMA Connection

Access

For RTK rover and TPS:

- In **Connection Settings**, highlight a connection which has a digital cellular phone of CDMA technology attached. **Cntrl...**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a digital cellular phone of CDMA technology attached. **Cntrl...**

CDMA Connection

CDMA Connection | ↶

CDMA Type: -----

Dial-up connection: My Dial-up Stn

Number: +41987654321

Protocol: Analog

3DCQ:0.760m 2DCQ:0.391m 1DCQ:0.652m Fn abc 09:54

OK | Near | Fn Info

OK

To accept changes and return to the screen from where this screen was accessed.

Near

To find the nearest base station with a digital cellular phone of CDMA technology. Available when base stations to dial are already created in **Dial-up Connection List**. Coordinates of these stations must be known.

Fn Info

To provide information about the CDMA device being used, such as the manufacturer, the model and the electronic serial number.

Fn Reg

To register the settings of the CDMA digital cellular phone over the air. For US and Canada only.

Fn Cmd..

To send AT commands to the digital cellular phone.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
CDMA Type	Display only	The type of digital cellular phone highlighted when this screen was accessed.
Dial-up connection	Selectable list	The digital cellular phone base station to be dialled. Opening the selectable list accesses Dial-up Connection List where new base stations can be created and existing base stations can be selected or edited. Refer to "15.7 Configuring the Stations to Dial".
Number	Display only	The number of the digital cellular phone at the selected Dial-up connection as configured in Dial-up Connection List .
Protocol	Display only	The configured protocol of the digital cellular phone at the selected Dial-up connection as configured in Dial-up Connection List .

Next step

Fn Info changes to **CDMA Information**.

CDMA Information

Description of fields

Field	Option	Description
Manufact	Display only	The manufacturer of the CDMA device being used.
Model	Display only	The model of the CDMA device being used.
ESN No.	Display only	Electronic Serial Number 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 CDMA Registration .

Next step

Step	Description
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
MSL/SPC	Display only	The S ervice P rogram C ode provided by the network provider.
MDN	Display only	The M obile D irectory N umber provided by the network provider
MSID/MIN	Display only	M obile S tation I dentity Number and M obile I dentification N umber. Another 10-digit number to identify the mobile phone. Sometimes identical with the MDN.

Next step

OK to return to **CDMA Connection**.

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 TPS:

- In **Connection Settings**, highlight a connection which has a modem attached. **Cntrl...**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a modem attached. **Cntrl...**

Modem Dial-up Connection

Modem Dial-up Connection | ↶

Modem: Manufact ModelId

Dial-up connection: My Dial-up Stn

Number: +41987654321

Protocol: Analog

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Fn abc 09:54

OK | Near | | | |

OK

To accept changes and return to the screen from where this screen was accessed.

Near

To find the nearest base station with a modem. Available when base stations to dial are already created in **Dial-up Connection List**. Coordinates of these stations must be known.

Fn Cmd..

To send AT commands to the modem.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Modem	Display only	The type of modem highlighted when this screen was accessed.
Dial-up connection	Selectable list	The modem base station to be dialled. Opening the selectable list accesses Dial-up Connection List where new base stations can be created and existing base stations can be selected or edited. Refer to "15.7 Configuring the Stations to Dial".

Field	Option	Description
Number	Display only	The number of the modem at the selected Dial-up connection as configured in Dial-up Connection List .
Protocol	Display only	The configured protocol of the modem at the selected Dial-up connection as configured in Dial-up Connection List .

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

- Pacific Crest radios:
 - channel changing must be activated by a Pacific Crest dealer.
 - A special licence might be required.
- Satellite radios: The radio must be in programming mode. This mode can be set by a Satellite dealer.



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.



If channel changing is to be used, when configuring the base real-time connection, set **RTK base ID** in **RTK base settings (RTK1)/RTK base settings (RTK2), Data rates** page to a different ID for each base site. 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 TPS:

- In **Connection Settings**, highlight a connection which has a radio attached. **Cntrl...**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has a radio attached. **Cntrl...**

Radio Channel

Radio Channel | ↶

Radio type: Satellite 3AS

Channel: 31

Actual frequency: 434.3000MHz

3DCQ:7.456m 2DCQ:3.728m 1DCQ:6.457m Fn ABC 17:09

OK | | | | Scan |

OK

To accept changes and return to the screen from where this screen was accessed.

Scan

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.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Radio type	Display only	The type of radio highlighted when this screen was accessed.
Channel	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 channel supported by the radio and the spacing between the channels.
Actual frequency	Display only	Available for Radio type: Satellite 3AS . Displays the actual frequency of the radio.

Next step

Scan to access **Scan for Base Station**.

Scan for Base Station

This screen 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.

Scan for Base Station			↶
Stn Id	Latency(s)	RTK format	
1	0.09	Leica 4G	

OK

To select the highlighted base station and to continue with the subsequent screen.

Chnl-1 and Chnl+1

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 those broadcasting on the new channel.

3DCQ:7.273m	2DCQ:4.041m	1DCQ:6.047m	Fn ABC	17:10
OK	Chnl-1	Chnl+1		

Description of columns

Column	Description
Station ID	Station ID of available base stations from which a signal is being received. For radios, the base station radios transmitting on the same channel will be listed.
Latency(s)	Time delay, in seconds and configured on the base, from when the base collects the data to when the data is transmitted.
RTK format	Format of the data from the base station. Refer to "14.8.1 Configuration of a Reference Real-Time Connection" for more information about data formats.

15.4

Radios for Remote Control

Description

For radios the channels on which the radio broadcasts can be changed. Changing channels changes the frequency at which the radio operates. This change in frequency can be necessary to enable multiple pairs of radios to work simultaneously in the same area without interfering with each other.

Access

For TPS:

- In **Connection Settings**, highlight a connection which has an internal radio, a TCPS or a GFU attached. **Cntrl...**

Internal radio

Internal radio | ↶

Radio type: Internal radio

Link number: 1

Set as: Base ▼

3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 10:25

OK | | | Default

OK

To accept changes and return to the screen from where this screen was accessed.

Default

To change to the default radio settings.

Fn Save

To save the radio settings.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Radio type	Display only	The type of radio device selected for the connection.
Link number	Editable field	The assigned channel number.  The channel number for the field controller and the radio must be the same. The communication settings for the field controller and the radio must also be same.
Set as	Remote or Base	 The radio modules inside the field controller and the radio must be set to opposite settings. It is recommended to set the field controller to Remote and the radio to Base .

15.5

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 TPS:

- In **Connection Settings**, highlight a connection which has an RS232 device attached. **Cntrl...**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has an RS232 device attached. **Cntrl..**

RS232 Connection

Displayed is the type of device highlighted when this screen was accessed.

15.6

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** in **Internet Connection**.
 - An Internet port must be selected in **RTK base settings (RTK1)/RTK base settings (RTK2)** or **RTK Rover Settings**.
-

Access

For RTK rover:

- In **Connection Settings**, highlight a connection which has an Internet device attached. **Cntrl...**

For RTK base:

- In **Base Connection Settings**, highlight a connection which has an Internet device attached. **Cntrl...**
-

Internet Port Connection

Internet Port Connection | ↩

Internet port: GS Internet 1

Server to use: MyServer 

NTRIP mountpoint: MAX-RTCM3

Press Source to get a list of mountpoints

OK

To accept changes and return to the screen from where this screen was accessed.

3DCQ:0.008m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:35

OK | | | | Source |

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Internet port	Display only	The name of the Internet port attached to the connection that was highlighted when this page was accessed.
User type	Selectable list Client	How the instrument will operate in the Internet. Available for RTK base. Must be selected when using Ntrip as Internet application. Inside the Internet, Ntrip Clients and Ntrip Servers are considered as clients.
Server to use	Selectable list	The server to be accessed in the Internet. Opening the selectable list accesses Server to Connect where new servers can be created and existing servers can be selected or edited.

Field	Option	Description
NTRIP mount-point	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
Identifier	Display only	The name of the selected Mountpoint.
Format	Display only	The real-time data format sent out by the Mountpoint.
Format details	Display only	Details about Format , for example the RTCM message types including update rates in seconds displayed in brackets.
Authentic		The type of password protection required for the authorisation to the Ntrip server.
	None	If no password is required
	Basic	If the password does not require encryption.
	Digest	If the password must be encrypted.

Field	Option	Description
NMEA	Display only	Indicates if the Mountpoint must receive GGA NMEA data from the rover in order to compute VRS information.
Charges	Display only	Indicates if charges are currently made for the connection.
Carrier	Display only	The type of carrier message sent out.
System	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 **Miscell** page.

Mountpoint, Miscell page

Description of fields

Field	Option	Description
Generator	Display only	The hard- or software generating the data stream.
Compress	Display only	The name of the compression / encryption algorithm.
Bitrate	Display only	The data speed in bits per second.
Info	Display only	Miscellaneous information if available.

Next step

OK to return to the previous screen.

15.7

15.7.1

Configuring the Stations to Dial GPS

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.

The configuration is possible for rover and base digital cellular phones and modems.

Access step-by-step

Step	Description
1.	In Connection Settings , highlight a connection which has a digital cellular phone of any technology or modem attached.
2.	Cntrl...
3.	Open the selectable list for Dial-up connection .

Dial-up Connection List

Dial-up Connection List	
Name	Number
<None>	-----
My Dial-up Stn	+41987654321

3DCQ:0.010m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:11	
OK	New.. Edit.. Delete

OK

To select the highlighted station and to return to the screen from where this screen was accessed.

New..

To create a new station. Refer to "15.7.2 Creating / Editing a Station to Dial".

Edit..

To edit a station. Refer to "15.7.2 Creating / Editing a Station to Dial".

Delete

To delete the highlighted station.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Name	Name of all available base stations.
Number	Phone number of the station to dial.

15.7.2

Creating / Editing a Station to Dial

Access

In **Dial-up Connection List** press **New..** or **Edit...**

New Dial-up Connection

Store

To return to the screen from where this screen was accessed.

Coord

To view other coordinate types.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	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. Input optional.
Number	Editable field	The number of the base station to dial. If the survey is to be undertaken 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.

Field	Option	Description
Protocol	Analog ISDN v.110 or ISDN v.120	Available for digital cellular phones of GSM technology. The configured protocol of the digital cellular phone of GSM technology. For conventional phone networks. For GSM networks.
Use coordinates	Selectable list	Select Yes to type in the approximate coordinates of the base station.

15.8

15.8.1

Configuring the Server to Connect GPS

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

Step	Description
1.	In Connection Settings , highlight a connection which has an Internet connection attached.
2.	Cntrl...
3.	Open the selectable list for Server name .

Server to Connect

Server to Connect	
Name	IP address
MyServer	www.myserver.com

3DCQ:6.734m	2DCQ:3.759m	1DCQ:5.588m	Fn abc	10:17
OK	New..	Edit..	Delete	More

OK

To select the highlighted server and to return to the screen from where this screen was accessed.

New..

To create a new server. Refer to "15.8.2 Creating / Editing a Server".

Edit..

To edit a server. Refer to "15.8.2 Creating / Editing a Server".

Delete

To delete the highlighted server.

More

To change between the IP Address and the TCP/IP Port of the server.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Name	Name of all available servers.
IP address	IP addresses of all available servers.
TCP/IP port	TCP/IP Port numbers of all available servers.

15.8.2

Creating / Editing a Server

Access

In **Server to Connect** press **New..** or **Edit...**

New Server, General page

Store

To return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	A unique name for the new server to be accessed. The name can be up to 16 characters long and include spaces.
Address	Editable field	Type in the host name or the IP address of the server to be accessed in the Internet.of the server to be accessed in the Internet.

Field	Option	Description
Port	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
Use NTRIP	Check box	Check to activate Ntrip.
User ID	Editable field	A user ID is required to receive data from to the Ntrip Caster. Contact the Ntrip administrator for information.
Password	Editable field	A password is required to receive data from the Ntrip Caster. Contact the Ntrip administrator for information.

Next step

Store to store the settings.

16

16.1

16.1.1

Description

Configuration of Devices

Devices

Overview

Before using any device, it is necessary to configure the interface with which it will be used. Refer to "14.1 Accessing Configuration Connections" for information on how to configure the interfaces.

Some devices can be used with different interfaces for different applications. For example:

- **GPS** A radio can be used to receive real-time base data but a second radio could also be used to output simultaneous NMEA messages.
 - **TPS** A radio can be used for remote control with a TPS but also to send GeoCOM commands from a computer to a TPS.
-

16.1.2

Digital Cellular Phones

Description

Digital cellular phones comprise of the technologies CDMA and GSM.

Typical uses

- To transmit real-time data.
- To receive real-time data.
- To download raw observations from a remote location.
- To steer an instrument.

Example use

Step	Description
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 "16.3 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

Always required:

- AT command language must be supported by the digital cellular phone.
- Working area must be covered by a digital cellular phone network.
- The network operator must support data transmission.

- Sometimes required:
- 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 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 "16.3 Creating/Editing a Device". These digital cellular phones must be connected with a cable or Bluetooth. Refer to "Appendix E 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.

16.1.3

Modems

Typical uses

- To transmit NMEA messages.
- To download raw observations from a remote location.
- To transmit real-time data.

Example of use

Step	Description
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 "16.3 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 "16.3 Creating/Editing a Device".

16.1.4

Radios for Real-Time GPS

Typical uses

- To transmit real-time data.
- To receive real-time data.
- To steer an instrument.

Example of use

Step	Description
1.	Base and rover must both be equipped with radios using the same frequency range and the same data format.
2.	The base radio continuously sends out real-time data until the instrument is turned off, the configuration is changed or the radio is detached.
3.	The rover radio continuously receives real-time data until the instrument is turned off, the configuration is changed or the radio is detached.
4.	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 "16.3 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.

16.1.5

Radios for Remote Control TPS

Typical uses

- To remote control the TPS.
 - To transmit data between a TPS and computer.
-

Supported radios

- The default radios used with TPS for remote control are the internal radio RadioHandle and the external radio TCPS28. The TPS has to be set to the correct communication mode to send and receive data and commands via the radio. A radio is also integrated in the field controller to allow communication.
 - A Communication side cover must be fitted to the TPS when operating with the Radio-Handle.
-

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 "16.3 Creating/Editing a Device". These radios must be connected with a cable. Refer to "Appendix E Cables" for information on cables.

16.1.6

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		

16.1.7

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 GPS, 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

Step	Description
1.	An instrument must be a rover with or without real-time configuration.
2.	A hidden point measurement device is connected to the instrument via 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 "16.3 Creating/Editing a Device".

16.1.8

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

Step	Description
	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 "16.3 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.

Description

Allows devices to be created, edited, selected and deleted.

Access step-by-step

Step	Description
1.	For RTK rover and TPS: - Select Main Menu:Instrument\Instrument connections\All other connections. For RTK base: - Select Main Menu:Base connections\Instrument connections\All other connections.
2.	Highlight the appropriate interface based on the type of device to be configured. For example, highlight RTK Rover when a radio is to be configured.
3.	Edit...
4.	Activate the interface by checking the check box.
5.	Devce.. to access Devices.

Devices

This screen may consist of several pages and provides different devices for selection depending on which interface the screen was accessed from. The functionality described here is always the same.

Connection Settings		
CS connections	Rover connections	
Connection	Port	Device
CS Internet	-	-
GPS Rover	Cable	GS
ASCII Input	-	-
GPS Hidden Pt	-	-
Export Job	-	-

3DCQ:-:---m	2DCQ:-:---m	1DCQ:-:---m	abc	16:21
OK		Edit..		Page

OK

To select the highlighted device and return to the screen from where this screen was accessed.

New..

To create a new device. Refer to "16.3 Creating/Editing a Device".

Edit..

To edit the highlighted device. Refer to "16.3 Creating/Editing a Device".

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 screen.

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.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Name	Names of available devices.
Type	Type of device defined when creating the device.
Creator	The creator of the device. The creator can be either Default if the device is a default, or User if the device has been created.  If a Default device is edited by using Edit.. then its creator is still displayed as Default.

16.3

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: 123

Type: Satel 2ASx

Baud rate: 9600 ▼

Parity: None ▼

Data bits: 8 ▼

Stop bit: 1 ▼

Flow control: None ▼

Hz: 50.0001g V: 99.9999g abc 09:56

Store | | | | |

Store

To store the new device and to return to the screen from where this screen was accessed.

AT Msg

Available for digital cellular phones and modems. To configure communication commands.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	Name of new device.
Type	Display only	Same device type as was highlighted when New.. or Edit.. was used.

Field	Option	Description
Use this device for internet	Check box	Available for digital cellular phones and modems. Defines the device as an Internet capable device and adds it to the list in GPRS Internet Devices .
Baud rate	From 2400 to 115200	Frequency of data transfer from instrument to device in bits per second.
Parity	None , Even or Odd	Error checksum at the end of a block of digital data.
Data bits	6 , 7 or 8	Number of bits in a block of digital data.
Stop bit	1 or 2	Number of bits at the end of a block of digital data.
Flow control	None or Flow control	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

IF the device is a	THEN
radio or device other than digital cellular phone or modem	Store to close the screen and to return to the screen from where this screen was accessed.
digital cellular phone or modem	AT Msg.

AT Msg

For **Use this device for internet** checked in **New Device** or **Edit Device**, this screen consists of two pages:

- GSM/CSD** page: The AT commands configure the devices for normal digital cellular phone/modem mode.
- GPRS/Internet** page: The AT commands configure the devices for GPRS/Internet mode. Please refer to the manual of the GPRS / Internet device for information about which AT commands must be entered or contact the supplier.

The following table lists the fields of both pages.

Description of fields

Field	Option	Description
Initialisation 1	Editable field	Initialisation sequence to initialise digital cellular phone/modem. When the device is used, between Initialisation 1 and Initialisation 2 , a check for the PIN is performed.
(continued)	Editable field	Allows the Initialisation 1 , Initialisation 2 or the Connect string to continue onto a new line.
Initialisation 2	Editable field	Initialisation sequence to initialise digital cellular phone/modem.
Dial	Editable field	Dialling string used to dial the phone number of the real-time base.
Hang-up	Editable field	Hangup sequence used to end the network connection.
Escape	Editable field	Escape sequence used to switch to the command mode before using the hangup sequence.

Field	Option	Description
Connect	Editable field	Dialling string used to dial into the Internet.

Next step

Store returns to **New Device** or **Edit Device**.

17

17.1



Instrument - Instrument status info

Status Functions

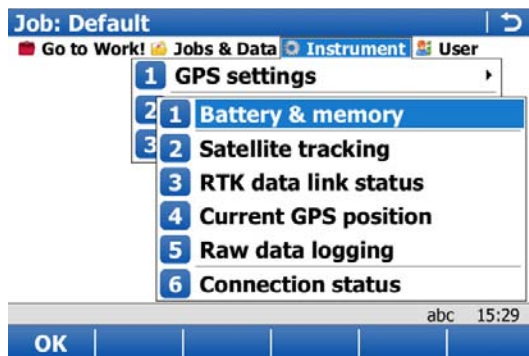
Description

The Status functions for the GPS RTK base menu, the GPS rover menu and for TPS are similar. The functions are described in the same chapters, differences are outlined.

Access

- For RTK base:
Select **Main Menu: Instrument\Base status info.**
- For RTK rover and TPS:
Select **Main Menu: Instrument\Instrument status info.**

Status Menu



OK

To select the highlighted option and to continue with the subsequent screen.

Description of the Status functions

STATUS function	Description	Refer to chapter
Battery & memory	Information related to usage and status of battery and memory.	"17.2 Battery & memory"
Satellite tracking	• Information related to the satellites ordered by the elevation angle. • A skyplot shows satellite information in a graphical way. • Another page shows the date of the used almanacs, and, as shown on the skyplot, the number of satellites tracked and the number of satellites available above the cut-off elevation mask.	"17.3 Satellite tracking"
RTK data link status	Information related to real-time data, for example the data link and the device used to transfer real-time data.	"17.4 RTK data link status"
Current GPS position	Information related to the current antenna position and the speed of the antenna.	"17.5 Current GPS position"
Raw data logging	Information related to logging of raw observations.	"17.6 Raw data logging"
Connection status	• Information related to the configuration and use of interfaces, ports and devices. • Information related to the incoming data from active devices.	"17.7 Connection status"
TPS TPS current station info	Information related to the current station set on the instrument.	"17.8 TPS current station info"

Access

Besides the standard access from the **Instrument status info/Base status info** menu, access is also possible by:

- Tapping the battery icon.
- Tapping the data storage device/internal memory icon.

Battery & Memory

This description is valid for all pages of the screen. For the **GPS base** page, the information that is displayed depends on the real-time message.

Leica/ Leica 4G: Transfers precise values for all fields.

RTCM: Transfer of any of the information not part of the message.

CMR/CMR+: Transfers general status information such as O.K. and Low.

Battery & Memory	
Controller	GPS rover GPS base
Battery:	Not connected
External power:	Not connected
Internal memory:	32730 Mb of 57231 fre
CF card:	32730 Mb of 57231 fre
SD card:	32730 Mb of 57231 fre
USB stick:	32730 Mb of 57231 fre
abc 15:30	
OK	Page

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Description
Battery, Battery 1 or Battery 2	The percentage of remaining power capacity for the battery is displayed numerically. If no information for a field is available, for example no battery is inserted, then 0% is displayed.
External power	Shows if an external power supply is connected.
Internal memory, CF card, SD card or USB stick	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.

Description

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

Access

Besides the standard access from the **Instrument status info/Base status info** menu, access is also possible by tapping the number of visible satellites icon.

Satellite Tracking Status:
GPS,
GPS/GLO/GAL page

Satellite Tracking : RTK rover				
GPS Skyplot Almanac				
Sat	Elev	Azmth	S/N L1	S/N L2
G23	84	79	50	44
G13	60	225	48	40
G20	55	91	47	39
G04	48	298	47	39
G32	29	91	43	34
G25	28	167	43	32
G17	19	236	--	--
G31	12	34	41	29
3DCQ:0.015m 2DCQ:0.008m 1DCQ:0.013m abc 14:17				
OK		Base	Hlth..	Page

OK

To return to the Main Menu.

Base / Rover

To change between the SNR values of rover and base.

Hlth..

To view the numbers of satellites categorised in good, bad and unavailable.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

More

To display information about the SNR values for GPS satellites (if **GPS L5** is checked in **GPS settings\Satellite tracking**) and Galileo satellites. Available on the **Satellite tracking** and **GAL** page.

Description of columns

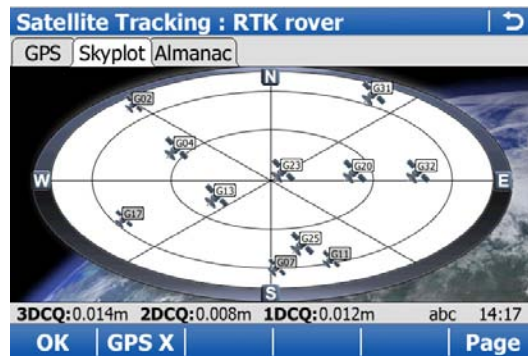
Column	Description
Sat	The Pseudo Random Noise number (GPS), the Slot number (GLONASS) or the S pace V ehicle number (Galileo) of the satellites.
Elev	The elevation angle in degrees. The arrows indicate if the satellite is rising or falling.
Azmth	The azimuth of the satellite.
S/N 1, S/N 2 and S/N L5	The SNR on L1, L2 and L5 for GPS, on L1 and L2 for GLONASS and on E1, E5a, E5b and Alt-Boc for Galileo. If the signal is currently not being used in the position calculations, the number is shown in brackets.

Next step

Page changes to another page on this screen.

Satellite Tracking Status:
GPS,
Skyplot page

Satellites below the **Cut-off angle** configured in **Satellite Tracking Status** are marked grey.
The part of the skyplot between the 0° elevation and the cut-off angle is marked grey.



OK

To return to the **Main Menu**.

GPS ? / GPS ?

To hide or show the GPS satellites (shown by the prefix G).

GLO ? / GLO ?

To hide or show the GLONASS satellites (shown by the prefix R).

Available when Glonass is activated in **Satellite Tracking Status**.

GAL ? / GAL ?

To hide or show the Galileo satellites (shown by the prefix E).

Available when **Galileo** is activated in **Satellite Tracking Status**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of symbols

Symbol	Description
	Satellites above the Cut-off angle configured in Satellite Tracking Status .
	Satellites below the Cut-off angle configured in Satellite Tracking Status .

Next step

Page changes to the **Almanac** page.

Satellite Tracking Status: GPS, Almanac page

The almanac page shows the date of the used almanacs, and, as shown on the skyplot, the number of satellites tracked and the number of satellites available above the cut-off elevation mask.



OK

To return to the **Main Menu**.

Page

To change to another page on this screen.

Satellite Tracking Status, RTK rover page

Next step

OK exits **Satellite Tracking Status**.

The information about the satellites at the base shown on this page is identical with the information shown for the rover.

Next step

OK exits **Satellite Tracking Status**.

17.4

RTK data link status GPS

Description

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

Access

Besides the standard access from the **Instrument status info/Base status info** menu, access is also possible by tapping the number of RTK status icon.

RTK Data Link Status, General page

RTK Data Link Status | ↻

General | Device | RTK base | Connectivity

RTK data format: Leica

GPS used L1/L2: ----

Last received: ----sec

In last minute: ----%

RTK network: None

abc 15:31

OK | Data.. | Page

OK

To exit the screen.

Data..

To view the data being received. Depending on the **RTK data format**, the shown data differ.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Description
RTK data format	The received real-time data format message type.
GPS used L1/L2	The number of satellites on L1, L2 and L5 (when GPS L5 is activated in Satellite Tracking Status) being used in the current position solution.

Field	Description
GLO used L1/L2	Available if Glonass is activated in Satellite Tracking Status . The number of satellites on L1 and L2 being used in the current position solution.
GAL used E1/E5a	Available if Galileo is activated in Satellite Tracking Status . The number of satellites on E1 and E5a being used in the current position solution.
GAL used E5b/ABOC	Available if Galileo is activated in Satellite Tracking Status . The number of satellites on E5b and Alt-BOC being used in the current position solution.
Last data sent	Available for an RTK base. Seconds since the last message from the base was sent.
Last received	Available for an RTK rover. Seconds since the last message from the base was received.
In last minute	Available for an RTK rover. 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.
RTK network	Available for an RTK rover. The type of base network in use.
Stream NMEA messages from the GS	Available for an RTK rover in a base network. NMEA positions must be sent to a network. The type of NMEA message sent to the base network. If more than one message is sent at a time, then all types are shown separated by comma.

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: Satel 3AS
Type: Satel 3AS/3ASd
Port: CS RS232 port
Channel: -----
Frequency: -----
Channel spacing: -----

abc 15:32

OK | | | | Page

OK

To exit the screen.

Page

To change to another page on this screen.

For all devices available

Description of fields

Field	Description
Name	The name of the device.

For RS232

Description of fields

Field	Description
Type	The type of device.
Port	The port to which the device is connected.

Field	Description
Bluetooth	Available if device is connected via Bluetooth. Indicates the state of the connection.

For digital cellular phones and modems

Description of fields

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.
Status	The current mode of the digital cellular phone. The options are Unknown, Detection and Registered.
Bluetooth	Available if device is connected via Bluetooth. Indicates the state of the connection.
Signal	Indication of received signal strength of the digital cellular phone network.

For radios

Description of fields

The available fields depend on the radio type.

Field	Description
Port	The port to which the device is connected.
Type	The type of device.
Channel	The radio channel.
Actual frequency	The current set frequency of the radio.
Central freq	The defined central frequency of the radio.
Firmware	The software version of the attached radio.
Signal	Indication of strength of received radio signal.

Next step

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

RTK Data Link Status, RTK base page

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

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

Description of fields

Field	Description
RTK base ID	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.
Antenna height	- For 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 with RTCM version: 2.3: The antenna height at the base from the marker to the MRP. - For RTK data format: CMR/CMR+ and RTK data format: RTCM 18,19 v2 or RTK data format: RTCM 18,19 v2 with RTCM version: 2.2: The antenna height at the base from the marker to the phase centre. - For all other RTK data format: ----- is displayed because the data format does not include information about the antenna height.
Coords of	The coordinates for the base station which are transferred depend on the active real-time data format. For real-time messages which include antenna height and antenna type: Marker.
	For real-time messages which do not include antenna information: Phase Centre of L1.
Number of aux ref	The number of active auxiliary base stations from which data is received.

Field	Description
Antenna at base	The antenna used at the base.
Sensor type at base	The instrument type used at the base.

Next step

IF	THEN
other coordinate types are to be viewed	Coord. Local coordinates are available when a local coordinate system is active.
another page is to be accessed	Page.
this screen is to be quit	OK exits the screen.

RTK Data Link Status, Connectivity page

This screen shows the status real-time connectivity as dynamic troubleshooting screen. It shows the success of each of the steps in the connectivity to receive real-time corrections. If one step fails, the check box is unchecked. As each step is successfully completed, the check box will be checked.

Real-Time Input Data

The following provides additional information on the satellite data received via 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:	G13	
Sat Time:	12:25:21	
Phase L1:	107951637.977cyc	
Phase L2:	84118141.614cyc	
Code L1:	20542512.847m	
Code L2:	20542508.917m	

3DCQ:0.020m	2DCQ:0.010m	1DCQ:0.017m	abc	14:25
OK		Sat +		

OK

To return to **RTK Data Link Status**.

Sat -

To display information about the satellite with the next smaller PRN.

Sat +

To display information about the satellite with the next larger PRN.

Description of fields

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

Field	Description
Sat PRN	The PRN number (GPS), the Slot number (GLONASS) or the Space Vehicle number (Galileo) of the satellites shown with the prefix G (GPS), R (GLONASS) or E (Galileo).
Sat Time	The GPS time of the satellite.
Phase L1, Phase L2, Phase L5	The number of phase cycles from the antenna to the GPS satellite on L1, L2 and L5.
Phase L1, Phase L2	The number of phase cycles from the antenna to the GLONASS satellite on L1 and L2.

Field	Description
Phase E1, Phase E5a, Phase E5b, Phase AltBOC	The number of phase cycles from the antenna to the Galileo satellite on E1, E5a, E5b and Alt-BOC.
Msg 18 L1, Msg 18 L2	The uncorrected carrier phases for L1 and L2.
Msg 20 L1, Msg 20 L2	The carrier phase corrections for L1 and L2.
Code L1, Code L2, Code L5	The pseudorange from the antenna to the GPS satellite for L1, L2 and L5.
Code L1, Code L2	The pseudorange from the antenna to the GLONASS satellite on L1 and L2.
Code E1, Code E5a, Code E5b, Code AltBOC	The pseudorange from the antenna to the Galileo satellite on E1, E5a, E5b and Alt-BOC.
Msg 19 L1, Msg 19 L2	The uncorrected pseudoranges for L1 and L2.
Msg 21 L1, Msg 21 L2	The pseudorange corrections for L1 and L2.
PRC	Pseudorange corrections.
RRC	Rate of change of the corrections.
IODE	Issue Of Data Ephemeris. The identification number of the ephemeris for a satellite.

Description

This screen shows information related to the current antenna position and the speed of the antenna. For real-time rover configurations, the baseline vector is also shown. MapView shows the current position in a graphical format.

Access

Besides the standard access from the **Instrument status info/Base status info** menu, access is also possible by:

- Tapping the position Status icon.

Current GPS Position, Position page

Current GPS Position					
Position	Baseline	Speed	Map		
Local time:	14:25:49.0				
Position latency:	0.00sec				
WGS84 latitude:	47°24'31.72786"N				
WGS84 longitude:	9°37'04.90872"E				
WGS84 ellipsoid ht:	469.660m				
Position quality:	0.009m				
Height quality:	0.015m				
3DCQ:0.018m 2DCQ:0.009m 1DCQ:0.015m					abc 14:25
OK	Coord				Page

OK

To return to the **Main Menu**.

Coord

To see other coordinate types. Local coordinates are available when a local coordinate system is active.

Page

To change to another page on this screen.

Fn Config..

To determine how often positions are computed and the screen display is updated.

Fn Elev

To see height as elevation. Available when local grid coordinates are displayed.

Fn Ell Ht

To see height as ellipsoidal height. Available when local grid coordinates are displayed.

Fn Quit

To exit the screen.

Description of fields

Field	Description
Position latency	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.
Position quality and Height quality	Available for phase fixed and code only solutions. The 2D coordinate and height quality of the computed position.
HDOP and VDOP	Available for navigated solutions.

Next step

IF	THEN
the instrument is a real-time rover	Page changes to the Baseline page.
the instrument is not configured for real-time	Page changes to the Speed page.
the instrument is a real-time base	OK exits Current GPS Position .

Current GPS Position, Baseline page

Information on the baseline vector is displayed.

Next step

Page changes to the **Speed** page.

Current GPS Position, Speed page

Description of fields

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

Next step

OK exits **Current GPS Position**.

17.6

Raw data logging GPS

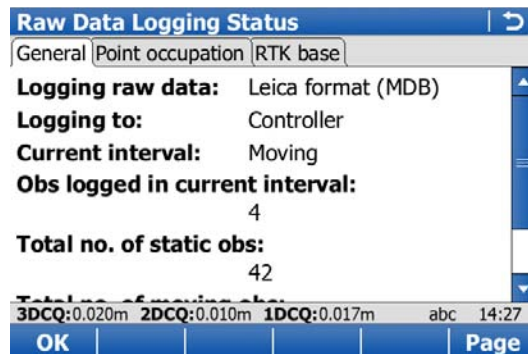
Description

This screen shows information related to logging of raw observations.

Access

Besides the standard access from the **Instrument status info**/**Base status info** menu, access is also possible by tapping the number of RTK status icon.

Raw Data Logging Status, General page



OK

To return to the **Main Menu**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Description
Logging raw data	Shows if raw data is saved and if so in which format.
Logging to	Shows where the data is saved.
Current interval	The type of current interval.

Field	Description
Obs logged in current interval	The number of observations logged in current interval.
Total no. of static obs.	The number of static epochs recorded in the current job.
Total no. of moving obs.	The number of moving epochs recorded in the current job.

Next step

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

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

Description of fields

Field	Description
Current Status	Shows if the instrument is moving or not.
GDOP	Current GDOP.
Logging rate	Rate at which raw observations are being recorded.
No. of moving obs	The number of logged moving raw observations. Reset as soon a new moving interval starts.
Logging data from >5 sats since	The time for how long five or more satellites are tracked on L1 and L2 without interruption. If less than five satellites were tracked, the counter is reset. The counter is not reset after Meas , Stop or Store .

Field	Description
Obs Completed	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 Automatically stop point measurement, Stop criteria and Auto STOP/%Indicator based on in Main Menu: Instrument\GPS settings\Quality control .
Time to go	The estimated time in hours, minutes and seconds until the configured criteria for Stop criteria or Auto STOP/%Indicator based on is reached. The criteria used to display this value depend on the settings for Automatically stop point measurement, Stop criteria and Auto STOP/%Indicator based on in Main Menu: Instrument\GPS settings\Quality control .

Next step

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

Raw 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
RTK base page	Base is a real base station.
Base (Nearest) page	Base is the closest to the rover determined by for example Leica GNSS Spider.
Base (i-MAX) page	Base information is individualised Master-Auxiliary corrections determined and sent by for example Leica GNSS Spider.
Base (MAX) page	Base information is Master-Auxiliary corrections determined and sent by for example Leica GNSS Spider.
Base (VRS) page	Base is a virtual base station.

Name of page	Description
Base (FKP) page	Base information is area correction parameters.

Description of fields

Field	Option	Description
Logging static obs	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 **Raw Data Logging Status**.

17.7

17.7.1

Connection status

Connection Status

Description

This screen gives an overview of all interfaces with the port and the devices currently assigned.

Access

Besides the standard access from the **Instrument status info/Base status info** menu, access is also possible by tapping the number of RTK status icon.

Connection Status

This screen consists of two pages, one for the field controller interfaces and one for the rover interfaces.

Connection Status				
CS connections			GS connections	
Connection	Port	Device		
CS Internet	-	-		
GPS Rover	Cable	GS		
ASCII Input	-	-		
GPS Hidden Pt	-	-		
Export Job	-	-		
3DCQ:0.018m 2DCQ:0.009m 1DCQ:0.016m abc 14:28				
OK				Page

OK

To return to the **Main Menu**.

Intfce

Available for configured interfaces being highlighted. To view information related to real-time data or the internet connection.

Devce..

To view the status of the attached device.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

17.7.2

Internet

Description

This screen shows

- if the instrument is online on the Internet.
 - for how long the instrument is online.
 - the technology of data transfer.
 - the amount of data received or sent since the instrument is online.
-

Access

This screen is accessible for a configured and activated Internet interface.

- On the **Connection Status, CS connections** page, highlight **CS Internet.Intfce**.
 - On the **Connection Status, GS connections** page, highlight **GS Internet. Intfce**.
-

17.7.3

ASCII Input GPS

Description

This screen shows the

- incoming ASCII data which is stored as an annotation.
- description of the incoming ASCII data for each annotation field.

Not used is shown for annotation fields which are not configured to receive incoming ASCII data.

Access

This screen is accessible for a configured and activated ASCII Input interface.

On the **Connection Status, CS connections** page, highlight **ASCII Input.Intfce.**

ASCII Input - Data

ASCII Input - Data ↩

Annotation 1:	Not used
Annotation 2:	Not used
Annotation 3:	Not used
Annotation 4:	Not used

OK

To exit the screen.

Data.. and **Descr**

To change between the given description for the incoming ASCII data or the last received ASCII data.



17.7.4

RTK Data Link Status GPS

Description

For information about this screen, refer to "17.4 RTK data link status".

Access

This screen is accessible for a configured RTK rover interface.

On the **Connection Status, GS connections** page, highlight **RTK Rover.Intfce**.

17.7.5

Remote (OWI) GPS

Description

This screen shows all available ports and the interfaces and devices configured to these ports.

Access

This screen is accessible for a configured and activated remote interface.

On the **Connection Status, GS connections** page, highlight **Remote (OWI) Connections**.

Remote (OWI)

Remote (OWI) Interfaces			
Port	Connection	Device	
GS Port 1	Remote (OWI)	RS232	
GS Port 2	Remote (OWI)	-	
GS Port 3	Remote (OWI)	-	
GS BT	Remote (OWI)	-	

OK

To exit the screen.

Device..

Available for some devices. To view status information about the devices.

			abc	15:44
OK			Device..	

Description of fields

Column	Description
Port	The physical port on the instrument which is being used for the interface functionality.
Connection	The interface configured for the ports.
Device	The hardware connected to the chosen port.

Next step

OK exits the screen.

Access

Standard access from the **Instrument status info** menu.

TPS Current Station Info

TPS Current Station Info

Station ID: 1

Instrument height: 0.0000m

Easting: 0.0000m

Northing: 0.0000m

Elevation: 0.0000m

Temperature: ----°C

Pressure: ----mbar

Atmospheric ppm: 0 ppm

Hz: 20.0000g **V:** 50.0000g abc 15:44

OK | **ppm** | **Fn Quit**

OK

To exit the screen.

Coord

To display other coordinate types.

ppm/SF

To switch between displaying the station scale factor and the station ppm.

Fn Quit

To exit the screen.

Description of fields

Field	Description
Station ID	Station ID of the current station setup.
Instrument height	Instrument height of the current station setup.
Easting	Easting value of the instrument position.
Northing	Northing value of the instrument position.
Local ellipsoid ht or Elevation	For a selected coordinate system, ellipsoidal height and elevation can be displayed.
Temperature	Temperature set on the instrument.

Field	Description
Pressure	Pressure set on the instrument.
Atmospheric ppm	Atmospheric ppm set on the instrument.
Station ppm	Ppm of the current station set up.
Station scale	Scale factor of the current station set up.

18

Instrument - Base settings GPS

18.1

Satellite tracking GPS

Description

The settings on this screen define which satellite system, satellites and satellite signals are used by the instrument.



This screen contains the same settings as the RTK Rover **Satellite Tracking Status** screen. Changes made to the settings here in RTK Base mode, will be reflected in the RTK Rover mode and vice versa.

Access

For RTK base:

Select **Main Menu: Instrument\Base settings\Satellite tracking**.

Satellite Tracking Status, Tracking page

Satellite Tracking | ➔

Tracking | Advanced

☒ **GPS L5**

☐ **GLONASS**

☐ **GALILEO**

☐ **COMPASS**

☒ **Show message & audio warning, when loss of lock occurs**

3DCQ:6.926m 2DCQ:3.705m 1DCQ:5.851m abc 10:01

OK | | | | **Page**

OK

To accept changes.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
GPS L5	Check box	Defines if the GPS L5 signal will be tracked.
GLONASS	Check box	Defines if GLONASS satellite signals are accepted by the instrument when tracking satellites.
GALILEO	Check box	Defines if Galileo satellite signals are accepted by the instrument when tracking satellites.
COMPASS	Check box	Defines if Compass satellite signals are accepted by the instrument when tracking satellites.
Show message & audio warning, when loss of lock occurs	Check box	Activates an acoustic warning signal and a message given by the instrument when satellites are lost.

Next step

Page changes to the **Advanced** page.

Satellite Tracking Status, Advanced page

Satellite Tracking | ↻

Tracking | **Advanced**

Cut-off angle: 10.000 °

DOP limit: None ▼

L2C tracking: Automatic ▼

Satellite health: Automatic ▼

3DCQ:6.876m 2DCQ:3.680m 1DCQ:5.809m abc 10:02

OK | Page

OK

To accept changes.

Hlth..

Available for **Satellite health: User defined**.
To configure the satellites used in the survey.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Cut-off angle	Editable field	Sets the elevation in degrees below which satellite signals are not recorded and are not shown to be tracked. Recommended settings: - For real-time: 10°. - For purely post-processing applications: 15°.
DOP limit	None, GDOP, HDOP, PDOP or VDOP	If activated, the limit defined in Limiting value is checked. GPS positions are unavailable when the limit is exceeded.
Limiting value	Editable field	The maximum acceptable DOP value. Available unless DOP limit: None .
Satellite health		Sets the satellite tracking behaviour.

Field	Option	Description
		 This setting is remembered when the instrument is turned off. It is stored as part of the configuration set.
	Automatic	Incoming satellite signals are monitored by the instrument. Data from signals which are flagged as unhealthy is not recorded or used for real-time computations.
	User defined	Satellites must manually be included/excluded from data recording and real-time computations with Hlth...

Next step

Hlth.. changes to **Satellite Health**.

Satellite Health

This screen consists of the **GPS** page, **Glonass** page and the **Galileo** page. The explanations given for the softkeys are valid for all pages.

Satellite Health		
GPS Glonass Galileo		
Satellite	System	User
G01	OK	Auto
G02	N/A	----
G03	OK	Auto
G04	OK	Auto
G05	OK	Auto
G06	OK	Auto
G07	OK	Auto
G08	Unhealthy	Auto
3DCQ:6.818m 2DCQ:3.651m 1DCQ:5.757m abc 10:02		
OK		Use Page

OK

To accept changes and return to the screen from where this screen was accessed.

Use

To change between the options in the column **User**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of columns

Column	Option	Description
Satellite	01 to 32	The Pseudo Random Noise number (GPS, 1 to 32), the Slot ID (GLONASS, 1 to 24) or the Space Vehicle number (Galileo, 1 to 30) of the satellites. There is a prefix G for GPS satellites, a prefix R for GLONASS satellites and a prefix E for Galileo satellites.
System	OK, N/A or Unhealthy	Information on the satellite health taken from the almanac. N/A stands for not available.
User	Bad OK	Excludes satellite from tracking. Includes satellite in tracking.

Column	Option	Description
	Auto	Automatic satellite tracking when satellite is healthy.

Next steps

Step	Description
1.	Page changes to the Glonass page and to the Galileo page, where GLONASS satellites and Galileo satellites used in the survey can be configured.
2.	OK returns to Satellite Tracking Status .
3.	OK returns to Main Menu .

18.2

Base 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.

Observations must be logged on all instruments which will be used for post-processing.

The settings on this screen define the logging of raw observations.

Access

For RTK base:

Select **Main Menu: Instrument\Base settings\Base raw data logging**.

Logging GPS Base Data

Logging GPS Base Data | ↩

☒ **Log base data for post processing**

Note that only static data can be logged to the GS

Rate: 1.0s

Data type: Leica format (MDB)

3DCQ:-:--m 2DCQ:-:--m 1DCQ:-:--m abc 16:47

OK

OK

To accept changes.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Log base data for post processing	Check box	Activates raw data logging.
Rate	From 0.05s to 300.0s	Rate at which raw observations are logged. Recommendations: - For static operations with long baselines and over long time Rate: 15.0s or Rate: 30.0s. - For base stations for post-processed and real-time kinematic rovers, Rate at the base should be the same rate as at the rover.

Field	Option	Description
Data type	Selectable list	Data can be logged in the Leica proprietary MDB format or in RINEX.

19

19.1

19.1.1

User - Work settings

ID templates

Accessing ID Template Configuration

Description

ID templates are predefined templates for point, line or area numbers. ID templates save having to type in the ID for each object. They are useful when many points are collected quickly, for example in post-processed and real-time kinematic operations. The ID templates that are selected to be used suggest IDs for **Point ID**, **Line ID** and **Area ID** when points, lines and areas are to be surveyed.

Access

Select **Main Menu: User\Work settings\ID templates**.

ID Templates

ID Templates

TPS points:

TPS0001

TPS auto points:

TPS_Auto_0001

Auxiliary points:

Aux0001

Lines:

Line0001

Areas:

Area0001

Hz: -°-′-″

V: -°-′-″

abc

16:03

OK

OK
To accept changes and return to the screen from where this screen was accessed. The currently active working style is automatically updated, to include the selected ID template.

Fn Quit
To exit the screen.

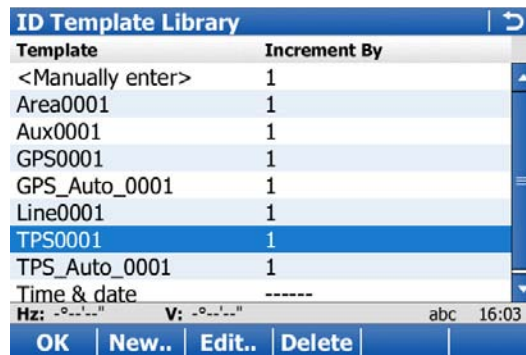
Description of fields

Field	Option	Description
GPS points GPS	Selectable list	Sets the ID templates for manually occupied GPS points.
GPS auto points GPS	Selectable list	Sets the ID templates for GPS auto points. These points are automatically recorded at a specific rate.
TPS points TPS	Selectable list	Sets the ID templates for manually occupied TPS points.
TPS auto points TPS	Selectable list	Sets the ID templates for TPS auto points. These points are automatically recorded at a specific rate.
Auxiliary points	Selectable list	Sets the ID templates for auxiliary points. These points are used when trying to find a stakeout point.
Lines	Selectable list	Sets the ID templates for lines.
Areas	Selectable list	Sets the ID templates for areas.

Next step

ENTER to open a selectable list and to access **ID Template Library**.

ID Template Library



Template	Increment By
<Manually enter>	1
Area0001	1
Aux0001	1
GPS0001	1
GPS_Auto_0001	1
Line0001	1
TPS0001	1
TPS_Auto_0001	1
Time & date	-----

Hz: -0-.-.- V: -0-.-.- abc 16:03

OK New.. Edit.. Delete

OK

To select the highlighted template.

New..

To create a new 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 will be rebuilt when that working style becomes active.

Fn Default

To recall deleted default ID templates.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Template	The name of the ID template and the format of the ID object.
Increment	The amount by which the point ID is incremented.

Default ID templates

Some ID templates are implemented by default.

Default ID template	Description
<Manually enter>	The last point ID during a survey will be 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.
Area0001	Suggested as ID for areas in default working styles. This ID is automatically incremented.
Aux0001	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.
GPS0001	Suggested as ID for GPS measured points in default working styles. This ID is automatically incremented.
GPS_Auto_0001	Suggested as ID for GPS auto points in default working styles. These points are automatically recorded at a specific rate. This ID is automatically incremented.
Line0001	Suggested as ID for lines in default working styles. This ID is automatically incremented.
TPS0001	Suggested as ID for TPS measured points in default working styles. This ID is automatically incremented.
TPS_Auto_0001	Suggested as ID for TPS auto points in default working styles. These points are automatically recorded at a specific rate. This ID is automatically incremented.
Time & date	The current local time and date is the ID.

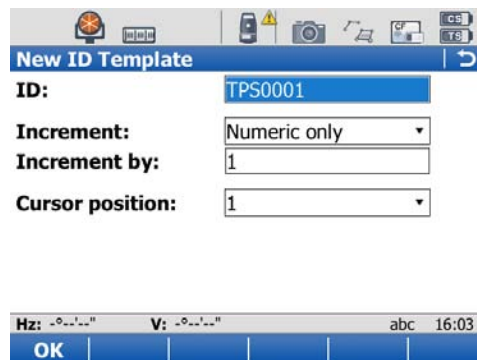
19.1.2

Creating/Editing an ID Template

Access

In **ID Template Library**, highlight an ID template. A copy of this ID template is taken for further configurations. **New...**

New ID Template/Edit ID Template



OK

To store the new ID template into the ID template library.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
ID	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.
Increment	Selectable list	IDs are incremented numerically or alphanumerically.
Increment by	Editable field	The amount by which the point ID is incremented.

Field	Option	Description
Cursor position	Selectable list	The character position at which the cursor is placed when ENTER is pressed in Point ID , Line ID or Area ID when surveying points. Last Character means that the cursor is placed immediately to the right of the last character.

Examples for incrementation

For Increment: Numeric only

The rightmost numeric part is incremented within the point ID.

ID	Increment by	Next point ID	Notes
Point994	5	Point999 Point1004 ...	-
994point	5	999point 1004point ...	-
123point123	-10	123point113	Numbers on the right are incremented. Negative increments allowed.
Point11	-6	Point5 Point-1 Point-7 Point-13 ...	-

ID	Increment by	Next point ID	Notes
Abcdefghijklmn94	5	Abcdefghijklmno99 Point ID increment fail	Incrementation fails if next increment will result in more than 16 characters.
Abcdefghijklmno9	-5	Abcdefghijklmnop4 Point ID increment fail	Negative incrementing fails if next increment requires negative sign and will result in more than 16 characters.

For Increment: Alphanumeric

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 Point99E Point99J ...	-
994point	5	994poiny Point ID increment fail	Lower case alpha characters increment until z is reached. Then a new point ID must be entered.
Abcdef	-5	Abcdea AbcdeV ... AbcdeB Point ID increment fail	Lower case alpha characters decrement from lower to upper case until A is reached. Then a new point ID must be entered.

ID	Increment by	Next point ID	Notes
ABCDEB	5	ABCDEB ABCDEG ... Abcdez Point ID increment fail	Upper case alpha characters increment from upper to lower case until z is reached. Then a new point ID must be entered.

Description The settings on this screen define the method of coding. Refer to "20 Coding" for a complete description of coding.

Access Select **Main Menu: User\Work settings\Coding & linework.**

Coding & linework settings,
Code & attributes page

Coding & Linework Settings

Code & attributes

Linework

Quick coding

☒ Use a list box to view codes

Suggested attributes:

Default values

Prompt for mandatory attributes:

Only if no value

Hz: -°-'-"

V: -°-'-"

abc

16:03

OK

Page

- OK**
To accept changes and return to **Main Menu.**
- Page**
To change to another page on this screen.
- Fn Quit**
To exit the screen.

Description of fields

Field	Option	Description
Use a list box to view codes	Check box	If checked, codes stored within the job codelist can be selected from a selectable list to code points, lines and areas. Otherwise, each code must be entered manually.

Field	Option	Description
Suggested attributes	Default values	Determines the attribute values displayed under certain circumstances. This setting is applicable to both the storing and displaying of attribute values. When available, the default attribute values, as stored in the job, are displayed and stored.
	Last used	When available, the last used attribute values as stored in the job are displayed and stored.
Prompt for mandatory attributes	Always prompt	A screen to enter mandatory attributes will always appear 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 LGO.
	Only if no value	A screen to enter mandatory attributes will only appear 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 LGO.
	Code change only	A screen to type in mandatory attributes will only appear when a new code with a mandatory attribute was selected.

Next step

Page changes to the **Linework** page.

Coding & linework settings, 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 a survey screen page of an application. The selection for **Linework** in a survey screen page determines the flag stored with a point. The availability of **Linework** in a survey screen page is configured in **My Survey Screen Settings**. Refer to "21 Linework" for information on Linework.

Description of fields

Field	Option	Description
Automatically create lines & areas when coding	Check box	If checked, lines and areas can be automatically created and opened using codes.
Use a stringing attribute	Check box	Available if Automatically create lines & areas when coding is checked. If checked, surveyed points that have the same code and attribute value for the Stringing attribute are strung together on one line.
Attribute	Selectable list	Available if Use a stringing attribute is checked. The attribute value used to determine which surveyed points are strung together on one line.

Field	Option	Description
Begin line	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.
3pt curve	Editable field	Stores the linework flag for a curve through the next three measured points and continues a line/area.
Re-open last line	Editable field	Opens the last used line again.
End line	Editable field	Closes all open lines.
Cont line/area	Editable field	Indicates a line/area is open.
Start spline	Editable field	Stores the linework flag for beginning a spline and continues any open line/area.
End spline	Editable field	Stores the linework flag to stop a spline.
Cont spline	Editable field	Indicates a line/area is open with spline line type.
Begin area	Editable field	Opens a new area when the next point is stored. Any areas which are currently open are closed. The point can be stored with a point code.
Re-open last area	Editable field	Opens the last used area again.
Close area	Editable field	Closes all open areas.

Next step

Page changes to the **Quick coding** page.

Description of fields

Field	Option	Description
Quick coding	Never On Off	Prevents the use of quick coding completely. Allows the use of quick coding and activates it. Allows the use of quick coding, but keeps it deactivated.
Digits to use	1, 2 or 3	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.
Store free code	After pt is stored or Before pt is stored	Determines if a free code measured with a quick code is stored before or after the point.

Next step

Page changes to another page on this screen.

Description

Display settings define the parameters shown on a page on the survey screen.

Four survey screen pages are definable.

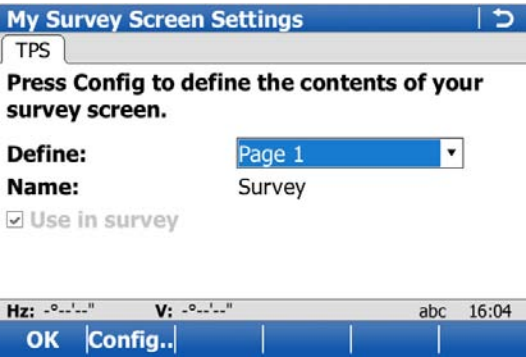
- Page 1:** Always shown on the survey screen.
- Page 2:** Can be shown or hidden on the survey screen.
- Page 3:** Can be shown or hidden on the survey screen.
- Page 4:** Never shown on the survey screen. Reserved for applications.

The settings on this screen define the layout of the four survey screen pages.

Access

Select **Main Menu: User\Work settings\My Survey Screen**.

My Survey Screen
Settings,
TPS and GPS page



- OK**
To accept changes and return to **Main Menu**.
- Config..**
To configure the selected survey screen page.
- Page**
To change to another page on this screen.
- Fn Quit**
To exit the screen.

Field	Option	Description
Define	Page 1, 2, 3 or 4	Selected survey screen page.
Use in survey	Check box	Indicates if the survey screen page is shown or hidden as a page in Survey .

Highlight the survey screen page and **Config..** to access **Configure Page.**

Configure Page 1

Name: Survey

1st line:	Point ID
2nd line:	Target height ▾
3rd line:	Line space full ▾
4th line:	Hz angle ▾
5th line:	V angle ▾
6th line:	Horiz distance ▾

Hz: 0...0...'' **V:** 0...0...'' abc 16:05

OK **Clear** **Default**

To accept changes and to return to previous screen.

To set all fields to **Line space full**.

To recall the default settings.

To exit the screen.

Field	Option	Description
Name	Editable field	The name of the page is shown as page name in Survey .

Field	Option	Description
Show in the Survey application	Check box	Shows or hides the page as a page in Survey .
1st line	Display only	Fixed to Point ID .
2nd line to 16th line	Angle right % completed Annotation 1 to Annotation 4 Antenna height Attrib (free) 01 to Attrib (free) 20 Attrib 01 to Attrib 20 Automation	For each line, one of the following options can be selected. Displays the horizontal angle difference between the backsight point and the current telescope position. Display only field for the percentage of the time for which the point has been occupied based on the setting for Stop criteria in screen Quality Control. Appears in the page during the point occupation if Quality Control is checked. Editable field for comments to be stored with the point. Input field for antenna height for static observations. Display only field for attributes for free codes. Editable field for attributes for codes. Unavailable for SmartStation. Select automation type.

Field	Option	Description
	Avg max #distances TPS	Input field for maximum number of distance measurements in the averaging EDM mode.
	Azimuth TPS	Display only field for the azimuth.
	Backsight pt ID TPS	Display only field for the point ID of the backsight point.
	Code	Editable field for codes.
	Code (free)	Editable field for free codes.
	Code desc (free)	Display only field for the description of free codes.
	Description	Display only field for the description of codes.
	Easting TPS	Display only field for Easting coordinate of measured point.
	GDOP GPS	Display only field for the current GDOP of the computed position.
	HDOP GPS	Display only field for the current HDOP of the computed position.
	Elevation TPS	Display only field for the height coordinate of the measured point.
	Height difference TPS	Display only field for the height difference between station and reflector.
	Horiz distance TPS	Display only field for horizontal distance.

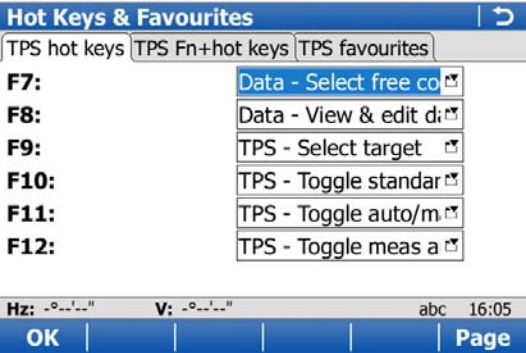
Field	Option	Description
	Humidity GPS	Editable field for relative humidity to be stored with point.
	Hz angle TPS	Display only field for the horizontal angle.
	Instrument height TPS	Display only field for the instrument height.
	Line space full	Insert full line space.
	Line space half	Insert half line space.
	Linework	Selectable list with option for flagging a line/area.
	Measure mode TPS	Select EDM measurement mode.
	Measure TPS	Select EDM type.
	Moving antenna ht GPS	Input field for antenna height for moving observations.
	Msd PP obs GPS	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.
	Northing TPS	Display only field for Northing coordinate of measured point.
	Number of dists TPS	Display only field for number of averaged distances measured with EDM mode averaging.

Field	Option	Description
	Offset left/right TPS	Input field for horizontal distance offset for measured point, perpendicular to the line of sight.
	Offset height TPS	Input field for height offset for measured point.
	Offset in/out TPS	Input field for horizontal distance offset, in the direction of line of sight.
	Offset mode TPS	Select offset mode.
	PDOP GPS	Display only field for the current PDOP of the computed position.
	PPM atmos TPS	Display only field for atmospheric ppm.
	PPM geometric TPS	Display only field for geometric ppm value.
	PPM total TPS	Display only field for the total ppm value.
	Point ID	Editable field for the point ID.
	Pressure GPS	Editable field for atmospheric pressure.
	Prism constant TPS	Display only field for additive constant of currently selected reflector.
	Quality 1D GPS	Display only field for the current height coordinate quality of computed position.
	Quality 2D GPS	Display only field for the current 2D coordinate quality of computed position.

Field	Option	Description
	Quality 3D ☐ GPS	Display only field for the current 3D coordinate quality of computed position.
	RTK positions ☐ GPS	Display only field for the number of positions recorded over the period of point occupation. Appears in the page of real-time rover configurations.
	SD (last recorded) ☐ TPS	Display only field for the last recorded distance.
	Slope distance ☐ TPS	Display only field for measured slope distance.
	Station ID ☐ TPS	Display only field for current station ID.
	Station easting ☐ TPS	Display only field for current station Easting coordinates.
	Station height ☐ TPS	Display only field for current station height coordinates.
	Station northing ☐ TPS	Display only field for current station Northing coordinates.
	Std deviation ☐ TPS	Display only field of standard deviation in millimetres of averaged distances.
	Target ☐ TPS	Select a prism.
	Target height ☐ TPS	Input field for prism height.

Field	Option	Description
	Temp dry GPS	Editable field for dry temperature to be stored with point.
	Temp wet GPS	Editable field for wet temperature to be stored with point.
	Time at point GPS	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.
	Type	Display only field for the type of code, for example point code, line code or area code.
	V angle TPS	Display only field for vertical angle.
	V angle display TPS	Select vertical angle display.
	VDOP GPS	Display only field for the current VDOP of the computed position.

Description	The settings on this screen assign functions, screens or applications to each of the first and second level of hot keys, and the favourites key.
Access	Select Main Menu: User\Work settings\Hot keys & favourites . OR Hold a hot key down for two seconds. This action is also possible after pressing Fn .
Hot Keys & Favourites, GPS Hot Keys/TPS Hot Keys page	To configure the first level of hot keys. This page is only available for CS15 models. CS10 models do not have hot keys.



- OK
To accept changes and return to **Main Menu**.
- Page
To change to another page on this screen.
- Fn Quit
To exit the screen.

Description of fields

Field	Option	Description
F7 to F12	Selectable list	All functions, screens or applications which can be assigned to the particular key.

Hot Keys & Favourites, GPS Fn+hot keys/TPS Fn+hot keys page

Next step

Page changes to the **GPS Fn+hot keys/TPS Fn+hot keys** page.

To configure the second level of hot keys.

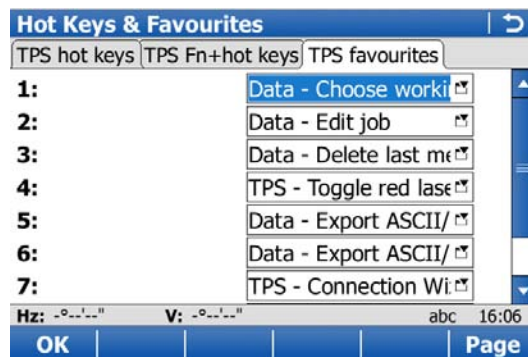
This page is only available for CS15 models. CS10 models do not have hot keys.

The functionality on this page is identical to the one on the **GPS Hot Keys/TPS Hot Keys** page.

Next step

Page changes to the **GPS favourites/TPS favourites** page.

Hot Keys & Favourites, GPS favourites/TPS favourites page



OK

To accept changes and return to **Main Menu**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
1 to 9	Selectable list	All functions, screens or applications which can be assigned to the individual lines in the user-defined menu.

Next step

Page changes to the first page on this screen.

Description

A code is a description which can be stored by itself or with a point, line, or area. SmartWorx Viva coding is flexible with what types of codes can be stored and also how they are entered. Thematical and/or free codes can be stored to the system by;

- selecting codes from a codelist,
- entering a quick code combination,
- directly typing in the code, or
- selecting the code from a SmartCodes screen.

Quick coding and SmartCodes are both quick ways for a code to be selected, a point to be measured, and both code and point to be stored.



For coding, points, lines and areas have the same behaviour. In this chapter, the word object is used as a generic term for points, lines and areas.

Coding methods

Coding method	Characteristic	Description
Thematical	Use	To store a description together with an object inside an application or in Main Menu: Jobs & Data\ View & edit data.

Coding method	Characteristic	Description
	Recording of the codes	For free coding with direct input: Pressing the configured hot key opens a screen for alphanumeric input. Stored as time-related information. A time stamp is stored with each free code. Free codes selected using quick coding can be configured to be stored before or after the object.
Quick	Use Selection of the codes Recording of the codes	Quick coding is the storing of an object plus a thematical or free code using a minimum number of keystrokes. Shortcuts must be assigned to codes in the jobodelist. Quick coding: On must be set in Coding & linework settings, Quick coding page. Typing the shortcut searches for the assigned code. Point measurement begins. - For thematical codes: Together with the objects. With Automatically stop point measurement and Automatically store point both checked in Quality control, the points and codes are immediately stored. - For free codes: Stored as time-related information before or after the points. A time stamp is stored with each free code.

Coding method	Characteristic	Description
		Quick codes must be created in LGO. Characters that can be assigned to quick codes are: • 0 to 9 • A to Z • a to z

Configure coding

Refer to "19.2 Coding & linework" for information on configuring coding.

20.2

20.2.1

Thematical Coding

Thematical Coding with Codelist

Requirements

- The job codelist contains thematical codes for points, lines and/or areas.
- **Use a list box to view codes** is checked in **Coding & Linework Settings**.
- A survey screen page with an editable field for codes must be configured.

Access

Open the selectable list for **Code** in a survey screen page of an application.

OR

Open the selectable list for a **Code/Point code** in **New Point, Code** page. The procedure is similar for lines and areas.

OR

Open the selectable list for **Point code** in **Edit Point:, Code** page. The procedure is similar for lines and areas.

OR

Open the selectable list for **Code (auto)** in **Survey, Auto** page, if configured.

Select Code

Select Code is shown as an example.

Depending on the setting for **Automatically create lines & areas when coding** in **Coding & Linework Settings, Linework** page, either;

- all point, line and area codes are available for selection, or
- only those point codes from the job codelist, which belong to an active code group, are available for selection.

Codes marked with * have attributes attached.

Select Code	
Code	Code description
<None>	
LFL*	LeftFenceLine
TR*	Tree
BU	Bush
MH	Manhole
RFL*	RightFenceLine
PG*	SurveyPeg

3DCQ:0.010m	2DCQ:0.005m	1DCQ:0.009m	Q1 abc	09:48
OK	New..	Attrib	Last	More

OK

To accept changes and to return to the screen from where this screen was accessed.

New..

To create a new code.

Attrib

Available unless creating/editing a point/line/area. To type in attribute values for the selected code and/or add new attributes for the selected code.

Last

Available if a code has been previously used in the working 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.

More

To display information about the code description, the code group, the code type and the quick code if codes with quick codes exist in the job.

Fn Group

To view, create, delete, activate and deactivate code groups. Refer to "6.5 Managing Code Groups"

Fn Sort

To sort codes by code name, code description, quick code, in the order they were added to the codelist, or the last used.

Fn Quit

To exit the screen.

Next step

Highlight the desired code.

- If a point code is selected then any open line/area is closed. The measured point is stored with the selected code independently of any line/area.
- If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The measured point is assigned to that line. The line stays open until it is closed manually or another line code is selected.
- If an area code is selected then the behaviour is as for lines.

Attrib 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. Type in the attribute values. Attribute values for attributes of type

- normal can be edited.
- fixed cannot be edited.

Enter Attributes	
Point code:	TR
Description:	Tree
Diameter:	-----
Attribute 2	-----

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Q1 abc 09:48				
OK	+Attrib	Value	Last	Default

OK

To return to the screen from where this screen was accessed.

+Attrib

To add a new 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 LGO.

Name or Value

Available for attributes for which an attribute name can be typed in. To highlight the field of the attribute name or the field for the attribute value. The name of the attribute can be edited and the attribute value to be used as the default attribute value can be typed in.

Last

To recall the last used attribute values for the selected code.

Default

To recall the default attribute values for the selected code.

Fn Quit

To exit the screen.

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 screen opens where the code or attribute mismatch can be corrected.

20.2.2

Thematical Coding without Codelist

Requirements

- **Use a list box to view codes** is NOT checked in **Coding & Linework Settings**.
 - A survey screen page with an editable field for codes must be configured.
 - A survey screen page with a selectable list for code types must be configured.
-

Access

A thematical code is typed in the field

Code in a survey screen page of an application.

OR

Code/Point code in **New Point, Code** page. The procedure is similar for lines and areas.

OR

Point code in **Edit Point:, Code** page. The procedure is similar for lines and areas.

OR

in the field **Code (auto)** in **Survey, Auto** page, if configured.

Survey, Code page

Type in a code and attribute values. Up to eight attributes can be added. This setting is configured in the survey screen page.

- If a point code is selected then any open line/area is closed. The measured point is stored with the selected code independently of any line/area.
- If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The measured point is assigned to that line. The line stays open until it is closed manually or another line code is selected.
- If an area code is selected then the behaviour is as for lines.

Next step

Press **Meas.**

20.3

20.3.1

Free Coding

Free Coding Using a Codelist

Requirements

- The job codelist contains free codes.
 - A hot key is configured to access the screen **Enter Free Code & Attributes** or the favourites menu is configured to display the option **Select free code from list**.
-

Access

Press a hot key configured to access the screen **Enter Free Code & Attributes**. Refer to "1.1 Hot Keys" for information on hot keys.

OR

For GPS mode, press  and select **Select free code from list** to access the screen **Select Free Code**.

For TPS mode, press Fn  and select **Select free code from list** to access the screen **Select Free Code**.

Refer to "1.2 Favourites Key" for information on the  key.

Select Free Code

All free codes from the job codelist which belong to an active code group, are available for selection. Free codes marked with * have attributes attached.

Select Free Code	
Code	Code description
RE	Right edge of rd
LE	Left edge of rd
CL	Centre line

3DCQ:0.010m	2DCQ:0.005m	1DCQ:0.008m	Q1 abc	09:49
Store	New..	Attrib	Last	More

Store

To store the free code and any associated attribute values and to return to the screen from where this screen was accessed.

New..

To create a new code.

Attrib

To type in attribute values and/or add new attributes for the selected free code. Refer to "20.2.1 Thematical Coding with Codelist".

Last

Available if a free code has been previously used in the working 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.

More

To display information about the code description, the code group and the quick code if codes with quick codes exist in the job.

Fn Group

To view, create, delete, activate and deactivate code groups. Refer to "6.5 Managing Code Groups"

Fn Sort

To sort codes by code name, code description, quick code or the last used.

Fn Quit

To exit the screen.

20.3.2

Free Coding with Direct Input

Requirements

A hot key is configured to access the screen **Enter Free Code & Attributes** or the favourites menu is configured to display the option **Enter free code**.

Access

Press a hot key configured to access the screen **Enter Free Code & Attributes**. Refer to "1.1 Hot Keys" for information on hot keys.

OR

For GPS mode, press  and select **Enter free code** to access the screen **Enter Free Code & Attributes**.

For TPS mode, press Fn  and select **Enter free code** to access the screen **Enter Free Code & Attributes**.

Refer to "1.2 Favourites Key" for information on the  key.

Enter 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 "20.3.1 Free Coding Using a Codelist" for a description of keys.

Next step

Press **Store**.

Requirements

- The job codelist contains quick codes for points, lines and/or areas.
- According to the user requirements, set **Store free code: Before pt is stored** or **Store free code: After pt is stored** in **Coding & Linework Settings, Quick coding**.

Activate quick coding

The current setting for **Quick coding** in the **Quick coding** page determines how quick coding is activated. Quick coding can be activated at any time.

- For **Quick coding: On**, Quick coding is active and can be used.
- For **Quick coding: Off**, use a hot key, the  favourites menu or tap the quick coding icon.
- For **Quick coding: Never**, change the setting manually.

Performing Quick coding

A screen 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 & Linework Settings, Quick coding** 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 attributes** in **Coding & Linework Settings, 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 screen 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 & Linework Settings, Quick coding** page determines if the free code is stored before or after the point.

For line/area codes:

- The line/area code assigned to the quick code is searched for in the job codelist.
 - A new line/area is created and immediately stored with that line/area code and attributes. For the line/area ID, the line/area ID template as defined in **ID Templates** is used.
-

20.5

20.5.1

SmartCodes

Overview

Description

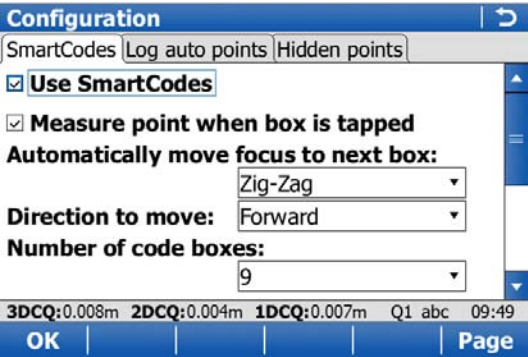
SmartCodes is a quick way for a code to be selected and a point to be measured. All existing coding, linework, and point measurement functionality is retained.

Access

In **Survey** press **Fn Config..** to access **Configuration**.

Configuration Smart-Codes page

The settings on this page activate the using of SmartCodes and define the method. All settings in this screen are stored within the currently active working style.



- OK**
To accept changes and return to the screen from where this screen was accessed.
- Page**
To change to another page on this screen.
- Fn Quit**
To exit the screen.

Description of fields

Field	Option	Description
Use Smart-Codes	Check box	If checked, using of SmartCodes is activated.  All other fields on the screen are active and can be edited.
Measure point when box is tapped	Check box	If checked, when one of the code boxes is tapped in Survey, SmartCodes page, then the code is selected and the point is measured.

Field	Option	Description
Automatically move focus to next box		Method by which subsequent code box is selected after a point is stored.
	Not used	Nine code boxes are shown in the Survey, Smart-Codes page, but no automatic movement of the focus takes place.
	Zig-Zag	Each new code rotation through the block is started at the same end where the previous code rotation finished.
	Same direction 	Each new code rotation through the block is started at the same end where the previous code rotation started. Refer to "47 Survey Cross Section" for an explanation of Zig-Zag and Same direction .
Direction to move		Available for Automatically move focus to next box: Zig-Zag and Automatically move focus to next box: Same direction . The way of using the code boxes. This setting controls the order in which the code boxes will be rotated through automatically.
	Forward	The code boxes are used in the same way as defined in Survey, SmartCodes page.
	Backward	The code boxes are used in the reverse way as defined in Survey, SmartCodes page.

Field	Option	Description
Number of code boxes	From 1 to 9	Available for Automatically move focus to next box: Zig-Zag and Automatically move focus to next box: Same direction . Number of code boxes shown in Survey, SmartCodes page.
Show at bottom of screen	Not used Point ID 3D CQ 2D CQ 1D CQ Linework Antenna height GPS	Information shown in line 8 of Survey, SmartCodes page. No survey screen page element is shown. The identifier for manually measured points. The configured point ID template is used. The current 3D coordinate quality of the computed position. The current 2D coordinate quality of the computed position. The current height coordinate quality of the computed position. The linework flag to be stored with the point. The options available depend on whether a line/area is currently open. The height of the antenna that is being used. Changing the antenna height here does not update the default antenna height as defined in the active working style.

Field	Option	Description
	Target height TPS Hz TPS V TPS Horiz distance TPS Slope distance TPS Height difference TPS	The height of the reflector that is being used. Changing the reflector height here does not update the default reflector height as defined in the active configuration set. The current horizontal angle of the measured point. The current vertical angle of the measured point. The current horizontal distance of the measured point. The current slope distance of the measured point. The current height difference between the station and the measured point.
Automatically create lines & areas when coding	Check box	If checked, lines and areas can be automatically created and opened using codes.
Use a stringing attribute	Check box	Available if Automatically create lines & areas when coding is checked. If checked, surveyed points that have the same code and attribute value for the Stringing attribute are strung together on one line.

Field	Option	Description
Stringing attribute	Selectable list	Available if Use a stringing attribute is checked. The attribute value used to determine which surveyed points are strung together on one line.

20.5.3

Code Block

Requirements

- Use **SmartCodes** ticked in **Configuration, SmartCodes** page.

Survey, SmartCodes page

Survey: JobName

Survey Code Annot SmartCodes Map

Code block: 1

LFL	TR	RFL
BU	<None>	<None>
<None>	<None>	<None>

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Q1 abc 09:50

Meas Codes.. Page

Meas

To start recording positions.

Codes..

To select a code to be assigned to the highlighted code block. Available when a code box is highlighted.

Page

To change to another page on this screen.

Description of fields

Field	Option	Description
Code block	Selectable list	The code block to be used.
Code box	-	A measured point is stored with the code assigned to the highlighted code box.

Field	Option	Description
		 When Stringing attribute is configured in Stringing attribute, SmartCodes page, an attribute value can be typed in below the code name of the highlighted code box. The attribute value can also be modified using the softkeys + and -.  For Measure point when box is tapped being checked in Stringing attribute, SmartCodes page, tapping the code box with the supplied stylus automatically starts measuring the point. Selecting the code box by using the arrow keys will not start measuring the point.  Lines/areas are automatically opened and closed using SmartCodes, as configured.
Linework	Selectable list	Available for Show at bottom of screen: Linework . Select the linework flag to be stored with the point. Then move the focus on the line/area code box.

Next step

Highlight a code block and press **Codes..** to access **Select Code**.

Select Code

Select Code		↩
Code	Code description	
<None>	----	
LFL*	LeftFenceLine	
TR*	Tree	
BU	Bush	
MH	Manhole	
RFL*	RightFenceLine	
PG*	SurveyPeg	

3DCQ:0.010m	2DCQ:0.005m	1DCQ:0.009m	Q1 abc	09:48
OK	New..	Attrib	Last	More

OK

To accept changes and return to the screen from where this screen was accessed.

New..

To create a new code.

Attrib

To type in attribute values for the selected code and/or add new attributes for the selected code.

Last

Available if a code has been previously used in the working 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.

More

To display information about the code description, the code group, the code type and the quick code if codes with quick codes exist in the job.

Fn Group

To view, create, delete, activate and deactivate code groups. Refer to "6.5 Managing Code Groups"

Fn Sort

To sort codes by code name, code description, quick code, in the order they were added to the codelist, or the last used.

Fn Quit

To exit the screen.

Copying a code block to a new job step-by-step

Step	Description
	Code blocks are stored in the job.
1.	Select Main Menu: Jobs & Data\ Job properties. OR Select Main Menu: Jobs & Data\ Choose working job or Choose control job. Edit.. to access Job Properties:.
	Codelist: If codes had been copied from the internal memory codelist, the name of the codelist is displayed. If codes have been typed in, then the name of the job is displayed.
2.	Fn Export to copy codes and code blocks from the job to an existing or new codelist.
	Copying code blocks to an existing codelist overwrites the code blocks of the existing codelist.
3.	OK and Store to save the current job and return to Main Menu.
4.	Create a new job and assign the related codelist to the job.
	SmartCodes from the codelist are now available within the new job.

20.6

20.6.1

Code and Attribute Mismatch

Code Mismatch

Description

When storing a point with a code, it can happen that a point with the same point ID already exists in the job. If the codes of the new and the existing point do not match, a screen opens where the code can be corrected. One point cannot have different codes.

Point Code Mismatch

This screen 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 | ➔

Point ID: P101

New Code: TR

Description: Tree

Stored Code: LFL

Description: LeftFenceLine

3DCQ:0.010m 2DCQ:0.005m 1DCQ:0.008m Q1 abc 09:53

Store More

Store

To store the highlighted code and any associated attributes with the point being stored and to continue with the application or data management.

More

To display information about the code description, the code group and any attributes associated with the highlighted code.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
New Code	Display only	The code for the point.
Stored Code	Display only	The code as stored for the existing point in the job.

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 screen opens where the attribute mismatch can be corrected. One point cannot have different attribute information.



The name of the screen changes with pressing **Current** or **Stored**:

Pressing Current :	Attributes Being Stored
Pressing Stored :	Attributes Already Stored

Attributes Already Stored/Attributes Being Stored

This screen opens automatically if the attribute names and/or values of the new and the existing point do not match.

Attributes Already Stored	
Point ID:	P101
Point code:	LFL
Description:	LeftFenceLine
Colour:	Beige

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Q1 abc 09:54				
Store				Current

Store

To store the selected attributes with the new/created point and to continue with the application or data management.

Current or Stored

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.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point code	Display only	• For Attributes Already Stored: The code of the existing point in the job. • For Attributes Being Stored: The code of the new point.
Attributes	Display only	• For Attributes Already Stored: The attributes as stored for the existing point in the job. • For Attributes Being Stored: The attributes of the new point.

Description

Working with lines can be automated. Two ways of working are available. They are listed in this table. The two ways of working can be mixed.

Linework by	Description
Linework listbox	In all applications and on the Auto page in Survey, a survey screen page can be configured to show a field Linework with a selectable list. The selection from the selectable list determines • the action taken for a line/area, for example opening or closing a line. • the linework flag stored with a point. The linework flags • are configured in Coding & Linework Settings, Linework page. • can be exported with a format file.
Coding	Point, line or area codes can be selected in many applications. Selecting a point, line or area code closes any open line/area and opens a new line/area. Refer to "20 Coding" for more information.



The linework flag can be used without thematical coding by using the linework field in the Survey screen page configuration.

The code can be linked to linework if it is configured as a point code to start a line/area, or it is a line or area code.

Quick coding can be used as described in "20.4 Quick Coding".



Requirements

The Survey application is used here to explain Linework.

- A survey screen page with a selectable list for Linework must be configured.
- The linework flags must be defined in **Coding & Linework Settings, Linework** page.
- GPS The rover menu must be used.

Access

Select **Main Menu: Go to Work!\Survey**.

Linework using the
linework field step-by-
step

Step	Description
1.	Go to the point to be measured.
2.	Select the linework flag to be stored with the point.
3.	Measure the point.
	Depending on the option selected for Linework , a line/area is opened, closed or reopened.
4.	Repeat steps 1. to 5. until all points for the linework are measured.
5.	Fn Quit to exit the Survey application.
6.	Use a format file to export the points including the linework flags.

Description

Linework and coding can be combined.

This combination can be useful, because coding, assigning linework flags and opening/closing lines/areas can all be done with one point observation.

Combining Linework and coding can only be configured if thematical point codes or if thematical point, line and area codes are available for selection. Thematical coding can be done with or without codelists.

**Configuration options**

Linework and coding can also be combined using SmartCodes. Refer to "20.5 SmartCodes".

The configuration for the types of codes available and the configuration for coding with/without a codelist both have an influence on the following:

- The required configuration of a survey screen page.
- The behaviour of the fields configured for the survey screen page.
- The behaviour of the software.

The possible configurations and their influence on the coding related fields are shown in this table:

Configuration selected in the Coding & Linework Settings screen		Behaviour of the coding related fields depending on the configuration selected.		
		Code	Code type	Linework
Use a list box to view codes	☒	Selectable list	Display only	Selectable list
Automatically create lines & areas when coding	☒			
Use a list box to view codes	☒	Selectable list	Display only	Selectable list
Automatically create lines & areas when coding	☐			
Use a list box to view codes	☐	Editable field	Selectable list	Selectable list
Automatically create lines & areas when coding	☒			
Use a list box to view codes	☐	Editable field	Display only	Selectable list
Automatically create lines & areas when coding	☐			

Requirements

- A survey screen page must be configured with
 - a field for **Code**.
 - a selectable list for **Linework**.
 - a selectable list for **Code type** when using point, line and area codes without a codelist (**Use a list box to view codes** is unchecked).
This field is not required if only point codes are used, or when working with a codelist (**Use a list box to view codes** is checked).
- Configure in **Coding & Linework Settings, Code & attributes** page
 - **Automatically create lines & areas when coding** checked or not checked.
 - **Use a list box to view codes** checked or not checked.
- In **Coding & Linework Settings, Linework** page, define the linework flags.
- GPS The rover menu must be used.



Access

The Survey application is used here to explain the combination of Linework and Coding.

Select **Main Menu: Go to Work!\Survey**.

Survey, Survey page

This example is what a survey screen page configured for Linework and coding looks like. The most important keys are explained.

The screenshot shows a software interface for a survey. At the top, there's a title bar 'Survey: Job name' with a refresh icon. Below it are four tabs: 'Survey' (selected), 'Code', 'Annot', and 'Map'. The main area contains several input fields: 'Point ID:' with a dropdown showing 'P1001', 'Code:' with a text box containing 'EL', 'Code type:' with a dropdown showing 'Line', 'Linework:' with a dropdown showing 'Begin line', and 'Antenna height:' with a text box containing '2.000' and a unit 'm'. Below these fields, there's a status bar showing '3D CO: -----m' and '3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 12:20'. At the bottom, there's a navigation bar with buttons: 'Meas', 'Near', 'HdnPt..', and 'Page'.

Meas **GPS**

To start recording positions. The key changes to **Stop**.

Stop **GPS**

To end recording of positions when enough data is collected. The key changes to **Store**.

Store **GPS**

To store the point information. The key changes to **Meas**.

All **TPS**

To measure and store distances and angles.

Stop **TPS**

Available if **Measure mode: Tracking** and **Dist** was pressed. Stops the distance measurements. The key changes back to **All**.

Dist **TPS**

To measure and display distances. Available unless **Measure mode: Tracking** and/or **Log auto points** checked, after the tracking or logging is started.

Store TPS

To record data. If **Measure mode: Tracking** and/or **Log auto points** checked, records measured point and continues tracking.

Linework and Coding step-by-step

Step	Field	Description for thematical coding	
		Use a list box to view codes checked	Use a list box to view codes not checked
1. 	Code	Select a code from the selectable list. Depending on the configuration only point codes, or also line and area codes are available for selection. <None> to store a point without code or to perform Linework without coding.	Type in a code. ----- to store a point without code or to perform Linework without coding.
2.	Code type	Point is displayed. This field is a display only field. It cannot be changed.	
3. 	Linework	Select an option for the linework flag to be stored with the point. Refer to "21.2 Performing Linework using the Linework Field" for a description of the options. Select ----- to store a point without linework flag or to perform coding without Linework.	
4.	-	GPS Press Meas, Stop and Store. TPS Press All.	

Step	Field	Description for thematical coding	
		Use a list box to view codes checked	Use a list box to view codes not checked
	- - -	• The point is stored with the selected code. • The point is stored with the selected linework flag. • The choice of linework flags available for Linework is updated.	

22

22.1

User - Working style wizard

Overview

Description

The software has many configurable parameters and functions which can be set by the user to suit their preferred method of working. These preferred settings can be saved as a Working Style.

Using the **Working Style Wizard**, all the settings can be defined at once. Alternatively, all screens of this wizard can also be accessed individually from **User\Work settings** and **User\System settings**.

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.

Edit outside the working style wizard

Parameters and functions can be edited without going through the working style wizard.

Access

Select **Main Menu: User\Working style wizard**.

Working Style Wizard



Next

To accept changes and to continue with the subsequent screen within the wizard.

Back

To return to the previous screen.

Fn Quit

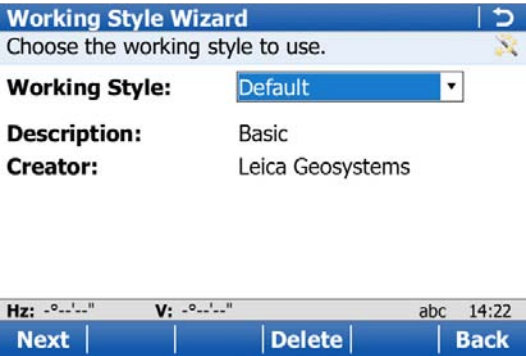
To exit the wizard.

Next step

IF you want to	THEN
select a different set of settings	select New working style , press Next and continue with "22.3 Choosing a Different Working Style".
create a new set of settings	select Choose a different working style , press Next and continue with "22.4 Creating a New Working Style".
edit an existing set of settings	select Edit a working style , press Next and continue with "22.5 Editing a Working Style".

**Working Style Wizard,
Choose the working style
to use.**

Select an existing working style from the selectable list.



- Next**
To accept changes and to continue with the subsequent screen within the wizard.
- Delete**
To delete the highlighted working style.
- Back**
To return to the previous screen.
- Fn Quit**
To exit the wizard.

**Working Style Wizard,
Enter the working style
details**

Type in the name and a description for the new working style.

Working Style Wizard

Enter the working style details

Name:

123

Description:

Creator:

Next

To accept changes and to continue with the subsequent screen within the wizard.

Back

To return to the previous screen.

Fn Quit

To exit the wizard.

Hz: -o-!-"

V: -o-!-"

abc

14:23

Next

Back

**Working Style Wizard,
Choose the working style
to edit.**

Select the working style to be edited from the selectable list.

Working Style Wizard

Choose the working style to edit.

Working Style:

Default

Description:

Basic

Creator:

Leica Geosystems

☐ Create a copy

Hz: -°_-'_..''

V: -°_-'_..''

abc

14:23

Next

Delete

Back

- Next**
To accept changes and to continue with the subsequent screen within the wizard.
- Delete**
To delete the working style currently shown in the selectable list immediately.
- Back**
To return to the previous screen.
- Fn Quit**
To exit the wizard.

Description of fields

Field	Option	Description
Create a copy	Check box	Creates a copy of the working style before the editing process starts.

23

23.1

User - System settings

Regional settings

Description

The settings on this screen 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 **Main Menu: User\System settings\Regional settings**.

Regional Settings, Distance page

The screenshot shows the 'Regional Settings' screen with a blue header bar. Below the header, there are tabs for 'Distance', 'Slope', 'Angle', 'Time', 'Coords', 'Language', and 'Other'. The 'Distance' tab is selected. The settings are as follows:

Distance:	Metre (m)
Distance decimal:	3
Chainage format:	+123456.789
Area:	m ²
Volume:	m ³

At the bottom, there is a status bar with 'Hz: -0.0000"', 'V: -0.0000"', 'abc', and '15:54'. Below this is a blue bar with 'OK' and 'Page' buttons.

OK

To accept changes and return to **Main Menu**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Distance	Metre (m) International ft (fi) Intl ft/inch (fi) US ft (ft) US ft/inch (ft) US miles (mi) Kilometres (km)	The units shown for all distance and coordinate related fields. Metres [m] International feet [fi], storage in US feet International feet [fi], inches and 1/8 inches (0' 00 0/8 fi), storage in US feet US feet [ft] US feet, inches and 1/8 inches (0' 00 0/8 fi) [ft] US miles [mi] Kilometres [km]
Distance decimal	From 0 to 4	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 Distance.
Chainage format	+123456.789 +123+456.789 +1234+56.789 +123.4+56.789	Selects display format for all chainage information fields. Default chainage display form. Separator between hundreds and thousands. Separators between tens and hundreds. Separator between tens and hundreds with additional decimal point.

Field	Option	Description
Area	m ² , Intl acres (Ai), US acres (A), Hectares (ha), fi ² or ft ²	The units shown for all area-related fields.
Volume	m ³ , fi ³ , ft ³ or yd ³	The units shown for all volume-related fields.

Next step

Page changes to the **Slope** page.

Regional Settings, Slope page

OK

To accept changes and return to **Main Menu**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
All fields		The input and output format for grades.

Field	Option	Description
	h:v	Horizontal by vertical distance.
	v:h	Vertical by horizontal distance.
	%(v/h x 100)	Percentage of vertical by horizontal distance.
	Elevation angle	Elevation angle.

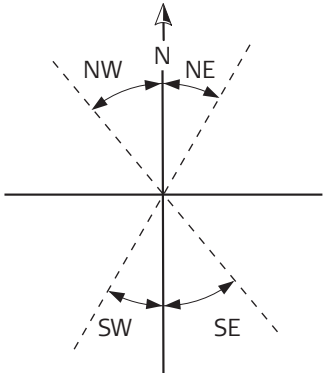
Next step

Page changes to the **Angle** page.

Regional Settings, Angle page

Description of fields

Field	Option	Description
Angle	400 gon, 360°", 360° dec or 6400 mil	The units shown for all angular and coordinate related fields.
Angle decimal	From 1 to 3 From 2 to 4 1", 5", 10" or 60"	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. Available for Angle: 6400 mil. Available for Angle: 400 gon and Angle: 360° dec. Available for Angle: 360°".

Field	Option	Description
Azimuth ref	North azimuth, South azimuth, North anti-clockwise or Bearing	Sets the reference direction as well as the direction from where and how azimuths are computed. For Azimuth ref: Bearing, the azimuth/bearing fields in other screens are called Bearing. NE, SW, SE and NW indicate the quadrant of the bearing.  GS_049 For all other options, the azimuth/bearing fields in other screens are called Azimuth.
GPS direction ref	True or Magnetic	Sets the North direction.
Declination	Editable field	Available for GPS direction ref: Magnetic . The value for the magnetic declination. It is considered when computing or using any azimuth values.

Field	Option	Description
V angle display TPS	Zenith angle	V = 0 in zenith.
	Elevation angle	V = 0 horizontal elevation angle. Vertical angles are positive above the horizon and negative below it.
	Elevation angle %	V = 0 horizontal. Vertical angles are expressed in % and are positive above the horizon and negative below it.
Hold V angle after a Dist measurement TPS	Check box	If checked, the vertical angle is fixed after a distance measurement with Dist, whereas the horizontal angle is continuously updated with the telescope movement. 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 Settings, Time page

The time zone is read from WinCE.

Description of fields

Field	Option	Description
Time format	24 hour or 12 hour (am/pm)	How the time is shown in all time-related fields.
Current time	Display only	Shows an example of the selected time format.
Date format	Day.month.year, Month/day/year or Year/month/day	How the date is shown in all date-related fields.
Current date	Display only	Shows an example of the selected date format.

Next step

Page changes to the **Coords** page.

Regional Settings, Coords page

Description of fields

Field	Option	Description
Grid format	Easting, northing or Northing, easting	The order in which grid coordinates are shown in all screens. The order in survey screen pages depends on the user settings.
Geodetic format	Latitude, longitude or Longitude, latitude	The order in which geodetic coordinates are shown in all screens. The order in survey screen pages depends on the user settings.

Regional Settings, Language page

Next step

Page changes to the **Language** page.



OK

To accept changes and return to **Main Menu**.

Delete

To delete the highlighted language.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Language	The languages available on the instrument. Three languages can be stored on the instrument at one time - English and two others. English cannot be deleted. The selected language is used for the system software. If a language is not available for the system software, the English language is used instead. Applications are available in the languages that were loaded on the instrument when the application was installed.

**Regional Settings,
Others page**

Next step

Page changes to the **Others** page.

Description of fields

Field	Option	Description
Temperature	Celsius (°C) or Fahrenheit (°F)	The units shown for all temperature-related fields.
Pressure	mbar, mmHg, Inch Hg (inHg), hPa or psi	The units shown for all pressure-related fields. PSI = pounds per square inch.
Velocity unit	Km/h (kmh), Mph (mph) or Knots (kn)	The units shown for all velocity-related fields.

Next step

Page changes to the **Device ID** page.

Regional Settings, Device ID page

Description of fields

Field	Option	Description
Device ID	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.

Next step

Page changes to another page on this screen.

Description

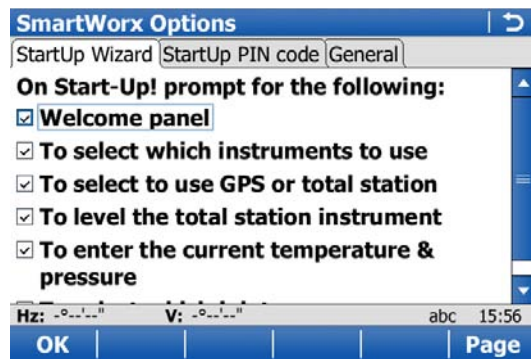
The settings on this screen define the behaviour of the instrument for a general start up.

Access

Select **Main Menu: User\System settings\SmartWorx options**.

Welcome to SmartWorx Viva!

If a check box is checked, the corresponding screen is shown during start up.
If all check boxes are unchecked, then, after turning on the instrument, the **Main Menu** is accessed immediately.



OK

To accept changes and return to **Main Menu**.

Fn Quit

To exit the screen.

Welcome to SmartWorx Viva!, StartUp PIN code page

If **Use PIN: Yes**, then, after turning on the instrument, a PIN code must be entered.

Description of fields

Field	Option	Description
Use PIN	Yes	PIN protection is activated and a PIN code must be entered at startup.

Field	Option	Description
New PIN	No	PIN protection is not activated and no PIN code is required at startup.
	Editable field	Available if Use PIN: Yes The new PIN code that will be required at startup. PIN codes must be numerical only and 4 to 6 digits in length.

Next step

Page changes to the **General** page.

Welcome to SmartWorx Viva!, General page

If the check box for **Use drop down menus in the main menu** is checked, then menus will appear as drop down menus.

If the check box for **Use drop down menus in the main menu** is unchecked, then menus will appear as graphical menus.

Next step

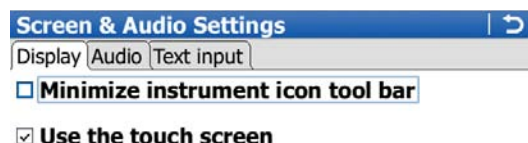
OK to save the changes and return to the **Main Menu**.

Description

The settings on this screen 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 **Main Menu: User\System settings\Screen & audio**.

**Screen & Audio Settings,
Screen page****OK**

To accept changes and return to **Main Menu**.

Calib

To calibrate the touch screen.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

**Description of fields**

Field	Option	Description
Minimize instrument icon tool bar	Check box	If checked, the icon tool bar on the top of the screen is minimised to one small icon on the top left. Tap this icon to make the full icon tool bar visible again.

Field	Option	Description
Use the touch screen	Check box	If checked, the touch screen is turned on.

Next step

Page changes to the **Audio** page.

Screen & Audio Settings, Audio page

Description of fields

Field	Option	Description
Message sounds	Sounds only	A sound alert will be given when an information message appears.
	Sounds & voice	A sound and voice alert will be given when an information message appears.
Warnings volume	Slider from 0% to 100%	Controls the beep for acoustic warning signals.
Key clicks	Slider from 0% to 100%	Controls the beep when pressing a key on the field controller.
Screen taps	Slider from 0% to 100%	Controls the beep when touching the touch screen.
Use Hz sector beeps	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''.

Field	Option	Description
Hz sector angle	Editable field	Editable field for the sector angle for which a beep will sound.

Next step

Page changes to the **Text input** page.

Screen & Audio Settings, Text input page

Description of fields

Field	Option	Description
Alpha mode	Function keys, Mobile phone style or Pop-up keyboard	Alphanumeric input can either be through function or numeric keys. For the CS10 model, alphanumeric input can also be through an on-screen pop-up keyboard to be used with the stylus.
Alpha input method	Selectable list	Sets the set of extra characters available through Alpha or F1-F6 whenever an entry is made. The choices available depend on the character sets loaded on the instrument and the language configured to be used.

Next step

Page changes to another page on this screen.

Description

This chapter describes the basic procedure for transferring objects between the data storage device and the internal memory. Refer to "Appendix C Directory Structure of the Memory Device" for information about file types and locations of files on the data storage device.

Access

Select **Main Menu: User\Tools & other utilities\Transfer user objects**.

Transfer User Objects

Transfer User Objects | ➔

Object to transfer: All objects ▼

From: Internal memory ▼

To: CF card ▼

OK

To transfer an object and return to the screen from where this screen was accessed.

Fn Quit

To exit the screen.

Hz: _o_!_'' V: _o_!_'' abc 15:02

OK | | | |

Description of fields

Field	Option	Description
Object to transfer	Selectable list	Listed are the objects that can be transferred. The available fields on the screen depend on the option selected.
From	CF card SD card USB Internal memory	Memory device to transfer object from. Transfer from CompactFlash card. Transfer from Secure Digital Memory card. Transfer from USB. Transfer from the field controller.
To	Selectable list	Memory device to transfer object to. Memory device not selected in From .
Antenna	Selectable list	To select the antenna records to be transferred.
Codelist	Selectable list	To select the codelist to be transferred.
Working style	Selectable list	To select the configuration set to be transferred.
Coordinate system	Selectable list	To select the coordinate system to be transferred.
CSCS field file	Selectable list	To select the Country Specific Coordinate System to be transferred.
File	Display only	The dial-up list or the server list to be transferred as a binary file.
Format file	Selectable list	To select the format files to be transferred.
Geoid field file	Selectable list	To select the Geoid Field File to be transferred.

Field	Option	Description
Choose working job	Selectable list	To select the job to be transferred.
Transfer all objects of the selected type	Check box	Available for some transfer object options. To transfer all objects.

Access

Select **Main Menu: User\Tools & other utilities\Load firmware & Apps.**

Load firmware & Apps

Load Firmware & Apps

Object to transfer:

Apps

From:

CF card

App:

<None>

Version:

OK
To upload an application, firmware or language and return to the screen from where this screen was accessed.

Delete
To delete an application or language.

Fn Quit
To exit the screen.

Hx: _ _ _ _ " V: _ _ _ _ "

abc 15:03

OK

Description of fields

Field	Option	Description
Object to transfer	Apps	Application uploads are possible from the data storage device to the field controller. These files are stored in the \SYSTEM directory of the data storage device and use the extension *.a*.
	Firmware GPS	Firmware uploads are possible from the data storage device to the field controller. These files are stored in the \SYSTEM directory of the active memory device and use the extension *.fw.

Field	Option	Description
	Language	Language uploads are possible from the data storage device to the field controller. These files are stored in the \SYSTEM directory of the data storage device and use an extension that is individual to each language.
From	Selectable list	Upload from CompactFlash card, Secure Digital Memory card or USB stick.
App	Selectable list	List of application files stored on the card.
Firmware	Selectable list	List of firmware files stored on the card.
Language	Selectable list	List of language files stored on the card.
Version	Display only	Version of the application/firmware/language file chosen.



It is not possible to have more than three language files stored on the instrument. English is always available as the default language and cannot be deleted.



There is only one version of each application. The application will be installed in English and in any other language that is already loaded onto the instrument. If a new language is loaded after an application has been installed, the application will need to be reinstalled to become available in the new language.

24.3

Load licence keys

Description

A licence key can be used to activate applications and protected options and can be used to define the expiry date of the software maintenance. Refer to "24.6 About Leica Viva" to find out how to check the expiry date of the software maintenance.

A licence key file can be uploaded to the field controller. To upload a licence key file the file must be located 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.

Access

Select **Main Menu: User\Tools & other utilities\Load licence keys**.

OR

Select an application not yet activated.

Load Licence Keys

Load Licence Keys | ➔

Load key: Enter manually ▼

Key: -----

Hz: -0--1--' V: -0--1--' abc 15:03

OK | | | | |

OK

To accept changes and return to **Main Menu** or continue with the application.

Fn Delete

To delete all licence keys on the field controller.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Load key		The method used to input the licence key to activate the application or the protected options or the software maintenance.
	Upload key from file	The licence key file is uploaded from the data storage device. The licence key file must be stored in the \SYSTEM directory on the data storage device.
	Enter manually	Allows the licence key to be typed in manually.
Key	Editable field	Available for Load key: Enter manually . The licence key required to activate an application. Entry is not case sensitive.

Description

Allows the data storage device and the internal memory to be formatted. All data will be 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 **Main Menu: User\Tools & other utilities\Format memory devices**.

Format Memory Device**OK**

To format a memory device and return to the screen from where this screen was accessed.

Apps

To format the applications memory.

System

To format the internal memory.

Fn Quit

To exit the screen.



Description of fields

Field	Option	Description
Memory Device	CF card, SD card, USB or Internal memory	The type of memory to be formatted.

24.5

View contents of ASCII files

Description

Allows ASCII files selected for **From file** in **Import ASCII Data** to be viewed in WordPad.

Access

Select **Main Menu: User\Tools & other utilities\View contents of ASCII files**. WordPad opens.

Access

Select **Main Menu: User\About Leica Viva**.

**About Leica Viva,
Controller page**

The information relates to the field controller. This screen shows:

- 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 is installed,
- If Wireless LAN is installed,
- If a GSM is installed.

Next step

Page changes to the **Total station** page.

**About Leica Viva,
Total station page TPS**

The information relates to the TPS instrument. This screen shows:

- The type of instrument,
- Additional instrument hardware options such as EDM or PowerSearch.

Next step

Page changes to the **GPS rover** page.

**About Leica Viva,
GPS rover page GPS**

The information relates to the GPS instrument. This screen shows:

- The currently active system language,
- The serial number of the measurement engine,

- The availability of additional instrument hardware options,
- If the protected OWI commands and the ability to track GPS L5, GLONASS, Galileo and Compass have been activated by a licence key.

Next step

Page changes to the **SmartWorx** page.

About Leica Viva, SmartWorx page

The information relates to the SmartWorx Viva instrument. This screen shows the applications installed on the instrument, and the following information.

Description of fields

Field	Description
Firmware version	Firmware version for the onboard software.
Build number	Build number for the onboard software.
API version	Firmware version for the application interface.
Maintenance end	Expiry date of the software maintenance.
Load licence keys	The information listed here indicates for which applications the licence keys are loaded.

Next step

Page changes to another page on this screen.

25

25.1

TPS Functions

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 **Measure & Target Settings**.

25.2

25.2.1

Prism Search Methods

Automatic aiming

Description

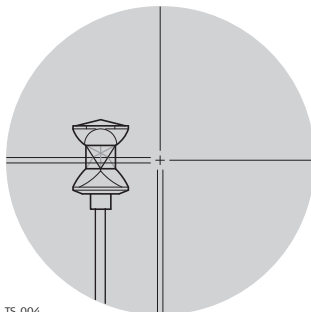
Automatic aiming is the function which recognises and measures the position of a prism using a CCD array. A laser beam is transmitted and the reflected beam is received by the built-in CCD array. The position of the reflected spot with respect to the centre of the CCD is computed. These automatic aiming 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 mode**. 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 **Target aiming: Automatic** the instrument can find a static prism and measure a distance once **Meas** or **Dist** 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 TPS instruments.

Automatic aiming measurement



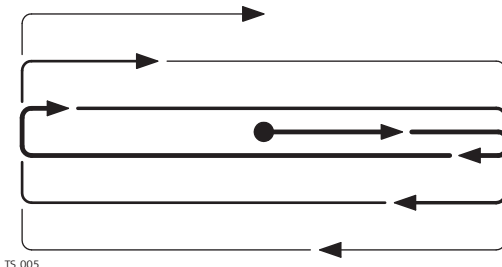
If the prism is in the field of view with **Target aiming: Automatic** the crosshairs are automatically positioned to the prism when, for example **Meas** or **Dist** is pressed. No automatic aiming search is started.



The displayed values are always related to the centre of the prism after **Meas** or **Dist** is pressed. For **Meas**, 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 **Meas** or **Dist** 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

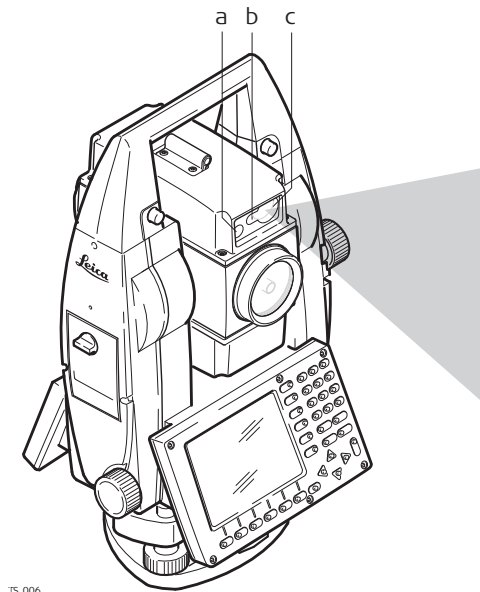
- prism was not found: **Retry** can be pressed to search for the prism in an increased area.
- prism was found: The automatic aiming measurement is performed to position the telescope to the centre of the prism.

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 Measure & Target Settings .

Description

The PowerSearch module allows an automatic prism detection within a short time period. The PowerSearch function can be started in the **Leica TPS Favourites** screen and configured in **TPS settings\Prism search settings, PowerSearch window**.

Functionality



TS_006

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.

- a) EGL
- b) Transmitter
- c) Receiver



360° search

If a PS window is defined and active, PowerSearch is executed within the defined limits.

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 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 **Prism Search Settings, 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.

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 **Leica TPS Favourites**, 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 **Leica TPS Favourites**, will immediately activate an automatic aiming search to find the prism. Alternatively, as long as **Target aiming** is set to **Lock** in **Measure & Target Settings**, then pressing **Meas**, **Dist**, **PowerSearch**, **OK** in **Check Point**, **Joystick**, **Turn to Hz/V** and **Orientation With Compass** will start 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.

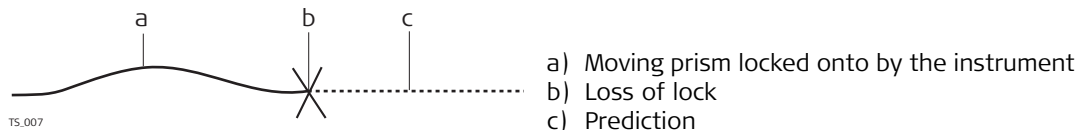
Loss of lock

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 **Prism Search Settings** 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



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 **Prism Search Settings**.

- **If no target found after prediction then: Stop searching.** If the prism moved in the field of view, the prism is not searched for until **Meas, Dist, 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 PowerSearch and Use PowerSearch window** is checked: prism is searched for in the PS window with PowerSearch.
- **If no target found after prediction then: Start PowerSearch 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

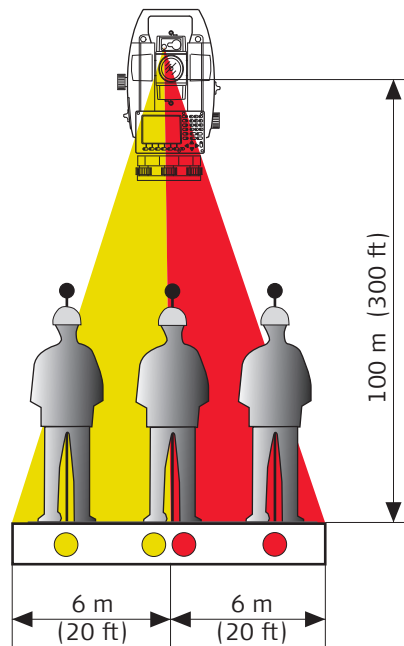
The instrument can be controlled by the field controller via radio. The automatic aiming function does not necessarily have to be active when working in RCS mode. The field controller is used to remote control the instrument. No data can be stored on the field controller. The screen and content displayed on the field controller are a copy of the remote controlled instrument.

The communication between the total station and the field controller is established via radio modems. One radio modem has to be connected to the total station serial port.

Description

The **Emitting Guide Light**, EGL, consists of two differently coloured flashing lights in the telescope housing of the TPS. 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 **Target aiming: 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

Step	Description
1.	Check Use the instrument guide lights (EGL) in the Instrument Lights screen. OR Set Target aiming: Lock and press Comps or Turn to Hz/V or J Stick on the Leica TPS Favourites screen.
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 has to be turned off by unchecking the check box.

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 the **Instrument\ TPS settings\ Level bubble & compensator** screen and turned off when leaving the screen.

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.

GUS74 Laser Guide

The GUS74 Laser Guide is an option for TPS instruments. It is built into a special telescope compartment and emits a visible red laser beam to visualise the line of sight over long ranges. The GUS74 Laser Guide is used for special applications such as tunnelling. Refer to GUS74 Laser Guide Manual for detailed information.

26

26.1

Calculator

Accessing the Calculator

Description

The calculator can be used to perform the following arithmetic operations such as

- addition, subtraction, multiplication and division
 - statistics
 - trigonometry, hyperbolic trigonometry and calculations with Pi
 - polar, rectangular and angle conversions
 - powers, logs, roots and exponential functions.
-

Operating modes

The calculator has two operating modes - RPN mode and Standard mode.

The arithmetic operations available are identical, the difference lies in the way information is entered, stored and displayed on the screen.

Type	Description
RPN	Reverse Polish Notation This operating mode was developed as a way of writing mathematical expressions without using parenthesis and brackets. Many scientific calculators, for example Hewlett Packard calculators, are implemented with this operating mode. Values are entered and kept in a working stack.
Standard	This operating mode is based on the principles of conventional pocket calculators. There is no stacking of values.

Access

Press **Calc** in any screen when editing an editable field for numeric characters, such as **Azimuth** in **Traverse Input**.

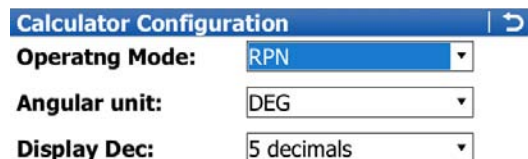
26.2

Configuring the Calculator

Access

In **RPN Calculator** or **Standard Calculator** press **Fn Config..** to access **Calculator Configuration**.

Calculator Configuration



The image shows the 'Calculator Configuration' screen. At the top, there is a title bar 'Calculator Configuration' with a right arrow icon. Below it, there are three settings, each with a label and a dropdown menu:

- Operatng Mode:** The dropdown menu is set to 'RPN'.
- Angular unit:** The dropdown menu is set to 'DEG'.
- Display Dec:** The dropdown menu is set to '5 decimals'.

OK

To accept changes and return to the screen from where this screen was accessed.

Fn Quit

To exit the screen.



The image shows the calculator's status bar. It contains the following information from left to right: '3DCQ:6.429m', '2DCQ:4.139m', '1DCQ:4.920m', 'abc', and '10:53'. Below this bar is a row of buttons: 'OK', followed by four empty buttons, and then a button with a right arrow icon.

Description of fields

Field	Option	Description
Operatng Mode	RPN	The principle of, for example, Hewlett Packard calculators.
	Standard	The principle of conventional pocket calculators.
Angular unit		The unit used for trigonometric functions in the calculator. The selection here is independent from the angle setting in Regional Settings, Angle .
	DEG	Degrees

Field	Option	Description
	RAD	Radians
	GRAD	Gon
Display Dec	From 0 to 10 decimals	The number of decimal places shown.

Next step

OK confirms the selections made and returns to the screen from where this screen was accessed.

26.3

26.3.1

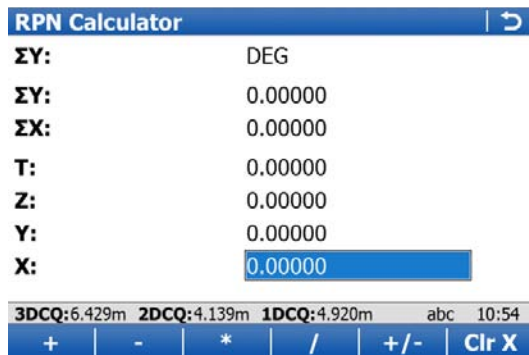
Requirements

RPN Calculator

Using the Calculator

RPN Mode

Operatng Mode: RPN in Calculator Configuration.



The function keys **F1** - **F6** are allocated seven times. Refer to **Description of Softkeys**.



Using the up and down keys the various allocations can be accessed.

Description of fields

Field	Option	Description
First field on the screen	Display only DEG RAD GRAD	The unit used for trigonometric functions in the calculator as configured in Calculator Configuration . Degrees Radians Gon

Field	Option	Description
ΣY	Display only	The result of the sum or difference of values in Y using $\Sigma +$ and $\Sigma -$.
ΣX	Display only	The result of the sum or difference of values in X using $\Sigma +$ and $\Sigma -$.
T	Display only	Third stack. After an operation, the value from Z is written here.
Z	Display only	Second stack. After an operation, the value from Y is written here.
Y	Display only	First stack. After an operation, the value from X is written here.
X	Editable field	The value for the next operation.

Next step

Fn Quit returns to **Main Menu**.

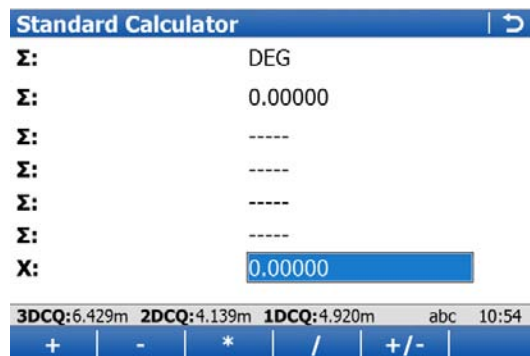
26.3.2

Standard Mode

Requirements

Standard Calculator

Operating Mode: **Standard** in **Calculator Configuration**.



The function keys **F1** - **F6** are allocated seven times. Refer to **Description of Softkeys**.



Using the up and down keys the various allocations can be accessed.

Description of fields

Field	Option	Description
First field on the screen	Display only DEG RAD GRAD	The unit used for trigonometric functions in the calculator as configured in Calculator Configuration . Degrees Radians Gon
Σ	Display only	The result of the sum or difference of values in the last field on the screen using Σ+ and Σ- .

Field	Option	Description
Third to sixth field on the screen	Display only	Previously entered value OR Latest operation including result. # indicates that the value is cut after the third decimal.
Last field on the screen	Editable field	The value for next operation or result from latest operation.

Next step

Fn Quit returns to **Main Menu**.

26.3.3

Description of Softkeys

Overview of softkeys

The softkeys shown and described are from **Operatng Mode: RPN**. Most of the softkeys are identical and their functionality is similar to the softkeys from **Operatng Mode: Standard**.

RPN Calculator						↩
ΣY:		DEG				
ΣY:		0.00000				
ΣX:		0.00000				
T:		0.00000				
Z:		0.00000				
Y:		0.00000				
X:		0.00000				
3DCQ:6.429m 2DCQ:4.139m 1DCQ:4.920m abc 11:06						
+	-	*	/	+/-	Clr X	
Σ+	Σ-	Mean	SDev		Clr Σ	
Sin	Cos	Tan	Asin	Acos	Atan	
°DMS	°Dec	PI		D->R	R->D	
Polar	Rect	Sqrt	X^2	1/X	Y^X	
Log	10^X	LN	e^X		Y^X	
Sto	Rcl	X<>Y	Last X		Clear	



The function keys **F1** - **F6** are allocated seven times.

Using the up and down keys the various allocations can be accessed.

Description of softkeys

First level

+	-	*	/	+/-	Clr X

+

To add X and Y.

- To subtract **X** from **Y**.
- * To multiply **X** by **Y**.
- * To divide **Y** by **X**.
- +/- To change between positive and negative algebraic sign for **X**.
- Clr X (F6)**
To clear **X**.

Second level

$\Sigma+$	$\Sigma-$	Mean	SDev	Clr Σ

- $\Sigma+$**
To add **X** to ΣX and **Y** to ΣY .
- $\Sigma-$**
To subtract **X** from ΣX and **Y** from ΣY .
- Mean**
To calculate the mean ΣX .
- SDev**
To calculate the standard deviation for ΣX .
- SDev**
To clear ΣX and **T**.

Third level

Sin	Cos	Tan	Asin	Acos	Atan

- Sin**
To calculate sine of **X**.

Cos

To calculate cosine of **X**.

Tan

To calculate tangent of **X**.

Asin

To calculate arcsine of **X**.

Acos

To calculate arccosine of **X**.

Atan

To calculate arctangent of **X**.

Fourth level**°DMS**

To convert decimal degrees into dd.mm.ss.

°Dec

To convert dd.mm.ss into decimal degrees.

PI

To insert **X: 3.1415926536**. The number of decimals depends on the selection for

Display Dec in **Calculator Configuration**.

D->R

To convert degrees into radians.

R->D

To convert radians into degrees.

Fifth level

Polar	Rect	Sqrt	X^2	1/X	Y^X

Polar

Conversion of rectangular coordinates into polar coordinates. The y coordinate must be visible in **Y** and the x coordinate in **X** when pressing this key. The angle is displayed in **Y** and the distance in **X**.

Rect

Conversion of polar coordinates into rectangular coordinates. The angle must be visible in **Y** and the distance in **X** when pressing this key. The y coordinate is displayed in **Y**, the x coordinate in **X**.

Sqrt

To calculate $\sqrt{X}$.

X^2

To calculate X^2 .

1/X

To inverse **X**:

Y^X

To calculate Y^X .

Sixth level

Log	10^X	LN	e^X		Y^X

Log

To calculate the $\log_{10} X$.

10^X

To calculate 10^X .

LN

To calculate the $\log_e X$.

e^X

To calculate e^X .

Y^X

To calculate Y^X .

Seventh level



Sto

To store **X** to the memory. Up to ten values can be stored.

Rcl

To recall a value for **X** from the memory. Up to ten values can be recalled.

$X \leftrightarrow Y$

To swap the values for **X** and **Y**.

Last X

To recall the last **X** before recent calculation.

Clear

To delete everything.

Fn to access the second level of function keys



Fn Config..

To configure the calculator.

Fn Done

To return to **Main Menu**.

Fn Quit

To exit the screen.

NTRIP via Internet

Configuring Access to the Internet



It is recommended to configure an Ntrip connection via the **RTK Rover Wizard**. Select **Main Menu\Instrument\GPS settings\RTK rover wizard** and follow the on-screen instructions. The remainder of this chapter describes each of the steps and screens when configuring without the use of the **RTK Rover Wizard**.



TPS One Internet interface is available - the **CS Internet**.

GPS 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 GPS or TPS instrument, **General Packed Radio System** devices will normally be used. GPRS is a telecommunication standard for transmitting data packages using the Internet Protocol (IP).

Select the internet interface

Select **Main Menu: Instrument\Instrument connections\All other connections**. On the **CS connections** page highlight **CS Internet**. Press **Edit...**

Configure the Internet interface

Internet Interface

Internet Advanced

☒ **Use Internet interface on CS**

Connect using: CS Bluetooth 1

Device: Nokia Phone

Bluetooth ID: BT_Address_1

☐ **Use user ID & password**

3DCQ:5.550m 2DCQ:3.278m 1DCQ:4.479m Fn abc 09:51

OK Search Devce.. Page

- 1 Select a port (**Connect using**).
- 2 Select a device (**Devce..**).
- 3 If necessary enter **User ID** and **Password**. Some providers ask for a **User ID** and a **Password** to allow connecting to the Internet via GPRS. Contact your provider if a user ID and password needs to be used.
- 4 **OK** to return to **Connection Settings**.
- 5 In **Connection Settings** press **Cntrl...** Continue with the next paragraph.

Configure the GSM Dial-up Connection

GPRS/Internet Connection

GPRS details Sim codes Advanced

Device: Manufact ModelId

APN: gprs.myinternet.com

(continued): -----

3DCQ:5.339m 2DCQ:3.169m 1DCQ:4.297m Fn abc 09:52

OK Page

- 1 On the **Dial-up details** page, type in the **APN** (**Access Point Name** of a server from the network provider). Contact your provider to get the correct APN.)

GPRS/Internet Connection | →

GPRS details | Sim codes | **Advanced**

PIN code:

PUK code:

3DCQ:5.335m 2DCQ:3.176m 1DCQ:4.287m Fn abc 09:52

OK | | | | Clear | Page

- 2 On the **Sim codes** page, type in the **PIN code** for the Sim card.
If the PIN is locked for any reason, for example the wrong PIN was entered, input the **Personal UnblockK**ing code for access to the PIN.
- 3 **OK** twice to return to the **Main Menu**.
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

Connection Status | →

CS connections | **GS connections**

Connection	Port	Device
CS Internet	CS Bluetooth 1	Nokia Phone
Total Station	-	-
GPS Rover	Cable	GS
ASCII Input	-	-
GPS Hidden Pt	-	-
GSI Output	-	-
Export Job	-	-

3DCQ:6.436m 2DCQ:3.494m 1DCQ:5.404m Fn abc 09:53

OK | | Intfce | | Devce.. | Page

- 1 Select **Main Menu: Instrument\Instrument status info\Connection status**.
- 2 On the **CS connections** page highlight **CS Internet**.
- 3 Press **Intfce**.
- 4 Check the Internet online status.
- 5 **OK** twice to return to the **Main Menu**.

27.2

Using the NTRIP Service with a Real-Time Rover

Select the internet interface

Settings for the RTK rover

Select **Main Menu: Instrument\Instrument connections\All other connections**.
On the **GS connections** page highlight **RTK Rover**.
Press **Edit...**

RTK Rover Settings | ↩

General | RTK base | RTK network | Advanced

☒ **Receive RTK data**

Connect using: CS Internet 1

RTK device: Internet

RTK data format: Leica 4G

☐ **Use auto coordinate system**

☐ **Receive RTK network information**

☐ **Auto connect when measuring**

3DCQ:5.519m 2DCQ:3.292m 1DCQ:4.430m Fn abc 09:55

OK | | | | Device.. | Page

RTK Rover Settings | ↩

General | RTK base | RTK network | Advanced

☒ **Use RTK network**

Network type: MAX

☐ **Send user ID**

3DCQ:5.519m 2DCQ:3.296m 1DCQ:4.426m Fn abc 09:56

OK | | | | | 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 **Cntrl..** to access **Internet Port Connection**. Continue with the next paragraph.

Select the server to be accessed in the Internet

Internet Port Connection		↩
Internet port:	CS Internet 1	
Server to use:	<None> 	

3DCQ:7.125m	2DCQ:3.807m	1DCQ:6.023m	Fn abc	10:00
OK				

New Server		↩
General	NTRIP	
Server name:	MyServer	
Address:	www.myserver.com	
Port:	1000	

3DCQ:7.017m	2DCQ:3.752m	1DCQ:5.930m	Fn abc	10:01
Store				Page

- 1 The **Server to use**, must be Ntrip enabled. To create a new server click into the selectable list.

- 2 In **New Server, General** page, type in the IP address and the port of the server through which the data is provided. Each server has several ports for various services.

New Server | ↩

General | NTRIP

☒ **Use NTRIP with this server**

NTRIP user ID: NTRIP User

NTRIP password: *****

3DCQ:6.915m 2DCQ:3.700m 1DCQ:5.843m Fn abc 10:01

Store | | | | Page

Select the Ntrip mount-
point

Internet Port Connection | ↩

Internet port: CS Internet 1

Server to use: MyServer

NTRIP mountpoint:

Press Source to get a list of mountpoints

3DCQ:6.832m 2DCQ:3.679m 1DCQ:5.757m Fn abc 10:05

OK | | | Source

- 3 In **New Server**, **NTRIP** page, activate the use of Ntrip.
- 4 Type in the **NTRIP user ID** and the **NTRIP password**. A user ID and the password are required to receive data from to the Ntrip Caster. Contact the Ntrip administrator for information.
- 5 **Store** followed by **OK** to return to **Internet Port Connection**.

- 1 If the selected server is Ntrip enabled, Ntrip mountpoint is available.
- 2 Press **Source** to access **NTRIP Source Table**.

NTRIP Source Table	
Mountpoint	Identifier
MAX-RTCM3	MAX-RTCM3
iMAX-RTCM3	iMAX-RTCM3
iMAX-CMR	iMAX-CMR
iMAX-LEICA	iMAX-LEICA
iMAX-2021	iMAX-2021
iMAX-1819	iMAX-1819
VRS-RTCM3	VRS-RTCM3
VRS-CMR	VRS-CMR
VRS-LEICA	VRS-LEICA
3DCQ:6.829m 2DCQ:3.666m 1DCQ:5.762m Fn abc 10:04	
OK	Info

- 3 All mountpoints are listed. Mountpoints are the Ntrip servers sending out real-time data. This screen consists of two columns. The first column shows the abbreviations for the Mountpoints, the second the city where the Mountpoint is located.
- 4 Highlight a mountpoint.
- 5 Press **OK** twice to return to **Connection Settings, GS connections** page.
- 6 **Fn Conect** and **Fn Disco** are now available in all applications to connect to and disconnect from the Ntrip server.

28

28.1

MapView Interactive Display Feature

Overview

Description

MapView is an interactive display feature embedded in the firmware but used by all applications as well as data management. MapView provides a graphical display of the survey elements which allows for a better overall understanding of how the data being used and measured relates to each other.

Depending on the application and where in the application MapView is accessed from, different functionality is available.

The displayed data in all modes of MapView can be shifted by using both the arrow keys and the touchscreen.

Displayable data

The data displayed in MapView is defined by the application through which it was accessed, filters set in **Sorts & Filters**, and the selections made in **Map View Configuration**.

Description

The MapView interactive display feature is provided as a page within all applications and data management. It is accessed through the application itself. Depending on the application and from where in the application MapView is accessed, different MapView modes are available.

Access step-by-step

Example for data management

Step	Description
1.	Select Main Menu: Jobs & Data\ View & edit data.
2.	Page until the Map page is active.

Example for an application

Step	Description
1.	Select Main Menu: Go to Work!\ COGO\Intersection.
2.	COGO Intersection Choose a method and enter appropriate data.
3.	Calc to access the results page.
4.	Page until the Plot page is active.

Description

Allows options to be set which are used as default options within MapView. These settings are stored within the working style and apply to all Map and Plot pages, regardless of how MapView is accessed.



Any changes made in **Map View Configuration** affect the appearance of MapView in all applications, not just the active application.

Access step-by-step

Press **Fn Config..** on any **Map** or **Plot** page.

Map View Configuration,
General page

Description of fields

Field	Option	Description
Display toolbar	Check box	Determines if the toolbar of touch icons is displayed. Refer to "28.4.2 Keys, Softkeys and Toolbar".
Show my path	Check box	Displays the path of the rover as a dashed line.
Centre to TPS	Target	To centre the map on the target. For Measure mode: Standard and Measure mode: Single (fast) , the map will centre onto the last measured point. For Measure mode: Continuous and Measure mode: Long range (>4km) , the map will centre onto the current reflector position.
	TPS instrument	To centre the map on the instrument.

Field	Option	Description
Datum view	WGS 1984 or Local	Determines the datum in which the points are viewed.  Depending on the configured coordinate system being used, it is possible that some data will not be displayed.
Reverse coordinates	Check box	Available for Datum view: Local . To rotate the map by 180°. The north arrow is not rotated and still orientated towards the top of the screen.
Vertical exaggeration of alignment maps	Editable field	The exaggeration factor of the map. The value can be between 0.1 and 50.  This setting only has an affect in applications where vertical alignments are displayed.

Next step

Page changes to the **Points** page.

Map View Configuration,
Points page

Map View Configuration

General

Points

Lines & areas

☒ Display toolbar

☐ Show my path

Datum view:

Local

☐ Reverse coordinates

Vertical exaggeration of alignment maps:

1.0

3DCQ:0.018m2DCQ:0.009m1DCQ:0.016mFn abc14:16

OK

Page

- OK

To confirm the selections and to return to the screen from where this screen was accessed.
- Symbol

To view all point symbols and their descriptions.
- Page

To change to another page on this screen.

Description of fields

Field	Option	Description
Display points	Check box	Determines if points are displayed in MapView.
Point ID	Check box	Available if Display points is checked. Determines if the ID of a point is displayed.
Point code	Check box	Available if Display points is checked. Determines if the code of a point is displayed.
Height of point	Check box	Available if Display points is checked. Determines if the height of a point is displayed.
Quality of point	Check box	Available if Display points is checked. Determines if the coordinate quality of a point is displayed.

Field	Option	Description
Show pt info for a maximum of 200 pts	Check box	If checked, the point information as configured is shown regardless of the number of points being displayed. If not checked, point information is not shown when more than 200 points are displayed.

Displayable point information

- ☒ 1001
HOUS
400.1741
0.0255
- a) **Point ID**
b) **Point code**
c) **Height of point**
d) **Quality of point**

Next step

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

Map View Configuration, Lines & areas page

Description of fields

Field	Option	Description
Display lines	Check box	Determines if lines are displayed in MapView.
Line ID	Check box	Available if Display lines is ticked. Determines if the ID of a line is displayed.
Line code	Check box	Available if Display lines is ticked. Determines if the code of a line is displayed.
Display areas	Check box	Determines if areas are displayed in MapView.

Field	Option	Description
Area ID	Check box	Available if Display lines is ticked. Determines if the ID of an area is displayed.
Area code	Check box	Available if Display lines is ticked. Determines if the code of an area is displayed.

Displayable line/area information

A line is shown as example.



- a) **Line ID**
- b) **Line code**

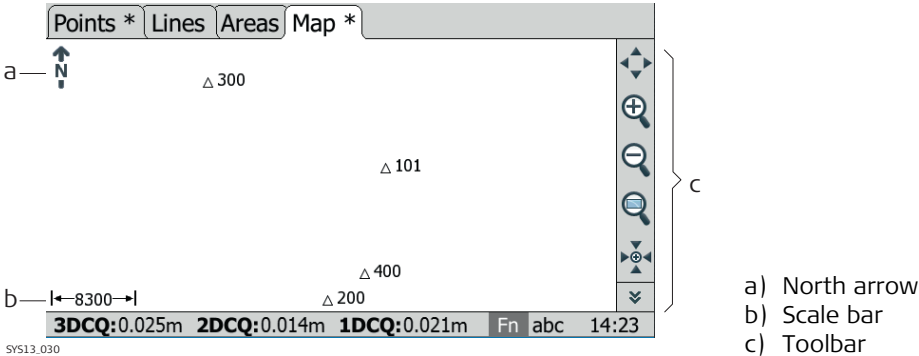
Next step

OK confirms the selections and returns to the previous screen.

28.4
28.4.1

MapView Components
Screen Area

Standard screen



Scale bar

Symbol	Description
	Scale of the current screen. The minimum is 0.1 m. There is no maximum for the zoom but the scale cannot display values greater than 99000 m. In this case the value displayed will be >99000 m.

North arrow

Symbol	Description
	North arrow. North is always orientated towards the top of the screen.

Toolbar

Symbol	Description
	Touch icon toolbar. Refer to "28.4.2 Keys, Softkeys and Toolbar" for more information about the functionality of the touch icons in the toolbar.

Point with focus

Symbol	Description
	The point that has the focus.

Line/area with focus

Symbol	Description
	The line/area that has the focus is bolder than other lines shown in blue for the full and in orange for Lite version of SmartWorx Viva.

Rover **GPS**

Symbol	Description
	Available in survey mode. Position of the rover. The rover path is shown as dotted line.

Prism **TPS**

Symbol	Description
	Measured position. The reflector path is shown as dotted line.

Instrument
station **TPS**

Symbol	Description
	Position of the instrument station.

Description

Standard functionality is provided by softkeys, keys and a toolbar within MapView. The softkeys are available regardless of the mode in which MapView was accessed and always perform the same functions. If **Display toolbar** is checked in **Map View Configuration, General** page, touch icons are available in a toolbar. The toolbar is always located on the right side of the screen. Some of the functions performed by the touch icons can also be replicated using a softkey or key in the same mode as when the touch icon appears. The softkey/key equivalent of each touch icon, if one exists, are indicated in the following table.

Overview of keys, softkeys and touch icons

The softkeys described in this table are standard on all MapView screens. For descriptions of mode-specific softkeys, see appropriate chapters.

Touch icon	Key or Softkey	Description
	-	To scroll the MapView toolbar.
	1 or Fn Refrsh in some applications	The fit touch icon fits all displayable data, according to filters and the map configuration, into the screen area, using the largest possible scale.
	2	To zoom into the map.  Pressing ESC stops the zooming process.
	3	To zoom out of the map.  Pressing ESC stops the zooming process.

Touch icon	Key or Softkey	Description
	-	The windowing touch icon zooms to a specified area window. An area window can be drawn by dragging the stylus on the screen in a diagonal line to make a rectangular area or by tapping twice on the screen to define diagonally opposite corners of a rectangular area. This action causes the screen to zoom to the selected area.
	5	To centre the selected point, the GPS rover, the TPS target or TPS instrument.
	-	TPS Available in survey mode. This touch icon displays the current direction as dashed line. A location on the Map page can then be tapped and the instrument turns to this direction. If Target aiming: Automatic the instrument does an ATR search. If Target aiming: Lock the instrument tries to lock on to a prism.
	Fn Config..	To configure MapView. Refer to "28.3 Configuring MapView".
	Fn Layrs..	To turn layers of background maps (CAD files) on and off. Refer to "4.2 Creating a New Job" for information on CAD files.
		To import CAD files for background only maps. Refer to "4.2 Creating a New Job".

Touch icon	Key or Softkey	Description
		To switch the view. Available in some applications, for example Reference Plane, Road or Rail.
-	0	To make the MapView do a complete redraw.
-	Fn Filter..	To change the filter settings. Refer to "5.6 Point Sorting and Filters".

Description

When **Display points** is checked in **Map View Configuration, Points** page, points are displayed, in all modes, according to their class. A list of the point types available, and their description, is available.

Access

Press **Symbol** in **Map View Configuration, Points** page.

Symbols

Symbol	Description
Δ	3D control point is a point of class Ctrl with full coordinate triplet.
Δ	2D control point is a position only point of class Ctrl .
⊗	Adjusted point is a point of class Adj .
▽	Base point is a point of class Ref .
⊙	Average point is a point of class Avge .
⊙	Measured point is a point of class Meas .
⊗	Single Point Position uploaded from LGO.
□	Navigated point is a point of class Nav .
+	Estimated point is a point of class Est .

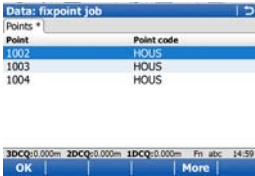


Points of class **None** or points of class **Ctrl/Meas** with a height only component cannot be displayed in MapView.

Selecting a point/line/area using the touch screen step-by-step

The instructions for selecting a point using the softkeys can be applied for lines and areas.

Step	Description	Display
1.	Go to Data ; Map page.	
	If no point field is highlighted on the previous page when the Map page is accessed, then any point that is selected will be assigned to the first point field on the previous page, the second point to the second point field, etc. If a point field is highlighted when the Map page is accessed then the point selected will be assigned to that field.	
2.	Tap on the point to be selected.	
	When there are multiple points within the same area and the precise selection is unclear, tapping on the point will access Select Point .	
3.	Have multiple points been selected? - If yes, continue with step 4. - If no, continue with step 5.	

Step	Description	Display
4.	Select Point Point ID The ID of the points within range of the point selection. Point code The code of the points within range of the point selection. Select the desired point.	
	More to display information about the point code, the 3D coordinate quality and class, the time the point was stored and the date the point was stored.	
5.	OK returns to Data: Map page with the focus on the selected point.	
6.	A square is centred on the selected point and the point parameter text is highlighted.	

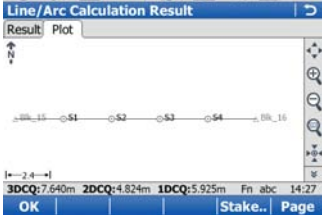
Select a point/line/area without touch screen

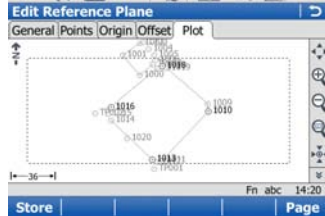
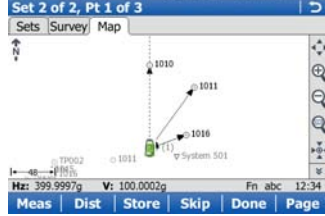
Without touch screen or when **Use the touch screen** is not checked in **Screen & Audio Settings**, **Screen** page, points, lines and areas can only be selected using the selectable lists.

Description

MapView can be used to view the results of an application. Results are shown in black, all other information, that is displayable, is shown in grey.

Example of results displayed in MapView

Application	Display	Description
COGO Intersection, Double bearing		Intersecting lines with known bearings from known points
COGO line calculation, Segmentation		Points defining the line and those points created on the line

Application	Display	Description
Reference Plane, Edit Reference Plane		A dashed rectangle indicates the face view of the plane.
Sets of Angles, Calculating Angles TPS		Directions from station to sets of angle points
Setup TPS		Directions to resection points.

Description

Applications are software packages supporting specific tasks. Available for both GPS and TPS are:

- COGO
- Determine coord system
- Go to Work! TPS hidden point TPS
- Reference plane
- Roads (Alignment Editor, Roads - Stakeout, Roads - As built check, Rail - Stakeout, Rail - As built check, Tunnel - Stakeout TPS, Tunnel - As built check TPS)
- Setup TPS
- Sets of Angles TPS including monitoring
- Stake a DTM
- Stakeout
- Stake points & DTM
- Measure to ref line / Stake to ref line
- Survey, including auto point and for GPS also hidden points
- Cross Section
- Setup TPS
- Traverse TPS
- Volume calculations
- Customised applications
- Start base over known point GPS

- Start base over last setup **GPS**
- Start base over any point **GPS**

For an explanation of the applications refer to the relevant chapters.

Loadable and non-loadable applications

Loadable applications:

- Can be loaded onto the instrument.
- Can be deleted from the instrument.

Non-loadable application:

- Are always available on the instrument.
- Survey is a non-loadable application. To get an update for the application, the system software has to be reloaded.

Licence key

Some loadable applications are protected. They are activated through a specific licence key, which can either be typed in **Main Menu: User\Tools & other utilities\Load licence keys** or the first time the application is started. Refer to "24.3 Load licence keys" for information on how to type in or upload a licence key.

Customised applications

Customised applications 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 the Go to Work! drop-down menu

Select **Main Menu: Go to Work!**.
OR
Press .



The screens for each COGO.. calculation method can be accessed directly by pressing a configured hot key or via the  key. The currently active configuration set and job are used.

Description

COGO is an application 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 Survey application, COGO is more of a calculation program than a measuring program.

**COGO calculation methods**

Changing coordinates of a point which has been previously used in COGO does not result in the point being recomputed.

The COGO calculation methods are:

- Inverse
- Traverse
- Intersection
- Line and arc calculations
- Area division
- Shift, rotate & scale

Distances and azimuths	Type of distances: The choices are • Ground • Grid • Ellipsoidal Type of azimuths: The azimuths are grid azimuths relative to the local grid.
Coding of COGO points	• Thematical coding is available in the results screen after the COGO calculation. Thematical coding of COGO points is identical to coding manually measured points. Refer to "20 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.
Properties of COGO points	The properties stored with COGO points are: • Class: Either Meas or Ctrl depending on the COGO configuration. • Sub class: COGO • Source: Arc base pt, Arc centre pt, Arc offset pt, Arc segment pt, COGO Area Div, COGO Shift/Rtn, COGO Traverse, Intsct (Brg Brg), Intsct (Brg Dst), Intsct (Dst Dst), Intsct (4 Pts), Line Base Pt, Line Offset Pt or Line Segmt Pt depending on the COGO calculation method used • Instrument source: GPS or TPS

Access

Select **Main Menu: Go to Work!\COGO** and select a COGO calculation method.

COGO calculation methods**Description of the COGO calculation methods**

COGO calculation methods	Description
Inverse	To calculate the direction, the distance and the 3D coordinate differences between two known points (or one known point and the current GPS position). To calculate the direction, the distance and the 3D coordinate differences between a known point (or the current GPS position) and a user-defined line. To calculate the direction, the distance and the 3D coordinate differences between a known point (or the current GPS position) and a user-defined arc. For these calculations, only points with full coordinate triplets or position only points can be used.
Traverse	To calculate the position of new points using - the azimuth/bearing and the distance from a known point. Offset optional. - the angle and the distance from a known point. Offset optional. For these calculations, only points with full coordinate triplets or position only points can be used.

COGO calculation methods	Description
Intersection	To calculate the position of an intersection point using • bearings from two known points. • a bearing and a distance from two known points. • distances from two known points. • four points. • two TPS observation lines. For these calculations, only points with full coordinate triplets or position only points can be used.
Line & arc calculations	To calculate; • the centre point of an arc. • an offset point from a distance along, and offset from, an arc. • an offset point from a distance along, and offset from, a line. • a base point on an arc of a known offset point. • a base point on a line of a known offset point. • new points along an arc by segmentation. • new points along a line by segmentation.
Area division	To divide an area by a • defined line. • percentage.

COGO calculation methods	Description
	defined area size.
Shift, rotate & scale	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.

30.3

Configuring COGO

Access

Press **Fn Config..** in the Input screen of any COGO calculation method.

Configuration, General page

This screen consists of the **General** page, **Points & Quality** page, **TPS specific** page, **Residuals** page and the **Report sheet** page. The explanations given for the softkeys given are valid for all pages.

Configuration | ↗

General | Points & Quality | TPS specific | Residuals | Report sheet | ◀ ▶

Distance type: Grid ▼

Use offsets: Yes ▼

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:53

OK | | | | | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Fn About

To display information about the program name, the version number, the date of the version, the copyright and the article number.

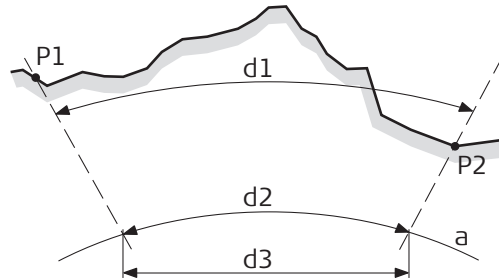
Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Distance type		The type of distances and offsets to be accepted as input or displayed in the fields, and used in the calculation.

Field	Option	Description
	Grid	Distances are calculated as the trigonometric distance between the position of two points. The distance field is Horiz distance .
	Ground	Distances are horizontal distances between two points at the mean elevation parallel to the ellipsoid of the active coordinate system. The distance field is Horiz dist (ground) .
	Ellipsoid	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 Horiz dist (ell).  In the attached coordinate system, a projection, an ellipsoid and a transformation have to be defined to calculate grid, ground and ellipsoid coordinates.
Use offsets	Yes or No	Activates the use of offsets in the COGO calculations. Editable fields for the offsets are available in the Input screen of any COGO calculation method.



SVS13.001

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.

Configuration,
Points & Quality page

Description of fields

Field	Option	Description
Store computed COGO points with class	Measured (Meas) or Control (Ctrl)	Defines the point class of COGO calculated and stored points as Measured (Meas) or Control (Ctrl) triplets.
Position quality for computed COGO point	Editable field	The estimated value for the position quality assigned to all calculated COGO points which is used for the averaging calculation.

Field	Option	Description
Height quality for computed COGO point	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 **TPS specific** page.

Configuration, TPS specific page

Description of fields

Field	Option	Description
Measure in two faces	Yes	Defines if the instrument measures the second face automatically after storing the first. After storing a measurement with Meas or Store motorised instruments change face automatically, non-motorised instruments access Telescope Positioning . The measurements of face I and face II are averaged on the base of face I. The averaged value is stored.
	No	No automatic measurement in two faces.
TPS observation Compute height		Defines the height being used within TPS observations.
	Using average	Using an average of the two observations.
	Use upper height	Using the upper height.
	Use lower height	Using the lower height.

**Configuration,
Residuals page**

Next step

Page changes to the **Residuals** page.

This page applies to **Shift, Rotate & Scale (Match Pts)**.

Description of fields

Field	Option	Description
Easting	Editable field	The limit above which Easting residuals will be flagged as possible outliers.
Northing	Editable field	The limit above which Northing residuals will be flagged as possible outliers.
Elevation	Editable field	The limit above which Height residuals will be flagged as possible outliers.
Residual Distbtn	None 1/distance, 1/distance² or 1/distance^{3/2} Multiquad- ratic	The method by which the residuals of the control points will be distributed throughout the transformation area. No distribution is made. Residuals remain with their associated points. Distributes the residuals according to the distance between each control point and the newly transformed point. Distributes the residuals using a multiquadratic interpolation approach.

Next step

Page changes to the **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

**Next step**

Page changes to the first page on this screen.

Azimuth is used throughout this chapter. This term should also always be considered to mean **Bearing**.

30.4

30.4.1

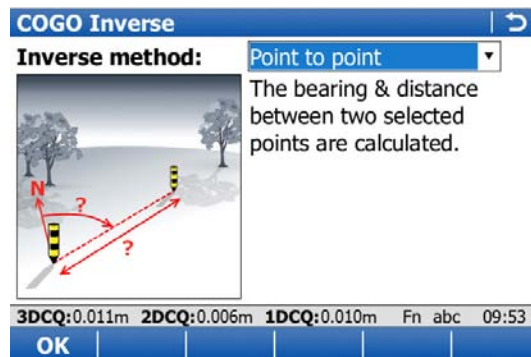
COGO Calculation - Inverse Method

Selecting the Inverse Method

Access

Select **Main Menu: Go to Work!\COGO\Inverse.**

COGO Inverse



OK

To select a method and to continue with the subsequent screen.

Description of the Inverse methods

Inverse methods	Description
Point to point	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 • coordinates of two points. The coordinates of the known points • can be taken from the working job. • can be manually measured during the COGO calculation. • can be entered.
Point to current pos	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. Elements that must be known are • coordinates of one point. The coordinates of the known point • can be taken from the working job. • can be manually measured during the COGO calculation. • can be entered.

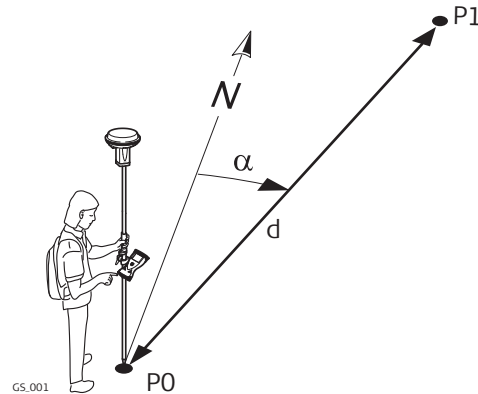
Inverse methods	Description
Current pos to line	The direction, distance and coordinate differences between the current position and a given line can be calculated depending on the data available. Points with full coordinate triplets, position only points and height only points can be used. Sufficient information must be known to define a line. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.
Point to line	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. Sufficient information to define a line and the coordinates of one point must be known. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

Inverse methods	Description
Point to arc	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. Sufficient information to define an arc and the coordinates of one point must be known. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.
Current pos to arc	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. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

30.4.2

Point to Point and Current Position to Point

Diagram



Known

P0 First known point/current position

P1 Second known point

Unknown

α Direction from P0 to P1

d1 Slope distance between P0 and P1

d2 Horizontal distance between P0 and P1

d3 Height difference between P0 and P1

Inverse Point to Point/ Inverse Point to Current Pos, Inverse page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

----- is displayed for unavailable information, for example **Δ height** cannot be calculated if a position only point is used.

Store

To store the result.

Revers

To swap the **From** and **To** points around.

Survey..

To manually measure a point for the COGO calculation. Available when **From** or **To** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
From	Selectable list	The point ID of the first known point for the COGO calculation.
	Current position	Available for Inverse method: Point to current pos.

Field	Option	Description
To	Selectable list	The point ID of the second known point for the COGO calculation.
	Current position	Available for Inverse method: Point to current pos.
Azimuth	Display only	The direction from the first to the second known point.
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Display only	The horizontal distance between the two known points.
Δ height	Display only	The height difference between the two known points.
Slope distance	Display only	The slope distance between the two known points.
Grade	Display only	The grade between the two known points.
Δ easting	Display only	The difference in Easting between the two known points.
Δ northing	Display only	The difference in Northing between the two known points.

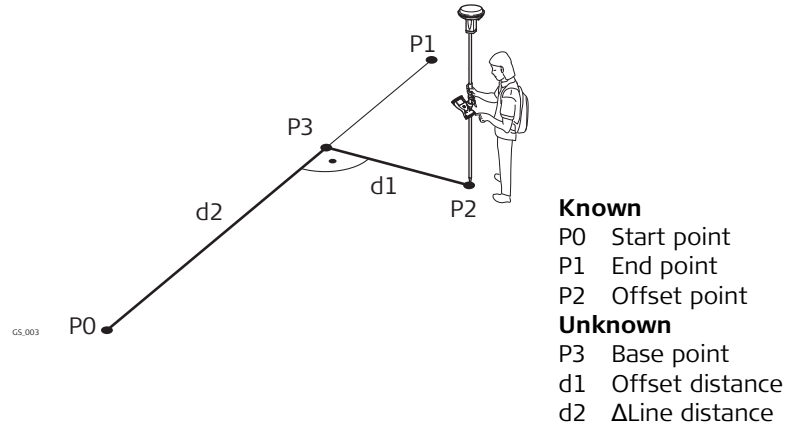
Next step

Page changes to the **Map** page. The calculated distance between the two known points is indicated.

30.4.3

Point to Line and Current Position to Line

Diagram



Inverse Point to Line/ Inverse Current Pos to Line, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

----- is displayed for unavailable information, for example **Δ height** cannot be calculated if a position only point is used.

Inverse Point to Line | ↺

Input | Map

Offset point: 103 [icon]

Create line using: 2 points [dropdown]

Start point: 101 [icon]

End point: 102 [icon]

3DCQ:0.012m 2DCQ:0.007m 1DCQ:0.010m Fn abc 10:12

Calc | | | Survy.. | Page

Calc

To calculate COGO point.

Inv..

To calculate the values for the distance and the offset from two existing points. Available if **Azimuth** or **Horiz distance** is highlighted.

Last..

To recall previous results from COGO inverse calculations. Available if **Azimuth** or **Horiz distance** is highlighted.

Survy..

To manually measure a point for the COGO calculation. Available if **Start point**, **End point** or **Offset point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To mathematically modify the values. Available if **Azimuth** or **Horiz distance** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Offset point	Selectable list	Available for Inverse to: Known Point . The offset point.
	Current position	Available for Inverse method: Current pos to line .
Create line using		The method by which the line will be defined.
	2 points Pt, bearing & dist	Uses two known points to define the line. Defines the line using a known point, a distance and an azimuth of the line.
Start point	Selectable list	The start point of the line.
End point	Selectable list	Available for Method: 2 points . The end point of the line.
Azimuth	Editable field	Available for Method: Pt, bearing & dist . The azimuth of the line.
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Editable field	Available for Method: Pt, bearing & dist . The horizontal distance from the start point to the end point of the line.

Next step

Calc calculates and accesses **Inverse Result**.

Inverse Result, Result page

The screenshot shows a handheld device screen with the title 'Inverse Result' and a back arrow. Below the title are two tabs: 'Result' (selected) and 'Plot'. The main display area contains the following data:

- Offset point: 103
- Distance along line: 8.682m
- Offset: -3.101m
- Bearing to offset pt: 7.9167g
- Line length: 32.249m
- Line bearing: 107.9167g

At the bottom, there is a status bar with the text '3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:13'. Below this is a navigation bar with five buttons: 'Store', 'Coord', a blank space, a blank space, and 'Page'.

Store

To store the result.

Coord

To view other coordinate types.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height.

Description of fields

Field	Option	Description
Offset point	Display only	Point ID of offset point or Current position .
Distance along line	Display only	Horizontal distance from start point to base point.
Offset	Display only	Offset from base point to offset point. Positive to the right and negative to the left of the line.
Bearing to offset pt	Display only	Bearing from base point to offset point.
Line length	Display only	Length of line from start point to end point.

Field	Option	Description
Line bearing	Display only	Bearing of line from start point to end point.
Easting and Northing	Display only	The calculated coordinates.
Elevation	Display only	The height of the calculated point.

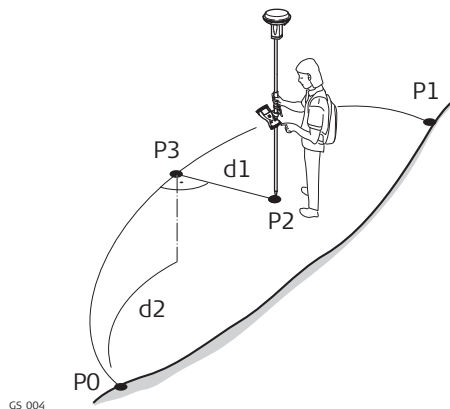
Next step

Page changes to the **Plot** page.

30.4.4

Point to Arc and Current Position to Arc

Diagram



Known

- P0 Start point
- P1 End point
- P2 Offset point

Unknown

- P3 Base point
- d1 Offset-XX
- d2 Δ ArcDist-XX

Inverse Point to Arc/Inverse Current Pos to Arc, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

----- is displayed for unavailable information, for example **Δ height** cannot be calculated if a position only point is used.

Inverse Point to Arc | ↻

Input | Map

Offset point: 103

Create arc using: 2 points & radius

Start point: 101

End point: 102

Radius: 17.500 m

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:14

Calc | Inv.. | Last.. | Page

Calc

To calculate COGO point.

Inv..

To calculate the values for the distance and the offset from two existing points. Available if **Radius**, **Arc length** or **Chord length** is highlighted.

Last..

To recall previous results from COGO inverse calculations. Available if **Radius**, **Arc length** or **Chord length** is highlighted.

Surv..

To manually measure a point for the COGO calculation. Available if **Start point**, **Second point**, **End point**, **Offset point** or **PI point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To mathematically modify the values. Available if **Radius**, **Arc length** or **Chord length** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Offset point	Selectable list	Available for Point to arc: Point to line . The offset point.
	Current position	Available for Inverse method: Current pos to arc .
Create arc using		The method by which the arc will be defined.
	3 points	Uses three known points to define the arc.
	2 points & radius	Defines the arc using two known points and a radius of the arc.
	2 tngnts & radius	Defines the arc using two tangents and a radius of the arc.
	2 tngnts & arc lngth	Defines the arc using two tangents and the length of the arc.
	2 tngnts & crd lngth	Defines the arc using two tangents and the chord of the arc.
Start point	Selectable list	The start point of the arc. Available for Method: 3 points and Method: 2 points & radius .

Field	Option	Description
Second point	Selectable list	The second point of the arc. Available for Method: 3 points .
End point	Selectable list	The end point of the arc. Available for Method: 3 points and Method: 2 points & radius .
Point 1	Selectable list	A point on the first tangent. Available for Method: 2 tngnts & radius , Method: 2 tngnts & arc lngth and Method: 2 tngnts & crd lngth .
PI point	Selectable list	The point of intersection of the two tangents. Available for Method: 2 tngnts & radius , Method: 2 tngnts & arc lngth and Method: 2 tngnts & crd lngth .
Point 2	Selectable list	A point on the second tangent. Available for Method: 2 tngnts & radius , Method: 2 tngnts & arc lngth and Method: 2 tngnts & crd lngth .
Radius	Editable field	The radius of the arc. Available for Method: 2 points & radius and Method: 2 tngnts & radius .
Arc length	Editable field	The length of the arc. Available for Method: 2 tngnts & arc lngth .
Chord length	Editable field	The length of the chord. Available for Method: 2 tngnts & crd lngth .

Next step

Calc calculates the result and accesses **Inverse Result**.

Inverse Result, Result page

Inverse Result

Result

Plot

Offset point:

103

Distance along arc:

9.225m

Offset:

5.113m

Bearing to offset pt:

166.8848g

Arc radius:

17.500m

Arc length:

41.008m

3DCQ:0.010m

2DCQ:0.005m

1DCQ:0.008m

Fn abc

10:15

Store

Coord

Page

Store

To store the result.

Coord

To view other coordinate types.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height.

Description of fields

Field	Option	Description
Offset point	Display only	Point ID of offset point for Inverse to: Known Point or current position.
Distance along arc	Display only	Horizontal distance along the arc from start point to base point.
Offset	Display only	Offset from base point to offset point. Positive to the right and negative to the left of the line.
Bearing to offset pt	Display only	Bearing of offset point from base point to offset point.
Arc radius	Display only	Computed radius of arc.
Arc length	Display only	Computed length of arc.

Field	Option	Description
Easting and Northing	Display only	The calculated coordinates.
Elevation	Display only	The height of the calculated point.

Next step

Page changes to the **Plot** page.

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 working 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.

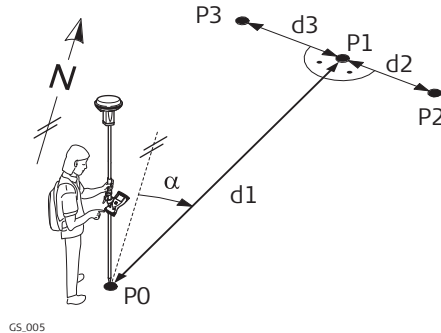
Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.

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



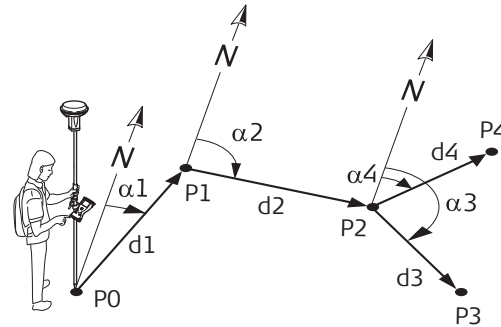
Known

- P0 Known point
- α 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



GS_002

Known

- P0 Known point
- α_1 Direction from P0 to P1
- α_2 Direction from P1 to P2
- α_3 Direction from P2 to P3
- α_4 Direction from P2 to P4
- d_1 Distance between P0 and P1
- d_2 Distance between P1 and P2
- d_3 Distance between P2 and P3
- d_4 Distance between P2 and P4

Unknown

- P1 First COGO point
- P2 Second COGO point
- P3 Third COGO point - sideshot
- P4 Fourth COGO point

Traverse Input, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

Traverse Input	
Input	Map
Method:	Azimuth
From:	101
Azimuth:	20.2000 g
Horiz distance:	16.920 m
Offset:	0.500 m
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:17	
Calc	Inv.. SShot Last.. Page

Calc

To calculate the result.

Inv..

To calculate the values for the distance and the offset from two existing points. Available when **Azimuth**, **Horiz distance**, **Offset** or **Angle right** is highlighted.

SShot

To calculate the point as a sideshot.

Last..

To recall previous results from COGO inverse calculations. Available when **Azimuth**, **Horiz distance**, **Offset** or **Angle right** is highlighted.

Surv..

To manually measure a point for the COGO calculation. Available when **From** or **Back-sight** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To add, subtract, multiply and divide values.

Available when **Azimuth**, **Horiz distance**, **Offset** or **Angle right** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Method	Azimuth	The direction from the known point to the COGO point is an azimuth.
	Angle right	The direction from the known point to the COGO point is an angle.
From	Selectable list	The point ID of the known point for the COGO calculation.
Backsight	Selectable list	The point ID of a point used as backsight. Available for Angle right .
Angle right	Editable field	The angle between Backsight and the new COGO point to be calculated from the point selected as From : A positive value is for clockwise angles. A negative value is for anticlockwise angles. Available for Angle right .
Azimuth	Editable field	The direction from the known point to the COGO point.

Field	Option	Description
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Editable field	The horizontal distance between the known point and the COGO point.
Offset	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 Use offsets: Yes in Configuration, General page.

Next step

Calc calculates the result and accesses **Traverse Results**.

Traverse Results, Result page

Traverse Results

Result Code Plot

Point ID:

Easting:

Northing:

Elevation:
 m

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:17

Store Coord Stake.. Page

Store

To store the result.

Coord

To view other coordinate types.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height. Available for local coordinates.

Fn IndivID

For an individual point ID independent of the ID template. **Fn Run** changes back to the next ID from the configured ID template.

Fn Quit

To not store the COGO point and to exit COGO calculations.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for the currently active instrument type in ID Templates . The point ID can be changed.
Easting and Northing	Display only	The calculated coordinates.
Elevation	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 **Plot** page, an arrow points from the known point to the calculated COGO point.

Store stores the result.

30.6

30.6.1

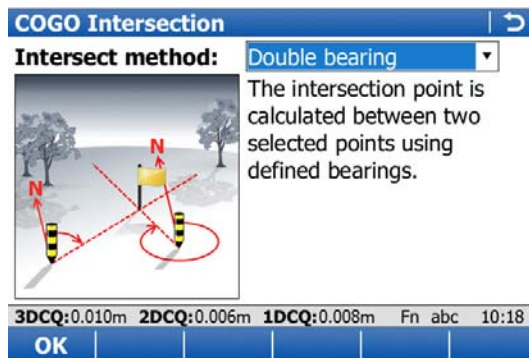
COGO Calculation - Intersection Method

Selecting the Intersection Method

Access

Select **Main Menu: Go to Work!\COGO\Intersection.**

COGO Intersection



OK

To select a method and to continue with the subsequent screen.

Description of the Intersection methods

Intersection methods	Description
Double bearing	Calculates the intersection point of two lines. A line is defined by a point and a direction. Elements that must be known are • the coordinates of two points. • the direction from these known points to the COGO point. • offsets if necessary and configured. The coordinates of the known points • can be taken from the working job. • can be manually measured during the COGO calculation. • can be entered. Points with full coordinate triplets and position only points can be used. Position only is calculated, height can be typed in.

Intersection methods	Description
Double distance	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. Elements that must be known are • the coordinates of two points. • the distance from the known points to the COGO point. The coordinates of the known points • can be taken from the working job. • can be manually measured during the COGO calculation. • can be entered. Points with full coordinate triplets and position only points can be used.

Intersection methods	Description
Bearing & distance	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. Elements that must be known are • the coordinates of points. • the direction from one known point to the COGO point. • the distance from the second known point to the COGO point. • offsets if necessary and configured. The coordinates of the known points • can be taken from the working job. • can be manually measured during the COGO calculation. • can be entered. Points with full coordinate triplets and position only points can be used.

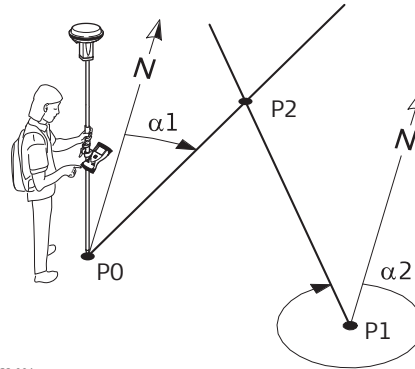
Intersection methods	Description
By points	Calculates the intersection point of two lines. A line is defined by two points. Elements that must be known are • the coordinates of four points. • offsets of the lines if necessary and configured. The coordinates of the known points • can be taken from the working job. • can be manually measured during the COGO calculation. • can be entered. Points with full coordinate triplets and position only points can be used.

Intersection methods	Description
TPS observations	Calculates the intersection point of two lines. A line is defined by a TPS station and a TPS measurement from this station. Elements that must be known are • the coordinates of two points. • azimuths of the lines. The coordinates of the known points • must be taken from the working job. • must be TPS station points. The azimuths of the lines • must be TPS measurements from the known points. Points with full coordinate triplets and position only points can be used.

30.6.2

Intersection with Double Bearing

Diagram



GS_006

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 Double Bearing, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

Intersection Double Bearing		↶
Input Map		
1st point:	101	↶
Azimuth:	22.3000	g
Offset:	2.400	m
2nd point:	102	↶
Azimuth:	340.0000	g
Offset:	10.900	m
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:19		
Calc	Inv..	Last.. Page

Calc

To calculate the result.

Inv..

To calculate the values for the distance and the offset from two existing points. Available when **Azimuth** or **Offset** is highlighted.

Last..

To recall previous results from COGO inverse calculations. Available when **Azimuth** or **Offset** is highlighted.

Survy..

To manually measure a point for the COGO calculation. Available when **1st point** or **2nd point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To add, subtract, multiply and divide values.
Available when **Azimuth** or **Offset** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
1st point	Selectable list	The point ID of the first known point for the COGO calculation.
2nd point	Selectable list	The point ID of the second known point for the COGO calculation.
Azimuth	Editable field	The direction from the first known point to the COGO point.
Offset	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 Use offsets: Yes in Configuration, General page.

Next step

Calc calculates the result and accesses **Intersection Result**.

Intersection Result, Result page

Intersection Result

Result

Code

Plot

Point ID:

104

Easting:

6.467m

Northing:

32.391m

Elevation:

7.000

m

3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 10:22

Store

Coord

Stake..

Page

Store

To store the result.

Coord

To view other coordinate types.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height. Available for local coordinates.

Fn Individ

For an individual point ID independent of the ID template. **Fn Run** changes back to the next ID from the configured ID template.

Fn Quit

To not store the COGO point and to exit COGO calculations.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for Auxiliary points in ID Templates . The point ID can be changed.
Easting and Northing	Display only	The calculated coordinates.

Field	Option	Description
Elevation	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.

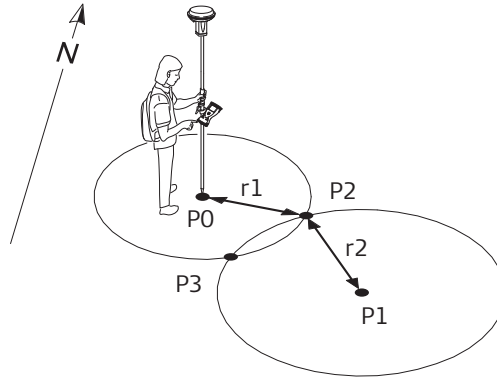
On the **Plot** page, arrows point from the known points to the calculated COGO point.

Store stores the result.

30.6.3

Intersection with Double Distance

Diagram



GS_008

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 Double Distance, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

Intersection Double Distance		↶
Input Map		
1st point:	101	↶
Horiz distance:	18.000	m
2nd point:	102	↶
Horiz distance:	14.500	m

3DCQ:0.011m	2DCQ:0.007m	1DCQ:0.009m	Fn abc	10:23
Calc	Inv..	Last..	Page	

Calc

To calculate the result.

Inv..

To calculate the values for the distance and the offset from two existing points. Available when **Horiz distance** is highlighted.

Last..

To recall previous results from COGO inverse calculations. Available when **Horiz distance** is highlighted.

Survy..

To manually measure a point for the COGO calculation. Available when **1st point** or **2nd point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To add, subtract, multiply and divide values.
Available when **Horiz distance** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
1st point	Selectable list	The point ID of the first known point for the COGO calculation.
2nd point	Selectable list	The point ID of the second known point for the COGO calculation.
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Editable field	The horizontal distance between the known points and the COGO point.

Next step

Calc calculates the result and accesses **Intersection Result**.

Intersection Result, Result 1/Result 2 page

Intersection Result

Result 1 Code Plot

Point ID: 104

Easting: 12.501m

Northing: 3.793m

Elevation: 7.000 m

3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 10:23

Store Coord Result2 Stake.. Page

Store

To store the result.

Coord

To view other coordinate types.

Result1 or Result2

To view the first and second result.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height. Available for local coordinates.

Fn IndivID

For an individual point ID independent of the ID template. **Fn Run** changes back to the next ID from the configured ID template.

Fn Quit

To not store the COGO point and to exit COGO calculations.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for GPS / TPS in ID Templates . The point ID can be changed.

Field	Option	Description
Easting and Northing	Display only	The calculated coordinates.
Elevation	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.

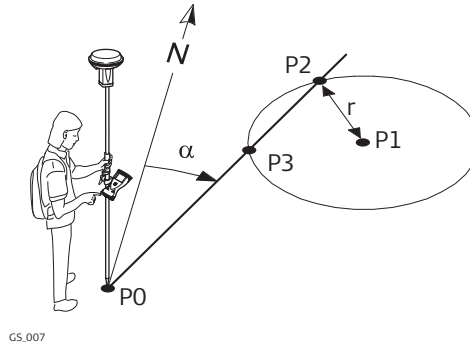
On the **Plot** page, the calculated COGO points are shown.

Store stores the result.

30.6.4

Intersection with Bearing - Distance

Diagram



Known

- P0 First known point
- P1 Second known point
- α 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 Bearing & Dist, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

Intersection Bearing & Dist	
Input Map	
1st point:	101
Azimuth:	47.0000 g
Offset:	3.200 m
2nd point:	102
Horiz distance:	25.250 m
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:25	
Calc	Inv..
Last..	Page

Calc

To calculate the result.

Inv..

To calculate the values for the distance and the offset from two existing points. Available when **Azimuth**, **Horiz distance** or **Offset** is highlighted.

Last..

To recall previous results from COGO inverse calculations. Available when **Azimuth**, **Horiz distance** or **Offset** is highlighted.

Survy..

To manually measure a point for the COGO calculation. Available when **1st point** or **2nd point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To add, subtract, multiply and divide values.
Available when **Azimuth**, **Horiz distance** or **Offset** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
1st point	Selectable list	The point ID of the first known point for the COGO calculation.
2nd point	Selectable list	The point ID of the second known point for the COGO calculation.
Azimuth	Editable field	The direction from the first known point to the COGO point.
Offset	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 Use offsets: Yes in Configuration, General page.
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Editable field	The horizontal distance between the known point and the COGO point.

Intersection Result, Result 1 page

Next step

Calc calculates the result and accesses **Intersection Result**.

Intersection Result	
Result 1	Code Plot
Point ID:	104
Easting:	3.101m
Northing:	12.148m
Elevation:	7.000 m

3DCQ:0.010m	2DCQ:0.006m	1DCQ:0.008m	Fn abc	10:27
Store	Coord	Result2	Stake..	Page

Store

To store the result.

Coord

To view other coordinate types.

Result1 or Result2

To view the first and second result.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height. Available for local coordinates.

Fn IndivID

For an individual point ID independent of the ID template. **Fn Run** changes back to the next ID from the configured ID template.

Fn Quit

To not store the COGO point and to exit COGO calculations.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for GPS / TPS in ID Templates . The point ID can be changed.
Easting and Northing	Display only	The calculated coordinates.
Elevation	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.

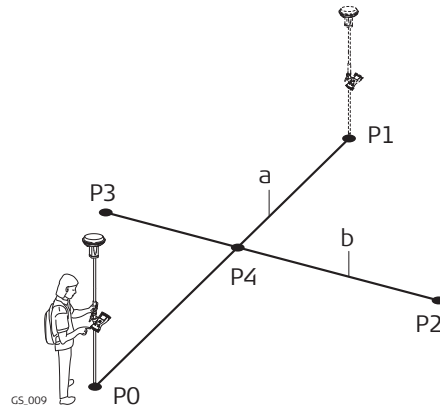
On the **Plot** page, an arrow points from the first known points to the calculated COGO point.

Store stores the result.

30.6.5

Intersection with By Points

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

Intersection By Points, Input page

For all point fields, the MapView interactive display on the **Map** page 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 new point.

Intersection By Points		↶
Input	Map	
1st point:	101	☒
2nd point:	102	☒
Offset:	0.500	m
3rd point:	103	☒
4th point:	104	☒
Offset:	1.250	m
3DCQ:0.011m 2DCQ:0.007m 1DCQ:0.009m Fn abc 10:29		
Calc	Inv..	Last.. Page

Calc

To calculate the result.

Inv..

To calculate the values for the distance and the offset from two existing points. Available when **Offset** is highlighted.

Last..

To recall previous results from COGO inverse calculations. Available when **Offset** is highlighted.

Survy..

To manually measure a point for the COGO calculation. Available when **1st point**, **2nd point**, **3rd point** or **4th point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Modif..

To add, subtract, multiply and divide values.
Available when **Offset** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
1st point	Selectable list	The point ID of the known start point of the first line for the COGO calculation.
2nd point	Selectable list	The point ID of the known end point of the first line for the COGO calculation.
3rd point	Selectable list	The point ID of the known start point of the second line for the COGO calculation.
4th point	Selectable list	The point ID of the known end point of the second line for the COGO calculation.
Offset	Editable field	The offset of the line in the direction 1st point to 2nd point or 3rd point to 4th point . A positive offset is to the right, a negative offset is to the left. Available for Use offsets: Yes in Configuration, General page.

Next step

Calc calculates the result and accesses **Intersection Result**.

Intersection Result, Result page

Intersection Result

Result Code Plot

Point ID: 105

Easting: 1.693m

Northing: 6.660m

Elevation: 7.000 m

3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 10:30

Store Coord Stake.. Page

Store

To store the result.

Coord

To view other coordinate types.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height. Available for local coordinates.

Fn IndivID

For an individual point ID independent of the ID template. **Fn Run** changes back to the next ID from the configured ID template.

Fn Quit

To not store the COGO point and to exit COGO calculations.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for GPS / TPS in ID Templates . The point ID can be changed.
Easting and Northing	Display only	The calculated coordinates.

Field	Option	Description
Elevation	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.

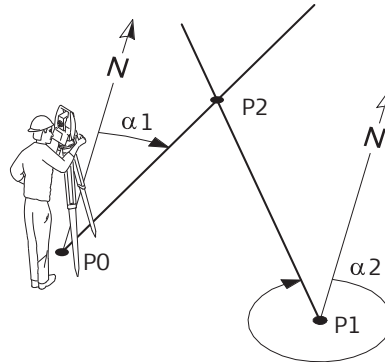
On the **Plot** page, two solid lines are displayed.

Store stores the result.

30.6.6

Intersection with TPS Observation - TPS Observation

Diagram



TS_001

Known

- P0 First known point (TPS station)
- P1 Second known point (TPS station)
- $\alpha 1$ Direction from P0 to P2
- $\alpha 2$ Direction from P1 to P2

Unknown

- P2 COGO point

**Intersection TPS Obs,
Input page**

For all point fields, the MapView interactive display on the **Map** page 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 new point.

Intersection TPS Obs

Input Map

1st TPS station: S101

TPS intersection observations: 106

Azimuth: 345.0000g

2nd TPS station: S102

TPS intersection observations: 108

3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 10:50

Calc Surv.. Page

Calc

To calculate the result.

Surv..

To manually measure a point for the COGO calculation. Available when **1st TPS station** or **2nd TPS station** is highlighted and the selected station is the active TPS setup.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
1st TPS station	Selectable list	The point ID of the first TPS station which is the known start point of the first line for the COGO calculation.

Field	Option	Description
TPS intersection observations	Selectable list	The point ID of the TPS measurement which is the known end point of the first line for the COGO calculation.
Azimuth	Display only	The azimuth related to the known end point of the first/second line for the COGO calculation.
2nd TPS station	Selectable list	The point ID of the second TPS station which is the known start point of the second line for the COGO calculation.
TPS intersection observations	Selectable list	The point ID of the TPS measurement which is the known end point of the second line for the COGO calculation.

Next step

Calc calculates the result and accesses **Intersection Result**.

30.7

30.7.1

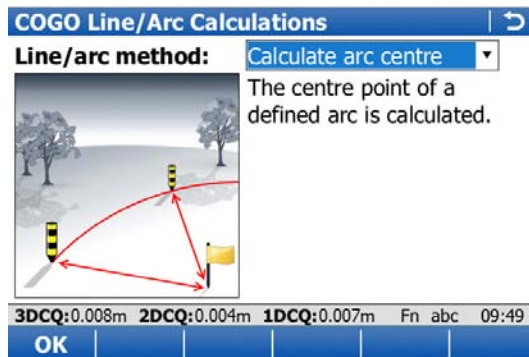
COGO Calculation - Line/Arc Calculations Method

Selecting the Line/Arc Method

Access

Select **Main Menu: Go to Work!\COGO\Line & arc calculations.**

COGO Line/Arc Calculations



OK

To select a method and to continue with the subsequent screen.

Description of the Line/Arc methods

Line/Arc Methods	Description
Calculate arc centre	Calculates the coordinates of the centre of the arc. Elements that must be known are • coordinates of three points OR • coordinates of two points • radius to the two points The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

Line/Arc Methods	Description
Calculate arc offset pt	Calculates the coordinates of a new point after input of arc and offset values in relation to an arc. Elements that must be known are • coordinates of three points. • offsets. OR • coordinates of two points. • radius to the two points. • offsets. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

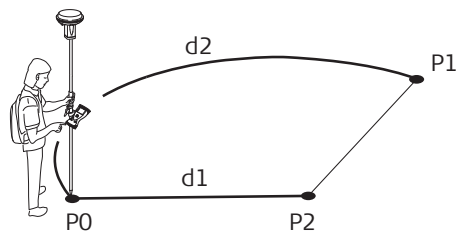
Line/Arc Methods	Description
Calculate line offset pt	Calculates the coordinates of a new point after input of station and offset values in relation to a line. Elements that must be known are • coordinates of two points. • offsets. OR • coordinates of one point. • bearing and distance from one point. • offsets. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

Line/Arc Methods	Description
Calculate arc base pt	Calculates the coordinates of the base point, station and offset of a point in relation to an arc. Elements that must be known are • coordinates of three points • coordinates of an offset point OR • coordinates of two points • radius to the two points • coordinates of an offset point The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

Line/Arc Methods	Description
Calculate line base pt	Calculates the base point, station and offset of a point in relation to a line. Elements that must be known are • coordinates of two points and an offset point. OR • coordinates of one point and an offset point • bearing and distance from one point The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.
Segment an arc	This method is similar to Segment a line . See the following row.

Line/Arc Methods	Description
Segment a line	Calculates the coordinates of new points on a line. Elements that must be known are • coordinates of the start and the end point of the line OR • a bearing and distance from a known point that define the line AND EITHER • the number of segments dividing the line OR • a segment length for the line. The coordinates of the known points • can be taken from the working job. • can be measured during the COGO calculation. • can be entered.

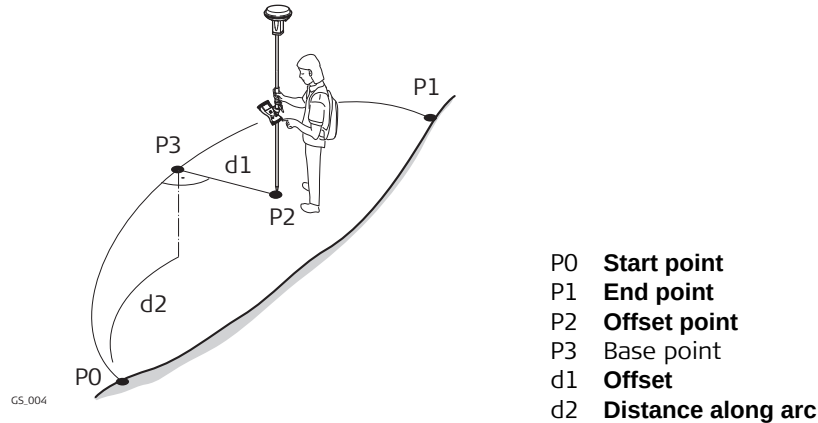
Diagram for arc centre



GS.010

P0 **Start point**
P1 **End point**
P2 Arc centre
d1 **Arc radius**
d2 **Arc length**

Diagram for arc base point and offset point



**Create Arc,
Input page**

The softkeys are similar to line calculation. Refer to "30.7.3 Calculate Line Offset Point and Calculate Line Base Point" for information on softkeys.

Description of fields

Field	Option	Description
Create arc using	3 points	The method by which the arc will be defined. Uses three known points to define the arc.
	2 points & radius	Defines the arc using two known points and a radius of the arc.

Field	Option	Description
	2 tngnts & radius	Defines the arc using two tangents and a radius of the arc.
	2 tngnts & arc lngth	Defines the arc using two tangents and the length of the arc.
	2 tngnts & crd lngth	Defines the arc using two tangents and the chord of the arc.
Start point	Selectable list	The start point of the arc. Available for Create arc using: 3 points and Create arc using: 2 points & radius .
Second point	Selectable list	The second point of the arc. Available for Create arc using: 3 points .
End point	Selectable list	The end point of the arc. Available for Create arc using: 3 points and Create arc using: 2 points & radius .
Point 1	Selectable list	A point on the first tangent. Available for Create arc using: 2 tngnts & radius , Create arc using: 2 tngnts & arc lngth and Create arc using: 2 tngnts & crd lngth .
PI point	Selectable list	The point of intersection of the two tangents. Available for Create arc using: 2 tngnts & radius , Create arc using: 2 tngnts & arc lngth and Create arc using: 2 tngnts & crd lngth .

Field	Option	Description
Point 2	Selectable list	A point on the second tangent. Available for Create arc using: 2 tngnts & radius , Create arc using: 2 tngnts & arc lngth and Create arc using: 2 tngnts & crd lngth .
Radius	Editable field	The radius of the arc. Available for Create arc using: 2 points & radius and Create arc using: 2 tngnts & radius .
Arc length	Editable field	The length of the arc. Available for Create arc using: 2 tngnts & arc lngth .
Chord length	Editable field	The length of the chord. Available for Create arc using: 2 tngnts & crd lngth .

Next step

IF	THEN
Line/arc method: Calculate arc centre	Calc accesses Centre of Arc Result .
Line/arc method: Calculate arc offset pt	OK accesses Calculations Input .
Line/arc method: Calculate arc base pt	OK accesses Calculations Input .

Calculations Input, Input page

Description of fields

Field	Option	Description
Distance along arc	Editable field	Horizontal distance along the arc from start point to base point. Available for Line/arc method: Calculate arc offset pt.
Offset, Offset (ground) or Offset (ell)	Editable field	Offset from base point to offset point. Positive to the right and negative to the left of the arc. Available for Line/arc method: Calculate arc offset pt.
Offset point	Selectable list	Point ID of offset point. Available for Line/arc method: Calculate arc base pt.

Next step

IF	THEN
Line/arc method: Calculate arc offset pt	Calc accesses Line/Arc Calculation Result.
Line/arc method: Calculate arc base pt	Calc accesses Line/Arc Calculation Result.

Centre of Arc Result/Line/Arc Calculation Result, Result page

The result screens for base point and offset point are similar.
Refer to paragraph " Line/Arc Calculation Result, Result page" for information on softkeys.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for GPS / TPS in ID Templates .
Elevation or Local ellipsoid ht	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.
Arc radius	Display only	Computed radius of arc.
Arc length	Display only	Computed length of arc.
Bearing to offset pt	Display only	Bearing of offset point from base point to offset point. Available for Line/arc method: Calculate arc offset pt .
Offset point	Display only	Point ID of offset point. Available for Line/arc method: Calculate arc base pt .
Distance along arc, Distance along arc (grnd) or Distance along arc (ell)	Display only	Horizontal distance along the arc from start point to base point. Available for Line/arc method: Calculate arc offset pt .
Offset, Offset (ground) or Offset (ell)	Display only	Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for Line/arc method: Calculate arc offset pt .

Next step

On the **Code** page, type in a code if desired.

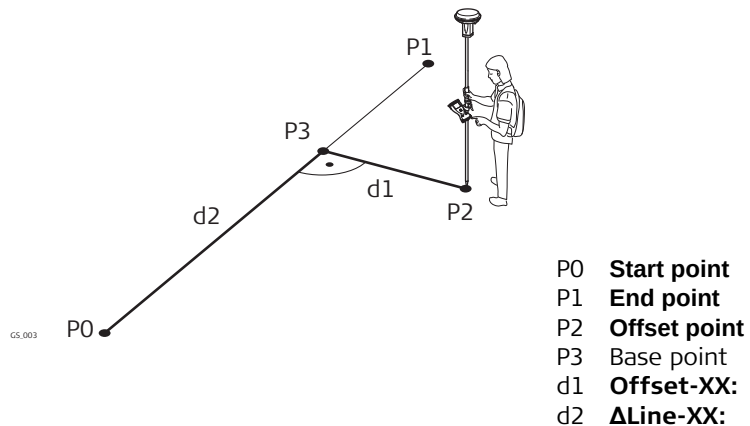
On the **Plot** page, the arc and the new point is shown.

Store stores the result

30.7.3

Calculate Line Offset Point and Calculate Line Base Point

Diagram



Line management is not available for COGO line calculations.

Create Line, Input page

Create Line | ↻

Input | Map

Create line using: 2 points ▼

Start point: 101 [icon]

End point: 102 [icon]

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Fn abc 09:50

OK | | | | Survy.. | Page

OK

To change to the second layer of editable fields.

Inv..

To calculate the values for the distance and the offset from two existing points. Available if **Azimuth** or **Horiz distance** is highlighted.

Last..

To select the values for the distance and the offset from previous COGO inverse calculations. Available if **Azimuth** or **Horiz distance** is highlighted.

Survy..

To measure a point manually for the COGO calculation. Available if **Start point** or **End point** is highlighted.

Fn Config..

To configure the COGO application.

Fn Modif..

To mathematically modify the values. Available if, **Azimuth** or **Horiz distance** is highlighted.

Page

To change to another page on this screen.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Create line using	2 points Pt, bearing & dist	The method by which the line will be defined. Uses two known points to define the line. Defines the line using a known point, a distance and an azimuth of the line.
Start point	Selectable list	The start point of the line.
End point	Selectable list	The end point of the line. Available for Create line using: 2 points .
Azimuth	Editable field	The azimuth of the line. Available for Create line using: Pt, bearing & dist .
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Editable field	The horizontal distance from the start point to the end point of the line. Available for Create line using: Pt, bearing & dist .

Next step

OK accesses **Calculations Input**.

Calculations Input, Input page

Description of fields

Field	Option	Description
Distance along line, Distance along line (ground) or Distance along line (ell)	Editable field	Available for Line/arc method: Calculate line offset pt. Offset from base point to offset point. Positive to the right and negative to the left of the line.
Offset, Offset (ground) or Offset (ell)	Editable field	Available for Line/arc method: Calculate line offset pt. Horizontal distance from start point to base point.
Offset point	Selectable list	Available for Line/arc method: Calculate line base pt. The offset point.

Next step

Calc accesses **Line/Arc Calculation Result**.

Line/Arc Calculation Result, Result page

The result screens for base point and offset point are similar. The explanations given for the softkeys are valid for the **Result** page.

Store

To store the result.

Coord

To view other coordinate types.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height.

Fn IndivID and Fn Run

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
Point ID	Editable field	The identifier for the COGO point depending on the point ID template configured for GPS / TPS in ID Templates .

Field	Option	Description
Elevation or Local ellipsoid ht	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.
Offset point	Display only	Point ID of offset point. Available for Line/arc method: Calculate line base pt.
Distance along line, Distance along line (ground) or Distance along line (ell)	Display only	Horizontal distance from start point to base point. Available for Line/arc method: Calculate line base pt.
Offset, Offset (ground) or Offset (ell)	Display only	Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for Line/arc method: Calculate line base pt.
Line length	Display only	Length of line from start point to end point.
Line bearing	Display only	Bearing of line from start point to end point.
Bearing to offset pt	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 **Plot** page, the line and the new point is shown.

Store stores the result.

30.7.4

Exceptions to line
calculation segmenta-
tion

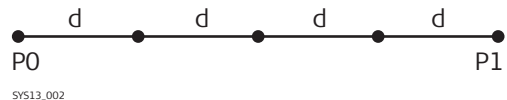
Segment an Arc

The arc segmentation and the functionality of all screens and fields are similar to those for line segmentation. Refer to "30.7.5 Segment a Line"

New field and option in Define Arc Segmentation

Field	Option	Description
Method	Delta angle	To divide the arc by an angular value.
Delta angle	Editable field	The angular value by which new points will be defined on the arc.

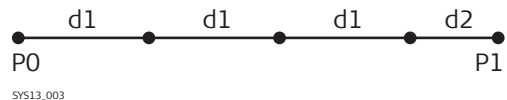
Diagram



Line divided by **Method**: **No. of segments**

- P0 **Start point**
- P1 **End point**
- d Equally spaced segments result from dividing a line by a certain number of points.

Line divided by **Method** **Segment length**



- P0 **Start point**
- P1 **End point**
- d1 **Segment length**
- d2 Remaining segment



For a description of the **Create Line, Input** page, refer to "30.7.3 Calculate Line Offset Point and Calculate Line Base Point".

Define Line Segmentation

Description of fields

Field	Option	Description
Method	Selectable list	How the line is to be divided. Depending on the selection, the following fields are editable or display only fields.
Line length	Display only	Calculated line length between the selected Start point and End point .

Field	Option	Description
No. of segments	Editable field or display only	For Method: No. of segments type in the number of segments for the line. For Method: Segment length this field indicates the calculated number of segments. This method can result in a remaining segment.
Segment length	Editable field or display only	For Method: No. of segments this field is the calculated length of each segment. For Method: Segment length type in the required segment length.
Last segment	Display only	Available for Method: Segment length . The length of the remaining segment.
Starting pt ID	Editable field	The point ID to be assigned to the first new point on the line. The selected point ID templates from ID Templates are not applied.
Pt ID increment	Editable field	Is incremented numerically for the second, third, etc. point on the line.

Next step

Calc 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 **Plot** page, the known points defining the line and those points created on the line are shown.

30.8

30.8.1

COGO Calculation - Area Division

Selecting the Division Method

Description

The COGO calculation area division divides an area by a defined line, by percentage or by the size of a subarea.

Elements that must be known for the calculation depend on the area division method. At least three points are required to form an area.

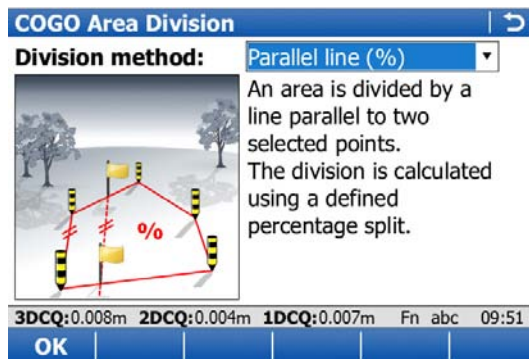
The coordinates of the known points

- can be taken from the working job.
- can be measured during the COGO calculation.
- can be entered.

Access

Select **Main Menu: Go to Work!\COGO\Area division.**

COGO Area Division



OK

To select a method and to continue with the subsequent screen.

Description of the Area Division methods

Area Division method	Description
Parallel line (%)	The border will be parallel to a line defined by two points. The division is calculated using a defined percentage split.
Parallel line (area)	The border will be parallel to a line defined by two points. The division is calculated using a defined area size.
Parallel line (line)	The border will be parallel to a line defined by two points. The division is calculated by defining the position of the dividing line.
Perpendic line (%)	The border will be perpendicular to a line defined by two points. The division is calculated using a defined percentage split.
Perpendic line (area)	The border will be perpendicular to a line defined by two points. The division is calculated using a defined area size.
Perpendic line (line)	The border will be perpendicular to a line defined by two points. The division is calculated by defining the position of the dividing line.
Swing line (%)	The border will be a line rotated around a rotation point by an azimuth. The division is calculated using a defined percentage split.
Swing line (area)	The border will be a line rotated around a rotation point by an azimuth. The division is calculated using a defined area size.

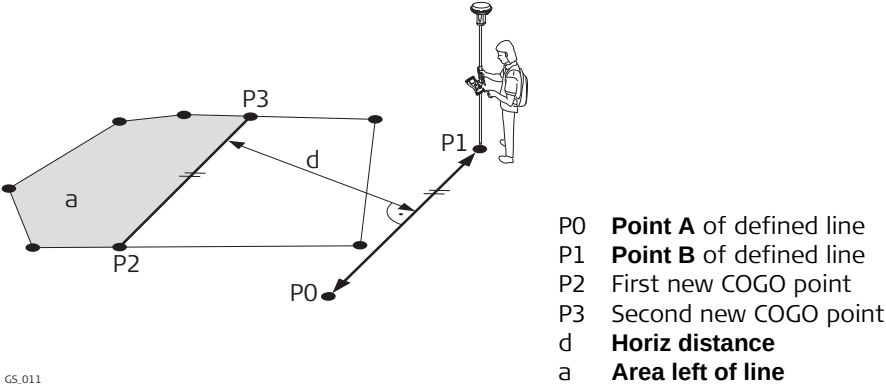
Elements required

Divide by	Using		Elements required
Line	Parallel line	Through a point	- Two points defining the line - One point on the dividing line
		By a distance	- Two points defining the line - Distance
	Perpendicular line	Through a point	- Two points defining the line - One point on the dividing line
		By a distance	- Two points defining the line - Distance
Percentage	Parallel line	-	- Percentage size of new area - Two points defining the line
	Perpendicular line	-	- Percentage size of new area - Two points defining the line
	Swing line	Rotation point	- Percentage size of new area - Rotation point of the swing line
Area	Parallel line	-	- Size of new area - Two points defining the line
	Perpendicular line	-	- Size of new area - Two points defining the line
	Swing line	Rotation point	- Size of new area - Rotation point of the swing line

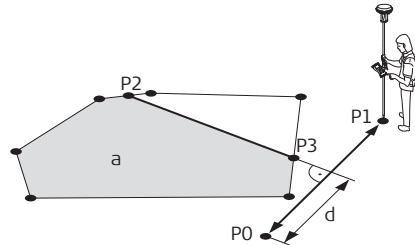
Diagram

The diagrams show the area division methods. Some diagrams apply to several area division methods.

Area division method	Using	Divide	Shift
1.	Parallel Line	By Defined Line	By Distance
2.	Parallel Line	By Percentage	-
3.	Parallel Line	By Area	-



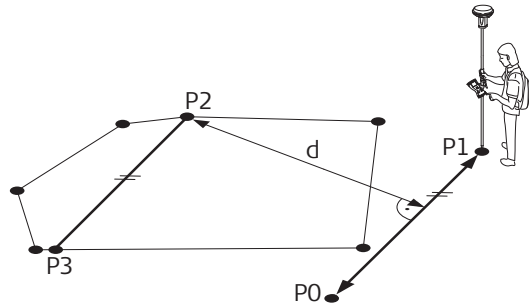
Area division method	Using	Divide	Shift
1.	Perpendic Line	By Defined Line	By Distance
2.	Perpendic Line	By Percentage	-
3.	Perpendic Line	By Area	-



GS_012

- P0 **Point A** of defined line
- P1 **Point B** of defined line
- P2 First new COGO point
- P3 Second new COGO point
- d **Horiz distance**
- a **Area left of line**

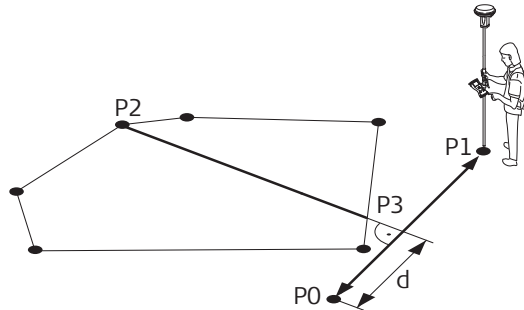
Area division method	Using	Divide	Shift
1.	Parallel Line	By Defined Line	Through Point



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 **Horiz distance**

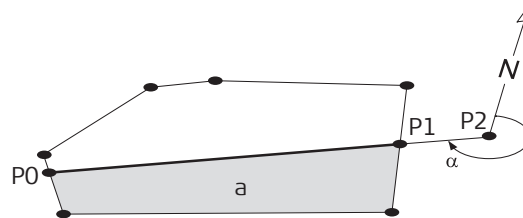
Area division method	Using	Divide	Shift
1.	Perpendic Line	By Defined Line	Through Point



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 **Horiz distance**

Area division method	Using	Divide	Shift
1.	Swing Line	By Percentage	-
2.	Swing Line	By Area	-



SYS13_007

P0 First new COGO point
 P1 Second new COGO point
 P2 **Rotation point**
 α **Azimuth**
 a **Area left of line**

30.8.2

Choosing an Area to be Divided

Choose Area to be Divided

Choose Area to be Divided | ↩

Area to use:

Area ID:

No. of points: 4

Area: 55.000m²

Perimeter: 105.168m

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.010m Fn abc 09:53

OK

OK

To accept the changes and access the subsequent screen.

Description of fields

Field	Option	Description
Area to use	Select existing area	The setting determines the availability of the subsequent fields and screen. To use an area from the working job. The area can be edited and a new area can be created from points existing in the job.
	Survey new area	To survey points that do not exist in the job yet. The points will be added to a new area.
	Create new with pts	To create a new area by selecting points from the job.

Field	Option	Description
Area ID	Selectable list	For Area to use: Select existing area . To select the area to be divided.
	Editable field	For Area to use: Survey new area and Area to use: Create new with pts . To enter a name for the new area.
No. of points	Display only	Number of points forming the area.
Area	Display only	The size of the selected area.
Perimeter	Display only	The perimeter of the area.

Next step

IF	THEN
Area to use: Select existing area	OK accesses Define How to Divide Area . Refer to "30.8.3 Dividing an Area".
Area to use: Survey new area	OK accesses Survey Job name . Refer to "44 Survey - General".
Area to use: Create new with pts	OK accesses Edit Area . Refer to "5.4.3 Editing a Line/Area".

30.8.3

Define How to Divide Area, Input page

Dividing an Area

After each change of parameters on this screen, the values in the display only fields are recalculated and updated.

Define How to Divide Area	
Input	Map
Area left of line:	50.00 %
Point A:	101
Point B:	102
Horiz distance:	10.284m

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Fn abc 09:55				
Calc			Surv..	Page

Calc

To perform the area division and to continue with the subsequent screen. Calculated COGO points are not yet stored.

Inv..

To calculate the value for the distance from two existing points. Available if **Horiz distance** is highlighted.

Size and %

To display the size and the percentage of the subarea.

Last..

To select the value for the distance from previous COGO inverse calculations. Available if **Horiz distance** is highlighted.

Surv..

To manually measure a point for the COGO calculation. Available if **Point A**, **Point B**, **Rotation point** or **Through point** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Area left of line	Editable field	For dividing by percentage or area. The size of the sub area must be typed either in % or in m². When dividing the area using a parallel or perpendicular line, a reference line is defined by Point A and Point 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 sub area is always to the left of the new dividing line. When dividing an area using a swing line, the direction of the new dividing line is defined by the Rotation point and the Azimuth. The sub area is always to the left of the new dividing line.
	Display only	For dividing by a line. The size of the sub area is calculated and displayed.
Point A	Selectable list	The first point of the line which is used as the reference for a new parallel or perpendicular border.
Point B	Selectable list	The second point of the line which is used as the reference for a new parallel or perpendicular border.
Shift		Available for dividing by a line.
	By distance	The new border will run in a certain distance from the line defined by Point A and Point B .

Field	Option	Description
	Through point	The new border will run through a point defined in Through point .
Through point	Selectable list	Available for Shift: Through point . The point through which the new border will run.
Rotation point	Selectable list	Available for using a swing line. The point around which the new border will rotate by Azimuth .
Azimuth	Display only	Available for using a swing line. The angle of the new border from Rotation point to the new COGO point.
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Display only	The distance from the line defined by Point A and Point B to the new border.

Next step

Calc performs the area division and accesses **Area Division Result**.

30.8.4

Results of the Area Division

Area Division Result, Result page

Area Division Result
↩

Result
Plot

Area ratio: 50%:50%

Area left of line: 27.497m²

Area right of line: 27.503m²

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 09:55

OK
Page

OK

To accept the calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored.

Page

To change to another page on this screen.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Area ratio	Display only	The ratio of the size of the two sub areas in percent.
Area left of line	Display only	The size of the first sub area in m ² .
Area right of line	Display only	The size of the second sub area in m ² .

Next step

On the **Plot** page, the points defining the area and the calculated COGO points are shown in black.

OK accesses **Area Divisions Results**.

Area Divisions Results, Result page

The coordinates of the intersection points of the new border with the original area are displayed.

Area Divisions Results	
Result 1	Code Plot
Point ID:	109
Easting:	0.100m
Northing:	-3.001m
Elevation:	7.000 m

3DCQ:0.009m	2DCQ:0.005m	1DCQ:0.008m	Fn abc	09:56
Store	Coord	Result2	Stake..	Page

Store

To store the two results and to return to **Choose Area to be Divided** once both points are stored.

Coord

To view other coordinate types.

Result1 or Result2

To view the first and second result.

Stake..

To access the Stakeout application and stake out the calculated COGO point.

Page

To change to another page on this screen.

Fn Ell Ht and Fn Elev

To change between the ellipsoidal and the orthometric height.

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit COGO calculation.

Next step

On the **Code** page, type in a code if desired.

On the **Plot** page, The points defining the area and the points of the new border are shown in black.

Store stores the results.

30.9

30.9.1

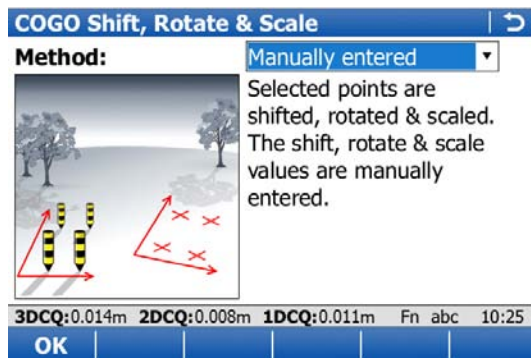
Access

COGO Shift, Rotate & Scale

COGO Calculation - Shift, Rotate & Scale

Selecting the Shift, Rotate & Scale Method and the Points to be Moved

Select **Main Menu: Go to Work!\COGO\Shift, rotate & scale.**



OK

To select a method and to continue with the subsequent screen.

Description of the Shift, Rotate & Scale methods

Shift, Rotate & Scale methods	Description
Manually entered	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. Elements that must be known are • the coordinates of the points to be shifted, rotated and/or scaled. They must be stored in the working job. • 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. • the rotation value. It can be defined by a point as rotation centre plus a rotation or by an existing and new azimuth. • the scale. It is only applied to the position, not to the height. Points with full coordinate triplets, position only points and height only points can be used.

Shift, Rotate & Scale methods	Description
Matching points	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. Elements that must be known are • the coordinates of at least two matching points for the calculation of the shifts and/or rotation and/or scale. • the coordinates of the points to be shifted, rotated and/or scaled. They must be stored in the working job. Points with full coordinate triplets, position only points and height only points can be used. 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.

Next step

OK accesses **Point Selection** which is the same for **Method: Manually entered** and **Method: Matching points**.

Point Selection

Listed are points which have been selected for shifting, rotating and/or scaling.

Point Selection		
Points	Code	
101	TR	
102	TR	
103	BU	
104	MH	

3DCQ:0.010m	2DCQ:0.006m	1DCQ:0.008m	Fn abc	10:26
OK	+ All..	+ One..	Remov	More

OK

To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored.

+ All..

To add all points from the working job to the list. Selected sort and filter settings apply.

OK adds all displayed points to the list in **Point Selection** and returns to that screen.

+ One..

To add one point from the working job to the list. Selected sort and filter settings apply. **OK** adds the currently highlighted point to the list in **Point Selection** and returns to that screen.

Remov

To remove the highlighted point from the list. The point itself is not deleted.

More

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.

Fn Rem A

To remove all points from the list. The points itself are not deleted.

Fn Range

To define a range of points from the working job to be added to the list.

Fn Quit

To exit COGO calculation.

Next step

IF	AND	THEN
all points are to be added	-	+ All...
one point is to be added	-	+ One...
a range of points is to be added	-	Fn Range accesses Select points by range .
all points are added	Method:Manually entered Method:Matching points	OK accesses Parameters . Refer to "30.9.2 Manually Entered". OK accesses Match Points (%d) . Refer to "30.9.3 Matching Points".

Select points by range

Select points by range | ↩

From pt ID:

To pt ID:

OK

To add the points within the selected range to the list in **Point Selection**. Returns to the screen from where this screen was accessed.

Next

To add the points within the selected range to the list in **Point Selection** without quitting this screen. Another range of point IDs can be selected.

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:26

OK | Next | | | |

Description of fields

Field	Option	Description
From pt ID and To pt ID	Editable field	Numeric point IDs in both fields: Points with numeric point IDs falling within the range are selected. Example: From pt ID: 1, To pt ID: 50 Selected are point IDs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.... 49, 50 as well as 001, 01, 0000045, ... Not selected are point IDs 100,200,300, ...

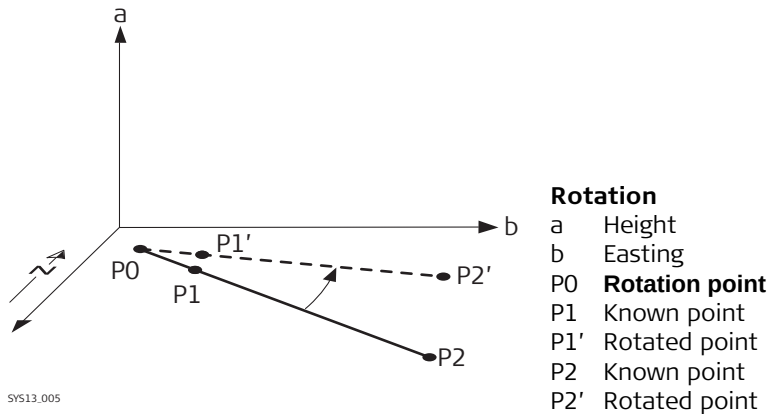
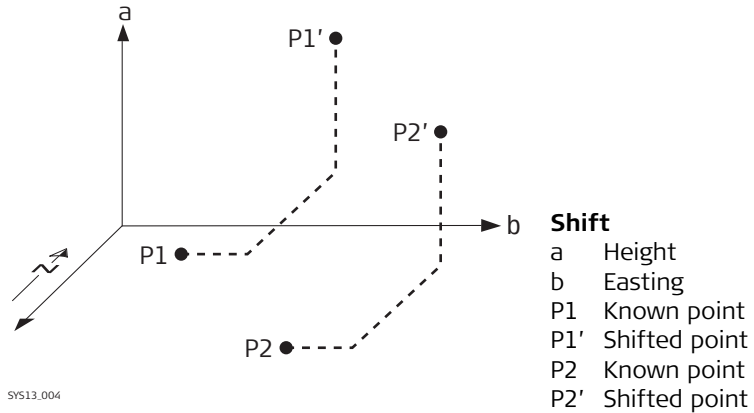
Field	Option	Description
		Alphanumeric point IDs in both fields: The left most character of both entries is used as the basis for the range. The standard ASCII numerical range is used. Points with alphanumeric point IDs falling within the range are selected. Example: From pt ID: a9, To pt ID: c200 Selected are point IDs a, b, c, aa, bb, cc, a1, b2, c3, c4, c5, a610, ... Not selected are point IDs d100, e, 200, 300, tzz ...

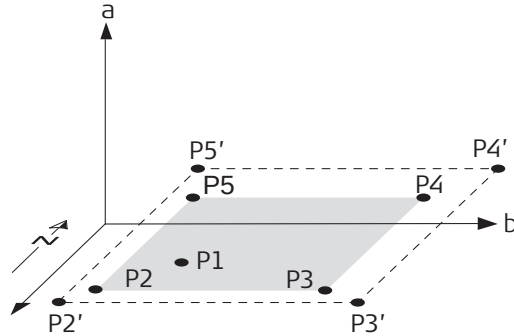
Next step

Select a range of points.

OK returns to **Point Selection**.

Diagram





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

Parameters,
Shift page

Parameters	
Shift	Rotate Scale
Method:	Δ east, Δ north, Δ ht
Δ easting:	10.000 m
Δ northing:	0.000 m
Δ height:	0.000 m

3DCQ:0.009m	2DCQ:0.005m	1DCQ:0.007m	Fn abc	10:26
Calc	Inv..	Last..	Page	

Calc

To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored.

Inv..

To calculate the amount of shift in Easting, Northing and height from two existing points. Available if **Azimuth**, **Horiz distance**, **Δ easting**, **Δ northing** or **Δ height** is highlighted.

Last..

To select the value for the shift from previous COGO inverse calculations. Available if **Azimuth**, **Horiz distance**, **Δ easting**, **Δ northing** or **Δ height** is highlighted.

Survy..

To manually measure a point for the COGO calculation. Available for **Method: Use 2 points** if **From** or **To** is highlighted.

Page

To change to another page on this screen.

Fn Config..

To configure the COGO application. Refer to "30.3 Configuring COGO".

Fn Modif..

To mathematically modify the values. Available if **Azimuth**, **Horiz distance**, **Δ easting**, **Δ northing** or **Δ height** is highlighted.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Method	Δeast, Δnorth, Δht Bearing, dist, height Use 2 points	The method by which the shift in Δ Easting, Δ Northing and Δ Height will be determined. Defines the shift using coordinate differences. Defines the shift using an azimuth, a distance and a height difference. Computes the shift from the coordinate differences between two known points.
From	Selectable list	Available for Method: Use 2 points . The point ID of the first known point for calculating the shift.
To	Selectable list	Available for Method: Use 2 points . The point ID of the second known point for calculating the shift.
Azimuth	Editable field	Available for Method: Bearing, dist, height . The azimuth defines the direction of the shift.

Field	Option	Description
Horiz distance, Horiz dist (ground) or Horiz dist (ell)	Editable field	Available for Method: Bearing, dist, height . The amount of shift from the original point to the calculated COGO points.
Δ easting	Editable field or display only	The amount of shift in East direction.
Δ northing	Editable field or display only	The amount of shift in North direction.
Δ height	Editable field or display only	The amount of shift in height.

Next step

Page accesses **Parameters, Rotate** page.

Parameters, Rotate page

The softkeys are the same as on the **Shift** page.

Description of fields

Field	Option	Description
Method		The method by which the rotation angle will be determined.
	User entered Computed	The rotation can be manually typed in. The rotation will be calculated as New azimuth minus Existing azimuth .

Field	Option	Description
Rotation point	Selectable list	The point around which all points will be rotated.
Existing azimuth	Editable field	Available for Method: Computed . A known direction before rotating.
New azimuth	Editable field	Available for Method: Computed . A known direction after rotating.
Rotation	Editable field or display only	The amount by which the points will be rotated.

Next step

Page accesses **Parameters, Scale** page.

Parameters, Scale page

The softkeys are the same as on the **Shift** page.

Description of fields

Field	Option	Description
Method		The method by which the scale factor will be determined.
	User entered Computed	The scale factor can be manually typed in. The scale factor will be calculated as New distance divided by Existing distance .
Existing distance	Editable field	Available for Method: Computed . A known distance before scaling. This value is used for calculating the scale factor.

Field	Option	Description
New distance	Editable field	Available for Method: Computed . A known distance after scaling. This value is used for calculating the scale factor.
Scale	Editable field or display only	The scale factor used in the calculation.
Scale from point	No Yes	Scaling is performed by multiplying the original coordinates of the points by Scale . Scale is applied to the coordinate difference of all points relative to Rotation point selected on the Rotation page. The coordinates of Rotation point will not change.

Next step

Calc performs the shift, rotation and scale calculation and accesses **Shift, Rotate & Scale Results**.

Shift, Rotate & Scale Results, General page

Shift, Rotate & Scale Results

General

Summary

Plot

Points selected: 4

Store points to job: Cogo job

Store Point ID with: Prefix

Prefix / suffix: S

3DCQ:0.010m 2DCQ:0.006m 1DCQ:0.008m Fn abc 10:26

Store

Page

Store

To store the results and continue with the next screen.

Page

To change to another page on this screen.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Points selected	Display only	The number of selected points having been shifted, rotated and/or scaled.
Store points to job	Selectable list	The calculated COGO points will be stored in this job. The original points are not copied to this job.
Add Identifier	Yes or No	Activates the use of identifiers for the point IDs of the calculated COGO points.
Store Point ID with	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.
Prefix / suffix	Prefix	Adds the setting for Store Point ID with in front of the original point IDs.

Field	Option	Description
	Suffix	Adds the setting for Store Point ID with at the end of the original point IDs.

Next step

IF	THEN
the used parameters are to be viewed	Page accesses Shift, Rotate & Scale Results, Summary page.
the calculated COGO points are to be viewed graphically	Page accesses Shift, Rotate & Scale Results, Plot page. Original points are displayed in grey, calculated COGO points are displayed in black.
the calculated COGO points are to be stored	Store accesses Shift, Rotate & Scale Results, Result page. Refer to paragraph "Shift, Rotate & Scale Results, Result page".

Shift, Rotate & Scale Results, Result page

Description of fields

Field	Option	Description
No. of new points	Display only	Number of new points created.
No. of skipped pts	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 Store points to job .

Next step

OK returns to **COGO Shift, Rotate & Scale**.

Point Selection

Listed are points which have been selected for shifting, rotating and/or scaling.

Point Selection		
Points	Code	
101	TR	
102	TR	
103	BU	
104	MH	

3DCQ:0.010m		2DCQ:0.006m	1DCQ:0.008m	Fn abc	10:26
OK	+ All..	+ One..	Remov	More	

OK

To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored.

+ All..

To add all points from the working job to the list. Selected sort and filter settings apply.

OK adds all displayed points to the list in **Point Selection** and returns to that screen.

+ One..

To add one point from the working job to the list. Selected sort and filter settings apply. **OK** adds the currently highlighted point to the list in **Point Selection** and returns to that screen.

Remov

To remove the highlighted point from the list. The point itself is not deleted.

More

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.

Fn Rem A

To remove all points from the list. The points itself are not deleted.

Fn Range

To define a range of points from the working job to be added to the list.

Fn Quit

To exit COGO calculation.

Next step

IF	AND	THEN
all points are to be added	-	+ All...
one point is to be added	-	+ One...
a range of points is to be added	-	Fn Range accesses Select points by range .
all points are added	Method:Manually entered	OK accesses Parameters . Refer to "30.9.2 Manually Entered".
	Method:Matching points	OK accesses Match Points (%d) . Refer to "30.9.3 Matching Points".

Match Points

This screen provides a list of points chosen from the working job. The points are used for the determination of the 2D Helmert transformation. The number of points matched is indi-

cated in the title, for example (2). Unless there is no pair of matching points in the list all softkeys are available.

Match Points (2)			↶
Source point	Target point	Match	
101	107	P & H	
102	108	P only	

3DCQ:0.008m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:28

Calc

To confirm the selections, compute the transformation and continue with the subsequent screen.

New..

To match a new pair of points. This pair is added to the list. A new point can be manually measured. Refer to paragraph "Choose Matching Points or Edit Matching Points".

Edit..

To edit the highlighted pair of matched points.

Delete

To delete the highlighted pair of matched points from the list.

Match

To change the type of match for a highlighted pair of matched points.

Resid

To display a list of the matched points used in the transformation calculation and their associated residuals. Refer to paragraph "Fix Parameters".

Fn Param

To define the parameters to be fixed in the 2D transformation.

Fn Quit

To exit COGO calculation.

Description of columns

Column	Description
Source point	The point ID of the points of origin for the calculation of the shifts and/or rotation and/or scale.
Target point	The point ID of the target points for the calculation of the shifts and/or rotation and/or scale.
Match	The type of match to be made between the points. This information is used in the transformation calculation. Position & Height, Position only, Height only or None. None 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	Calc. The calculated shift, rotation and scale values are displayed in Point Selection . They cannot be edited. The remaining functionality of the calculation is similar to shift, rotate & scale (manual). Refer to "30.9 COGO Calculation - Shift, Rotate & Scale".
a pair of points is to be matched or edited	New.. or Info . Refer to paragraph "Choose Matching Points or Edit Matching Points".

IF	THEN
parameters for the transformation are to be fixed	Fn Param. Refer to paragraph "Fix Parameters".

Choose Matching Points or Edit Matching Points

Choose Matching Points

Source point: 101

Target point: 107

Match type: Pos & height

OK

To confirm the selections.

Fn Quit

To exit COGO calculation.

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m Fn abc 10:27

OK

Survvy..

Description of fields

Field	Option	Description
Source point	Selectable list	A point of origin for the calculation of the shifts and/or rotation and/or scale.
Target point	Selectable list	A target point for the calculation of the shifts and/or rotation and/or scale.
Match type		The type of match to be made between the points selected.

Field	Option	Description
	Pos & height	Position and height
	Pos only	Position only
	Height only	Height only
	None	None

Fix Parameters

The settings on this screen define the parameters to be used in the transformation.

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
Δ easting	Editable field	Shift in Easting direction.
Δ northing	Editable field	Shift in Northing direction.
Δ height	Editable field	Shift in Height direction.
Rotation	Editable field	Rotation around the X axis.
Scale	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. Fix.
a field displays a value	the parameter must be calculated	highlight the field. Adjst.
all parameters are configured	-	OK to return to Match Points .

30.10

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**, **Horiz distance** or **Offset** and press **Last...**

Last Inverse Calculations

All previous COGO inverse calculations stored in the working job are displayed, sorted by time with the most recent at the top. This screen 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.

Last Inverse Calculations			↩
From	To	Azimuth [g]	
103	104	218.5547	
101	102	107.9167	

3DCQ:0.012m 2DCQ:0.007m 1DCQ:0.010m Fn abc 10:28				
OK		View	Delete	More

OK

To return to the previous screen.

View

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.

Delete

To delete the highlighted COGO inverse calculation.

More

To display other information in the third column.

Fn Quit

To exit COGO calculation.

Description of columns

Column	Description
From	The point ID of the first known point for the COGO inverse calculation.
To	The point ID of the second known point for the COGO inverse calculation.
Azimuth	The direction from the first to the second known point.
HDist	The horizontal distance between the two known points.
Date and Time	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.

30.11

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 step-by-step

In Traverse or Intersection, highlight **Azimuth**, **Horiz distance** or **Offset** and press **Fn Modif...**

Modify Value

On this screen, 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.

OK

To accept the modified value and to return to the screen from where this screen was accessed. The modified value is copied into the field which was initially highlighted on the **Input** page.

Fn Quit

To exit COGO calculation.

Description of fields

Field	Option	Description
Azimuth, Horiz distance or Offset	Display only	The name of the field and the value which was highlighted before accessing Modify Value .

Field	Option	Description
Multiply	Editable field	The number to multiply by. • Minimum: -3000 • Maximum: 3000 • ----- performs a multiplication by 1.
Divide	Editable field	The number to divide by. • Minimum: -3000 • Maximum: 3000 • ----- performs a division by 1.
Add	Editable field	The number to be added. • For azimuths Minimum: 0 Maximum: Full circle • For distances and offsets Minimum: 0 m Maximum: 30000000 m • ----- performs an addition of 0.000.
Subtract	Editable field	The number to be subtracted. • For azimuths Minimum: 0 Maximum: Full circle

Field	Option	Description
		- For distances and offsets Minimum: 0 m Maximum: 30000000 m ----- performs a subtraction of 0.000.
Azimuth, Horiz distance or Offset	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 screen from where this screen was accessed.

Example: Calculations for an azimuth

Step	Editable field	Value as calculated	Value as displayed
			Azimuth: 250.0000 g
1.	Multiply: 2	500	Azimuth: 100.0000 g
2.	Divide: 3	166.667	Azimuth: 166.6670 g
3.	Add: 300	466.667	Azimuth: 66.6670 g
4.	Subtract: 100	366.667	Azimuth: 366.6670 g

Example: Calculations for a distance

The behaviour for an offset is identical.

Step	Editable field	Value as calculated	Value as displayed
			Horiz distance: 250.000 m

Step	Editable field	Value as calculated	Value as displayed
1.	Multiply: 2	500	Horiz distance: 500.000 m
2.	Divide: 3	166.667	Horiz distance: 166.667 m
3.	Add: 300	466.667	Horiz distance: 466.667 m
4.	Subtract: 100	366.667	Horiz distance: 366.667 m

Determine Coordinate System

Overview

Description

GPS 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 application 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 WGS 1984 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.
-

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 **Main Menu: Go to Work!\Survey+\Determine coord system.**

Determine Coord System

Description of fields

Field	Option	Description
Method	Onestep	The type of transformation to be used when determining a coordinate system. Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure: 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. 2 The results of 1. are preliminary grid coordinates for the WGS 1984 points.

Field	Option	Description
	Twostep	3 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. 4 The height transformation is a single dimension height approximation. Refer to "Appendix H Glossary". 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: 1 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. 2 The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points. 3 A 2D transformation is applied, exactly as with the Onestep transformation. Refer to "Appendix H Glossary".

Field	Option	Description
	Classic 3D	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 "Appendix H Glossary".
	Modify existing	To modify an existing determine coordinate system. Refer to "31.3.3 Modifying a Coordinate System".

Next step

IF the selected method is	THEN
Onestep, Twostep or Classic 3D	OK to access Choose WGS84 & Local Jobs . Refer to the following paragraph: Choose WGS84 & Local Jobs .
Modify existing	OK to access Coordinate Systems . Refer to "31.3.3 Modifying a Coordinate System".

Choose WGS84 & Local Jobs

Choose WGS84 & Local Jobs

Name:

123

WGS84 points job:

Wgs84

Local points job:

Local

☐ Use one point localisation method

3DCQ:0.016m 2DCQ:0.009m 1DCQ:0.013m Fn abc 14:18

OK

Config..

OK

To confirm the selections and to continue with the subsequent screen.

Config..

To configure the selected coordinate system determination method.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	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.  Entering the name of a coordinate system will allow that existing system to be updated.
WGS84 points job	Selectable list	The job from which the points with WGS 1984 coordinates will be taken.
Local points job	Selectable list	The job from which the points with local coordinates will be taken.

Field	Option	Description
Use one point localisation method	Check box	Number of control points needed: One control point for both the WGS 1984 and the local datum. Transformation to use: • Onestep or Twostep when information about the necessary rotations and scale factor is known. • Classic 3D when the rotations are to be set to zero and the scale factor to one.

Next step

Press **Config..** with **Use one point localisation method** NOT checked to access **Configuration**.

31.3

31.3.1

The Normal Method

Configuring the Normal Method

Description

The configuration allows options to be set, which are used in the Determine Coordinate System application. These settings are stored within the active working style.

Access

Press **Config..** in **Choose WGS84 & Local Jobs** with **Use one point localisation method** NOT checked.

Configuration, Residuals page

The explanations for the softkeys given here are valid for all pages, unless otherwise stated.

Configuration | ➔

Residuals | Advanced

Flag residuals greater than

Easting: 0.050 m

Northing: 0.050 m

Elevation: 0.050 m

3DCQ:0.022m 2DCQ:0.012m 1DCQ:0.018m Fn abc 14:19

OK | | | | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Easting	Editable field	The limit above which Easting residuals will be flagged as possible outliers.

Field	Option	Description
Northing	Editable field	The limit above which Northing residuals will be flagged as possible outliers.
Elevation	Editable field	The limit above which Height residuals will be flagged as possible outliers.
Default Default residual distribution method	None 1/distance, 1/distance² or 1/distance^{3/2} Multiquadratic	The method by which the residuals of the control points will be distributed throughout the transformation area. No distribution is made. Residuals remain with their associated points. Distributes the residuals according to the distance between each control point and the newly transformed point. Distributes the residuals using a multiquadratic interpolation approach.

Next step

Page changes to the **Advanced** page.

Configuration,
Advanced page

Description of fields

Field	Option	Description
Model	Bursa-Wolf or Molodensky-Badakus	The transformation model to be used. Refer to standard surveying literature for details on the models.

Field	Option	Description
Prompt me to enter fixed transformation parameters	Check box	To configure Classic 3D transformation parameters during the process of calculation.

Next step

OK returns to **Choose WGS84 & Local Jobs**.

31.3.2

Determining a New Coordinate System

Access

Press **OK** in **Choose WGS84 & Local Jobs** with **Use one point localisation method** NOT checked.

Set Height Mode

Set Height Mode

Transformation name: 22

Transformation type: Onestep

Height mode: Ellipsoidal

3DCQ:0.019m 2DCQ:0.011m 1DCQ:0.016m Fn abc 14:19

OK

OK

To confirm the selections and to continue with the subsequent screen.

Fn Quit

To exit the screen.

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.
Transfrm Type	Display only	The type of transformation to be used when determining a coordinate system.

Field	Option	Description
Height mode	Orthometric or Ellipsoidal Display only	The height mode to be used in the determination of a coordinate system. Available when determining a new coordinate system. Available when updating a coordinate system. The height mode shown is the same as the mode used in the existing system.

Next step

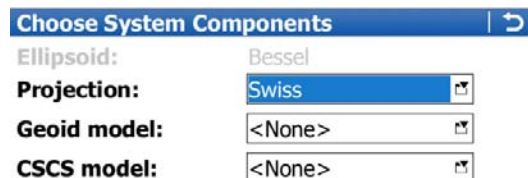
OK continues to **Choose System Components**.



If a coordinate system was chosen to be edited in **Choose WGS84 & Local Jobs**, pressing **OK** accesses **Matched Points (n)**. Pressing **ESC** does not reaccess **Choose WGS84 & Local Jobs** but accesses **Choose System Components** and **Set Height Mode**.

Choose System Components

This screen contains different fields, depending on what method was chosen in **Determine Coord System**.



OK

To confirm the selections and to continue with the subsequent screen.

Fn Quit

To exit the screen.



For Onestep

Description of fields

Field	Option	Description
Geoid model	Selectable list	The geoid model to be used in the transformation.
Pre Transform	Selectable list	For Twostep: The pre-transformation to use for the preliminary 3D transformation.
Ellipsoid	Selectable list	For Twostep and Classic 3D: The ellipsoid to use in the transformation.
	Display only	For Twostep and Classic 3D: The ellipsoid being used by a fixed projection when selected in Projection .

Field	Option	Description
Projection	Selectable list	For Twostep and Classic 3D: The projection to use in the transformation.
CSCS model	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 screen provides a list of points chosen from **WGS84 points job** and **Local pts**. 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 "31.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points" for information on how to match points.

Matched Points (4)			↩
WGS84 pts	Local pts	Match	
101	101	P & H	
200	200	P & H	
300	300	P & H	
400	400	P & H	

3DCQ:0.016m	2DCQ:0.009m	1DCQ:0.013m	Fn	abc	14:21
Calc	New..	Edit..	Delete	Match	Auto

Calc

To confirm the selections, compute the transformation and continue with the subsequent screen.

New..

To match a new pair of points. This pair is added to the list. A new point can be manually occupied. Refer to "Choose Matching Points/Edit Matching Points".

Edit..

To edit the highlighted pair of matched points. Refer to "Choose Matching Points/Edit Matching Points".



If a coordinate system to be updated contains a point that was deleted from the working job and a new point was created in that job with the same point ID but different coordinates, the coordinates of the old point will still be used for the calculation. Pressing **Edit..** to edit a highlighted pair of matched points containing the deleted point, will overwrite the coordinates of the old point. The coordinates of the new point will be used in the calculation.

Delete

To delete the highlighted pair of matched points from the list.

Match

To change the type of match for a highlighted pair of matched points. Refer to "31.3.4 Matching Points: Selecting/ Editing a Pair of Matching Points".

Auto

To scan both jobs for points that have the same point ID. Points with matching point IDs are added to the list.

Fn Quit

To exit the screen.

Description of columns

Column	Description
WGS84 pts	The point ID of the points chosen from WGS84 points job .
Local pts	The point ID of the points chosen from Local points job .
Match	The type of match to be made between the points. This information is used in the transformation calculation. Position & Height, Position only, Height only or None. - For Onestep or Twostep possible options are P & H, P only, H only or None. - For Classic 3D, possible options are P & H or None. None 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

Calc computes the transformation and continues to **Check Residuals** or to **Classic 3D Parameters** if **Prompt me to enter fixed transformation parameters** was checked during the configuration.

Classic 3D Parameters

The settings on this page define the parameters to be used in a Classic 3D transformation. Refer to "Appendix H 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.

IF the value for a field is	THEN the value for this parameter will be
any number	fixed to that value.

Description of fields

Field	Option	Description
Model	Bursa-Wolf or Molodensky-Badakus	The transformation model to be used. Refer to standard surveying literature for details on the models.
Shift dX	Editable field	Shift in X direction.
Shift dY	Editable field	Shift in Y direction.
Shift dZ	Editable field	Shift in Z direction.
Rotation X	Editable field	Rotation around the X axis.
Rotation Y	Editable field	Rotation around the Y axis.
Rotation Z	Editable field	Rotation around the Z axis.
Scale	Editable field	Scale factor.

Next step

IF	AND	THEN
a field displays - ----	the parameter must be fixed to a value	highlight the field. Fix. Enter the value of the parameter.

IF	AND	THEN
a field displays a value	the parameter must be calculated	highlight the field. Adjust.
all parameters are configured	-	OK computes the transformation and continues to Check Residuals.

Check Residuals

Displays a list of the matched points used in the transformation calculation and their associated residuals.

Check Residuals		
WGS84 pts	East[m]	North[m]
101	0.009!	0.004!
200	0.001	0.003
300	-0.002	-0.004
400	-0.008	-0.003

OK

To accept the residuals and to continue with the subsequent screen.

Result

To view results of the transformation. Refer to "31.3.5 Transformation Results for Onestep and Twostep".

More

To display information about height residuals.

Fn Quit

To exit the screen.

3DCQ:0.014m	2DCQ:0.008m	1DCQ:0.012m	Fn abc	14:21
OK	Result	More		

Description of columns

Column	Description
WGS84 pts	The point ID of the points chosen from WGS84 points job .
East	The Easting residual. If positions are not used in the transformation calculation then ----- will be displayed.

Column	Description
North	The Northing residual. If positions are not used in the transformation calculation then ----- will be displayed.
Height	The Height residual. If heights are not used in the transformation calculation then ----- will be displayed.
!	Indicates residuals that exceed the residual limit defined in Configuration, Residuals page.
!	Indicates the largest residual in East, North and Height .

Next step

IF the residuals are	THEN
unacceptable	ESC returns to Matched Points (n) . Matched points can be edited, deleted or temporarily removed from the list and the transformation recalculated.
acceptable	OK continues to Store Coordinate System .

Store Coordinate System, Summary page

Store Coordinate System

Name:

123

Shift dX:

-674.508m

Shift dY:

-16.130m

Shift dZ:

-404.908m

3DCQ:0.015m 2DCQ:0.008m 1DCQ:0.012m Fn abc 14:37

Store

Coord

Store

To store the coordinate system to the DBX and return to **Main Menu**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	The name of the coordinate system can be changed. The name can be up to 16 characters in length and include spaces.
Transformation type	Display only	The type of transformation used
No. of matched pts	Display only	Number of matched points.
Easting	Display only	Largest Easting residual from the transformation calculation.
Northing	Display only	Largest Northing residual from the transformation calculation.

Field	Option	Description
Elevation	Display only	Largest Height residual from the transformation calculation.

Next step

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

Store Coordinate
System,
Coord system page

Description of fields

Field	Option	Description
Residuals	None, 1/distance, 1/distance² or 1/distance^{3/2}	The method by which the residuals of the control points will be distributed throughout the transformation area.
Geoid model	Display only	Name of geoid model used.
Pre Transform	Display only	For Twostep: Name of the pre-transformation used.
Transformation	Display only	For Classic 3D: Name of transformation used.
Ellipsoid	Display only	For Twostep and Classic 3D: Name of ellipsoid used.
Projection	Display only	For Twostep and Classic 3D: Name of projection used.
CSCS model	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 **WGS84 points job** selected in **Choose WGS84 & Local Jobs**, replacing any coordinate system attached to this job. **WGS84 points job** becomes the working job.

Determine Coord System**Description of fields**

Field	Option	Description
Method	Onestep	The type of transformation to be used when determining a coordinate system. Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure: 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. 2 The results of 1. are preliminary grid coordinates for the WGS 1984 points. 3 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. 4 The height transformation is a single dimension height approximation. Refer to "H.11 T".

Field	Option	Description
	Twostep	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: 1 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. 2 The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points. 3 A 2D transformation is applied, exactly as with the Onestep transformation. Refer to "H.11 T".
	Classic 3D	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 "H.11 T".
	Modify existing	To modify an existing determine coordinate system. Refer to "31.3.3 Modifying a Coordinate System".

Next step

IF the selected method is	THEN
Onestep, Twostep or Classic 3D	OK to access Choose WGS84 & Local Jobs . Refer to the following paragraph: Choose WGS84 & Local Jobs .
Modify existing	OK to access Coordinate Systems . Refer to "31.3.3 Modifying a Coordinate System".

31.3.3

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)** screen onwards. Refer to "31.3.2 Determining a New Coordinate System"

31.3.4

Matching Points: Selecting/ Editing a Pair of Matching Points

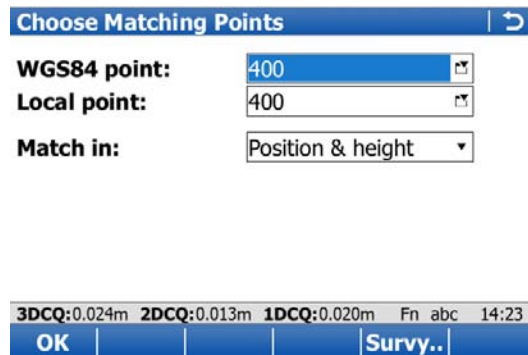
Description

Before calculating a transformation, it must be defined which points in **WGS84 points job** and **Local points job** 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

To return to **Matched Points (n)** and to add a new line of matched points to the matched points list.

Survy..

To manually occupy a point and store it in **WGS84 points job**. Available when **WGS84 point** is highlighted.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
WGS84 point	Selectable list	A WGS 1984 control point.
Local point	Selectable list	A local control point.
Match in		The type of match to be made between the points selected.

Field	Option	Description
	P & H, P only, H only or None.	Available for Onestep and Twostep.
	P & H or None	Available for Classic 3D.

31.3.5

Transformation Results for Onestep and Twostep

Access

Press **Result** in **Check Residuals**.

Transformation Results, Position page

Results of the transformation between the WGS 1984 datum and the local datum are shown for each of the transformation parameters. This screen consists of the **Position** page and the **Height** page. The explanations for the softkeys given here are valid for the pages as indicated.

Transformation Results	
Position	Height
Shift dX:	249519.001m
Shift dY:	758220.240m
Rotation:	-5511.36960"
Scale:	34.6518ppm
Rotation orgn X:	3.684m
Rotation orgn Y:	5.879m
3DCQ:0.017m 2DCQ:0.008m 1DCQ:0.015m Fn abc 14:32	
OK	Scale Rms Page

OK

To return to **Check Residuals**.

Scale.. or Ppm

Available on the **Position** page. To switch between displaying the true scale and displaying the ppm.

Rms or Param..

To switch between the root mean square values of the parameters and the actual parameter values. The name of the screen changes to **Transformation Results rms** when displaying rms values.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Shift dX	Display only	Shift in X direction.

Field	Option	Description
Shift dY	Display only	Shift in Y direction.
Rotation	Display only	Rotation of transformation.
Scale	Display only	Scale factor used in transformation. Either true scale or ppm.
Rotation X	Display only	Position in the X direction of the origin of rotation.
Rotation Y	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
Slope in X	Display only	Tilt of the transformation in the X direction.
Slope in Y	Display only	Tilt of the transformation in the Y direction.
Height shift	Display only	Shift in height between WGS 1984 datum and local datum.

Next step

OK returns to **Check Residuals**.

31.3.6

Transformation Results for Classic 3D

Access

Press **Result** in **Check 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 screen consists of the **Parameters** page and the **Rotation origin** page. The explanations for the softkeys given here are valid for the pages as indicated.

Transformation Results

Parameters Rotation origin

Shift dX: -665.283m

Shift dY: -1.960m

Shift dZ: -365.798m

Rotation X: -0.97097"

Rotation Y: -0.76252"

Rotation Z: -0.57553"

Scale: -5.7251ppm

3DCQ:0.014m 2DCQ:0.008m 1DCQ:0.012m Fn abc 14:33

OK Scale Rms Page

OK

To return to **Check Residuals**.

Scale.. or Ppm

Available on the **Position** page. To switch between displaying the true scale and displaying the ppm.

Rms or Param..

To switch between the root mean square values of the parameters and the actual parameter values. The name of the screen changes to **Transformation Results rms** when displaying rms values.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Shift dX	Display only	Shift in X direction.

Field	Option	Description
Shift dY	Display only	Shift in Y direction.
Shift dZ	Display only	Shift in Z direction.
Rotation X	Display only	Rotation around the X axis.
Rotation Y	Display only	Rotation around the Y axis.
Rotation Z	Display only	Rotation around the Z axis.
Scale	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
Model	Display only	Classic 3D transformation model used for the transformation.
Rotation orgn X	Display only	Available for Model: Molodensky-Badakus . Position in the X direction of the origin of rotation.
Rotation orgn Y	Display only	Available for Model: Molodensky-Badakus . Position in the Y direction of the origin of rotation.
Rotation orgn Z	Display only	Available for Model: Molodensky-Badakus . Position in the Z direction of the origin of rotation.

Next step

OK returns to **Check Residuals**.

31.4

31.4.1

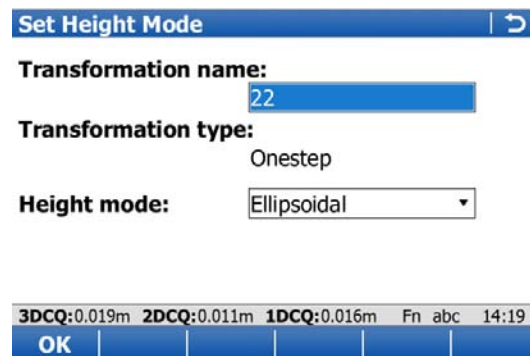
The One Point Localisation Method

Determining a New Coordinate System

Access

Press **OK** in **Choose WGS84 & Local Jobs** with **Use one point localisation method** being checked.

Set Height Mode



OK

To confirm the selections and to continue with the subsequent screen.

Fn Quit

To exit the screen.

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.
Transfrm Type	Display only	The type of transformation to be used when determining a coordinate system.

Field	Option	Description
Height mode	Orthometric or Ellipsoidal Display only	The height mode to be used in the determination of a coordinate system. Available when determining a new coordinate system. 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 **Choose System Components**.



Azimuth is used throughout this chapter. This term must always be considered to mean also **Bearing**.

Choose System Components

This screen contains different fields, depending on what method was chosen in **Determine Coord System**.

Choose System Components

Ellipsoid: Bessel

Projection: Swiss

Geoid model: <None>

CSCS model: <None>

3DCQ:0.013m 2DCQ:0.008m 1DCQ:0.011m Fn abc 14:35

OK

OK

To confirm the selections and to continue with the subsequent screen.

Fn Quit

To exit the screen.

For Onestep

Description of fields

Field	Option	Description
Geoid model	Selectable list	The geoid model to be used in the transformation.
Pre Transform	Selectable list	For Twostep: The pre-transformation to be used for the preliminary 3D transformation.
Ellipsoid	Selectable list	For Twostep and Classic 3D: The ellipsoid to be used in the transformation.
	Display only	For Twostep: The ellipsoid being used by a fixed projection when selected in Projection .

Field	Option	Description
Projection	Selectable list	For Twostep and Classic 3D: The projection to be used in the transformation.
CSCS model	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

Choose Common Point

WGS84 point:

400

Local point:

400

Local height:

Use WGS84 point ht

3DCQ:0.017m 2DCQ:0.009m 1DCQ:0.014m Fn abc 14:36

OK

Survvy..

OK

To confirm the selections and to continue with the subsequent screen.

Survvy..

Available for **WGS84 point** being high-lighted. To occupy a point manually and store it in **WGS84 points job**.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Match in		For Onestep and Twostep: How the horizontal and vertical shifts of the transformation will be computed.
	Position & height	Position and height are taken from the same pair of matching points.
	Position only	Position is taken from one pair of matching points. The height can be taken from another pair of matching points.
WGS84 point	Selectable list	The point ID of the horizontal and/or vertical control point chosen from WGS84 points job .
Local point	Selectable list	The point ID of the horizontal and/or vertical control point chosen from Local points job .
Match height	Check box	For Onestep and Twostep: Available for Match in: Position only . Activates the determination of the vertical shift from a separate pair of matching points.
Local height	Use WGS84 point ht or Use Local point ht	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.

Determine Rotation	
Method:	Two WGS84 points ▾
Point 1:	400 
Point 2:	400 
Azimuth:	_o_-'_-'"
Required azimuth:	0°00'00"
Rotation:	_o_-'_-'"

3DCQ:0.014m	2DCQ:0.008m	1DCQ:0.012m	Fn abc	14:38
OK	Inv			

OK

To confirm the selections and to continue with the subsequent screen.

Inv

Available for **Method: Two WGS84 points** and **Method: User entered**. To compute an azimuth between two local points. Refer to "31.4.2 Computing Required Azimuth".

Survy..

To manually occupy a point and store it in **WGS84 points job**. Available when **Point 1** or **Point 2** are highlighted for **Method: Two WGS84 points** or when **WGS84 point** is highlighted for **Method: Convergence angle**.

Fn Quit

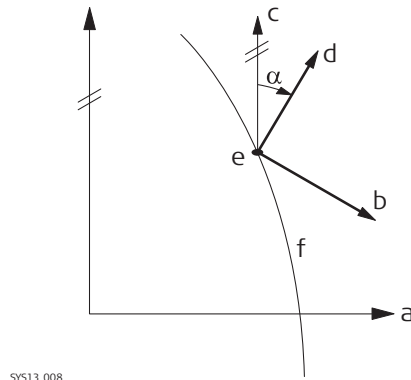
To exit the screen.

Description of fields

Field	Option	Description
Method	Use WGS84 north, User entered, Convergence angle or Two WGS84 points	Method by which the rotation angle for the transformation is determined.
Rotation	Display only	- For Method: Use WGS84 north: Transformation will be rotated to North as defined by the WGS 1984 datum. North is 0.00000 °. - For Method: Convergence angle: The rotation of the transformation calculated as 0.00000 ° minus the computed convergence angle. The field is updated as Coord system and WGS84 point are changed.
	Editable field	- For Method: Two WGS84 points: The rotation of the transformation calculated as required azimuth minus azimuth. The field is updated as Point 1, Point 2 and Required azimuth are changed. - For Method: User entered: Allows the orientation of the transformation to be manually typed in or calculated in Compute Required Azimuth.
Coord system	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 Method: Convergence angle .

Field	Option	Description
WGS84 point	Selectable list	WGS 1984 point of which the convergence angle will be calculated. Available for Method: Convergence angle .
Point 1	Selectable list	First point to use for computation of Azimuth . Available for Method: Two WGS84 points .
Point 2	Selectable list	Second point to use for computation of Azimuth . Available for Method: Two WGS84 points .
Azimuth	Display only	Computed azimuth between Point 1 and Point 2 . Available for Method: Two WGS84 points .
Required azimuth	Editable field	The required grid azimuth, computed between two local points. Refer to "31.4.2 Computing Required Azimuth". Available for Method: Two WGS84 points .

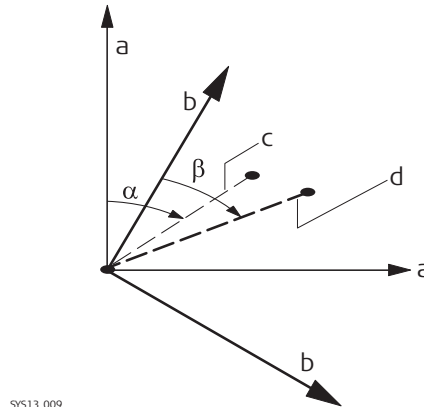
Diagram for Onestep, Method: Convergence angle



SVS13_008

- a) WGS 1984 coordinate system
- b) Local coordinate system
- c) Geodetic North
- d) Grid North
- e) Point on WGS 1984 datum
- f) Meridian
- α 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
- α Azimuth of two WGS 1984 points
- β 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
↩

Method: Known WGS84 pt ▼

WGS84 point: 400 ▼

Scale: 0.9999262

(Reducing points to the ground)

3DCQ:0.012m **2DCQ:**0.007m **1DCQ:**0.010m Fn abc 14:39

OK
Ppm

OK

To confirm the selections and to continue with the subsequent screen.

Grid..

Available Twostep and for

Method: Combined SF. To compute the grid scale factor. Refer to "31.4.3 Computing the Grid Scale Factor".

Hgt..

Available Twostep and for

Method: Combined SF. To compute the height scale factor. Refer to "31.4.4 Computing the Height Scale Factor".

Scale or Ppm

To switch between displaying the true scale and displaying the ppm.

Survy..

To manually occupy a point and store it in **WGS84 points job.** **Method: Convergence angle** when **WGS84 point** is highlighted.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Method	Known WGS84 pt, Known WGS84 ht or User entered	Available for Onestep: Method of determining the scale factor of the transformation.
	User entered or Combined SF	Available for Twostep. The default method for determining the Combined Scale Factor to be used in the transformation process.
Scale (Reducing points to the ground)	Editable field	Available for Onestep. Allows the scale factor to be typed in manually. Available for Method: User entered .
	Display only	Available for Onestep. The calculated scale factor. Available for Method: Known WGS84 pt and Method: Known WGS84 ht .
WGS84 point	Selectable list	Available for Onestep. WGS 1984 point from which the scale factor will be calculated. The scale factor is calculated using the height of the known WGS 1984 point. Available for Method: Known WGS84 pt .
Known height	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 Method: Known WGS84 ht .

Field	Option	Description
Grid SF	Display only	Available for Twostep and Method: Combined SF . The grid scale factor as computed in Compute Grid Scale Factor . Refer to "31.4.3 Computing the Grid Scale Factor".
Height SF	Display only	Available for Twostep and Method: Combined SF . The height scale factor as computed in Compute Height Scale Factor . Refer to "31.4.4 Computing the Height Scale Factor".
Combined SF	Editable field	Available for Twostep. The combined scale factor of the transformation. Available for Method: User entered . The scale factor can be typed in.
	Display only	Available for Method: Combined SF . 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

Name: 123

Shift dX: -674.508m

Shift dY: -16.130m

Shift dZ: -404.908m

3DCQ:0.015m 2DCQ:0.008m 1DCQ:0.012m Fn abc 14:37

Store | Coord | | | |

Store

To store the coordinate system to the DB-X, attach the system to **WGS84 points job** that was selected in **Choose WGS84 & Local Jobs** and return to **Main Menu**.

Scale or Ppm

For Onestep and Twostep. To switch between displaying the true scale and displaying the ppm.

Coord

For Classic 3D: To view other coordinate types.

Fn Quit

To exit the screen.

For Onestep

Description of fields

Field	Option	Description
Name	Editable field	A unique name for the coordinate system. The name can be up to 16 characters in length and include spaces.
Shift dX	Display only	For Onestep and Twostep: Shift in X direction.
Shift dY	Display only	For Onestep and Twostep: Shift in Y direction.
Shift dZ	Display only	For Classic 3D: Shift in Z direction.

Field	Option	Description
Rotation	Display only	For Onestep and Twostep: Rotation of transformation.
Scale	Display only	For Onestep and Twostep: Scale factor of transformation.
Rotation orgn X	Display only	For Onestep and Twostep: Position in the X direction of the origin of rotation.
Rotation orgn Y	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 **Main Menu**.

31.4.2

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 will be 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 **Inv** in **Determine Rotation**.

Compute Required Azimuth

OK

To calculate the required azimuth and return to the screen from where this screen was accessed.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
From	Selectable list	The point ID of the first known point for the azimuth calculation.
To	Selectable list	The point ID of the second known point for the azimuth calculation.
Azimuth	Display only	The calculated azimuth.

Next step

OK returns to **Determine Rotation**.

31.4.3

Computing the Grid Scale Factor

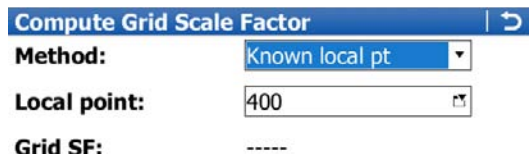
Description

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



OK

To confirm the selections and return to the screen from where this screen was accessed.

Scale or Ppm

To switch between displaying the true scale and displaying the ppm.



Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Method		Method by which the grid scale factor is to be calculated.
	User entered	Grid scale factor can be manually typed in.
	Known local pt	Grid scale factor is computed using the position of a known local point.

Field	Option	Description
Local point	Selectable list	Available for Method: Known local pt. The point ID of the point chosen from the local job from which the grid scale factor is computed using the projection selected.
Grid SF	Editable field	The grid scale factor. Available for Method: User entered. To type in the grid scale factor.
	Display only	Available for Method: Known local pt. The computed grid scale factor.

Next step

OK returns to **Determine Scale.**

31.4.4

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 **Hgt..** in **Determine Scale.**

Compute Height Scale Factor

Compute Height Scale Factor | ↵

Method:

Local point:

Height SF: 0.9999334
(Reducing points to the ground)

OK

To confirm the selections and return to the screen from where this screen was accessed.

Scale or Ppm

To switch between displaying the true scale and displaying the ppm.

Fn Quit

To exit the screen.

3DCQ:0.012m 2DCQ:0.007m 1DCQ:0.010m Fn abc 14:51

OK | | | Ppm | |

Description of fields

Field	Option	Description
Method		Method by which the height scale factor is to be calculated.
	User entered	Height scale factor can be manually typed in.
	Known local pt	Height scale factor is computed using the position of a known local point.

Field	Option	Description
	Known local ht	Height scale factor is computed using an entered height value.
Known Point	Selectable list	Available for Method: Known local pt . The point ID of the point chosen from the local job from which the height scale factor is computed.
Known height	Editable field	Available for Method: Known local ht . A known local height.
Height SF	Editable field	The height scale factor. Available for Method: User entered . To type in the height scale factor.
	Display only	Available for Method: Known local pt and Method: Known local ht . The computed height scale factor.

Next step

OK returns to **Determine Scale**.

32

32.1



Description

Access

Choose QuickGrid Method

QuickGrid

Selecting the Transformation Method

For an overview of determine coordinate systems, refer to "31.1 Overview"

QuickGrid is designed to allow for quick coordinate system determination on site. Particularly for those users who must combine GPS and TPS data. All points must be measured by GPS, and therefore this method is not available in TPS mode. There are five different methods to choose from, Single point, Multi point, Single point from base, Orientate to line & Quickshift.

Select **Main Menu: Go to Work!\Survey+\QuickGrid.**

Description of fields

Field	Option	Description
Method	Single point	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 GPS distances to "ground" using measured point WGS 1984 height.
	Multiple points	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.

Field	Option	Description
	Single point base	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 GPS distances to "ground" using measured point WGS 1984 height.
	Orientate to line	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 GPS distances to "ground" using measured point WGS 1984 height.
	QuickShift	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 Define Local Quickgrid Point. Refer to paragraph Define Local Quickgrid Point.

IF the selected method is	THEN
QuickShift	OK to access Select Coordinate System . Refer to paragraph Select Coordinate System .

Select Coordinate System

This screen is only available for **Method: QuickShift**.

OK

To confirm the selections and to continue with the subsequent screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Coord system	Selectable list	Select the coordinate system to be shifted.
Transformation	Display only	The type of transformation.
Ellipsoid	Display only	The coordinates are based on this ellipsoid.
Projection	Display only	The map projection.
Geoid model	Display only	The geoid model.

Field	Option	Description
CSCS model	Display only	The Country Specific Coordinate System model.

Next step

OK accesses **Define Local Quickgrid Point**.

Define Local Quickgrid Point

OK

To confirm the selections and to continue with the subsequent screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Local point	User entered	The local QuickGrid point is entered by the user.
	From working job	The local QuickGrid point is selected from the working job.
	From control job	The local QuickGrid point is selected from the control job.

Field	Option	Description
Point ID	Editable field Selectable list	The point ID of the local QuickGrid point. For Local point: User entered . For Local point: From working job and Local point: From control job .
Easting	Editable field Display only	The Easting coordinate of the local QuickGrid point. For Local point: User entered . For Local point: From working job and Local point: From control job .
Northing	Editable field Display only	The Northing coordinate of the local QuickGrid point. For Local point: User entered . For Local point: From working job and Local point: From control job .
Elevation	Editable field Display only	The orthometric height of the local QuickGrid point. For Local point: User entered . For Local point: From working job and Local point: From control job .
Ignore local height & use WGS84 height	Check box	When this box is checked, no height adjustment is calculated. When this box is not checked, a height adjustment is calculated.
Use geoid	Check box	Check this box to select a geoid model for the calculation.

Field	Option	Description
Geoid model	Selectable list	Available when Use geoid is checked. To select a geoid model.

Next step

OK accesses **Measure QuickGrid Point**.

Access

Press **OK** in **Define Local Quickgrid Point**.

Measure QuickGrid Point

This screen is similar to the standard Survey screen. Refer to "44.1.2 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 QuickGrid methods: After measuring and storing a point, **Store Coordinate System** is accessed.

Matched Pts & Residuals

This screen shows what points have been matched so far. More points can be added, matched points can be deleted.

Matched Pts & Residuals			
WGS84 pts	Match	East[m]	North[m]
GPS0004	P & H	0.000	0.000

OK

To confirm the selections, compute the transformation and continue with the subsequent screen.

New..

To survey another point and return to the Survey screen.

Match

To change the type of match for the highlighted point.

3DCQ:0.020m 2DCQ:0.011m 1DCQ:0.016m abc 14:22			
OK	New..	Match	Rmove
More			

Delete

To delete the highlighted point from the list.

More

To display information about height residuals.

Fn Quit

To exit the screen.

Description of columns

Column	Description
WGS84 pts	The point ID of the points chosen from WGS84 points job .
Match	The type of match to be made between the QuickGrid point and the surveyed point. This information is used in the transformation calculation. Position & Height, Position only, Height only or None.
East, North and Height	The residuals of the matched points.

Next step

Press **New..** to return to **Measure QuickGrid Point** and 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 QuickGrid method.

Select Coordinate System | ↩

Select coordinate system to be shifted

Coord system: Local

Transformation: Local

Ellipsoid: Bessel

Projection: Swiss

Geoid model: <None>

CSCS model: <None>

3DCQ:0.016m 2DCQ:0.009m 1DCQ:0.014m abc 14:18

OK

- Store
- To store the coordinate system and to exit the Determine Coordinate System application.
- Page
- To change to another page on this screen.
- Fn Quit
- To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	The name of the new coordinate system.
No. of matched pts	Display only	Available for Multiple points. The number of matched points.
Largest residuals East, North and Height	Display only	Available for Multiple points. The largest residuals of the transformation.
Rotation from north	Display only	Available for Orientate to line. The rotation is shown in the configured angle units.

Field	Option	Description
Shift dX	Display only	Available for QuickShift . Shift in X direction.
Shift dY	Display only	Available for QuickShift . Shift in Y direction.
Shift dZ	Display only	Available for QuickShift . Shift in Z direction.

Next step

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

Store Coordinate System, Coord system page

The available fields, keys and pages depend on the selected QuickGrid method.

Store Coordinate System

Summary

Coord system

Transformation:

Local

Ellipsoid:

Bessel

Projection:

Swiss

Geoid model:

<None>

CSCS model:

<None>

3DCQ:0.014m

2DCQ:0.008m

1DCQ:0.012m

abc

14:20

Store

Page

Store

To store the coordinate system and to exit the Determine Coordinate System application.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Residuals		For Multiple points. The method by which the residuals of the control points will be distributed throughout the transformation area.
	None	No distribution is made. Residuals remain with their associated points.
	1/distance, 1/distance² or 1/distance^{3/2}	Distributes the residuals according to the distance between each control point and the newly transformed point.
	Multiquadratic	Distributes the residuals using a multiquadratic interpolation approach.
Transformation	Display only	Available for QuickShift . The type of transformation.
Ellipsoid	Display only	Available for QuickShift . The coordinates are based on this ellipsoid.
Projection	Display only	Available for QuickShift . The map projection.
Geoid model	Display only	Available for Multiple points and QuickShift . The geoid model used.
CSCS model	Display only	Available for QuickShift . The Country Specific Coordinate System model.

Next step

Store safes the new coordinate system.

Description

The Reference Line application can be used to set out or measure points relative to a reference line or a reference arc.

Reference line tasks

The Reference Line application can be used for the following tasks:

- Measuring to a line/arc where the coordinates of a target point can be calculated from its position relative to the defined reference line/arc.
- Staking to a line/arc where the position of a target point is known and instructions to locate the point are given relative to the reference line/arc.
- Gridstaking a line/arc where a grid can be staked relative to a reference line/arc.
- Staking points relative to an alignment.

Other functionality available includes:

- Offsetting the reference line/arc horizontally or vertically. The radius of the arc changes with the horizontal offset.
- Shifting the reference line with parallel offsets or rotating to match predefined setting out instructions.
- Measuring points and staking points on slopes related to a reference line/arc.

Activating the application

The Reference Line application must be activated via a licence key. Refer to "24.3 Load licence keys" for information on how to activate the application.



Measuring and staking out of points is possible for RTK base and TPS.

Point types

Reference lines/arcs can be created from points stored as:

- WGS 1984 geodetic
- Local grid

Heights and positions are always taken into account. Points must have full coordinate triplets.

Properties of measured points

The properties stored with staked points are:

- Class: Either **Meas** or for **GPS** also **Nav** depending on the position status when the point was measured.
- Sub class:
 - **GPS** **Code only**, **GPS code only**, **GPS fixed**, **GNSS Code Only** or **GNSS Fixed**.
 - **TPS** **TPS**
- Source: **RefLine (Grid)**, **RefLine (Meas)**, **RefLine (Stake)**, **RefLine (Seg)**
- Instrument source: **GPS** or **TPS**

Deleting points

A point that is used to define a reference line/arc can be deleted. If one or more points defining the reference line/arc have been deleted, a reference line/arc can still be used. Within **Edit reference line** and **Edit reference arc**, the deleted point field is shown in grey. Within MapView, the reference line is still displayed but the deleted point or points is/are not.

Terms

Reference point: Used in this chapter to refer to the point from which the perpendicular offset, from the reference line/arc to the target point, is measured.

Target point:

The design point.

- For measuring to a reference line, this term refers to the point with the coordinates of the current position and the designed or calculated height.
- For staking or grid staking to a reference line, this term refers to the point to be staked.

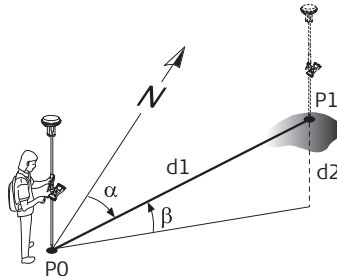
Measured point:

The current position.

Defining a reference line/arc

A reference line can be defined in the following ways:

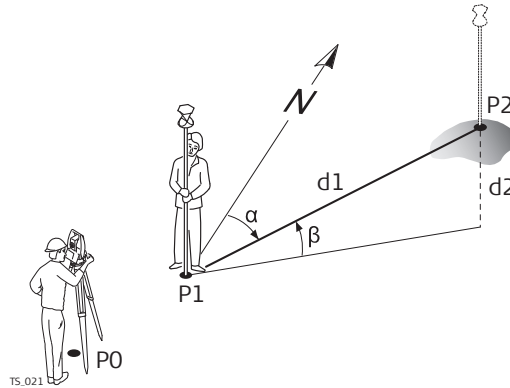
- Two known points
- One known point, an azimuth, a distance and a gradient
- One known point, an azimuth, a distance and a difference in height
- Alignments can be imported from a DXF job and selected from a list or on the **Map** page. Refer to "33.8.1 Overview".



GS.015

GPS

- P0 Start point
- P1 End point
- d1 Known distance
- d2 Difference in height, ΔHt
- α Azimuth
- β Elevation angle between the start point and the end point

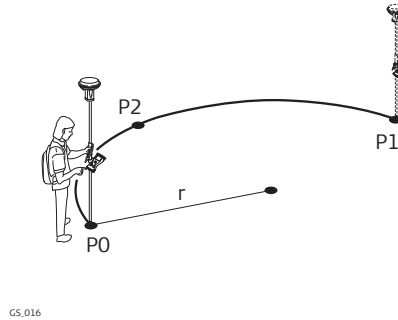


TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- d1 Known distance
- d2 Difference in height, ΔH_t
- α Azimuth
- β Elevation angle between the start point and the end point

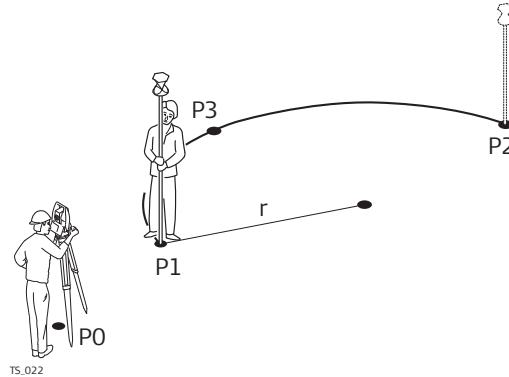
A reference arc can be defined in the following ways:

- Two known points and a radius
- Three known points



GPS

- P0 Start point
- P1 End point
- P2 Known point
- r Radius of arc



TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Known point
- r Radius of arc

Defining chainage

The chainage of the start point of a reference line/arc can be defined.



Coordinate systems

It is possible to define an arc that has an opening angle of more than 180° .

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.

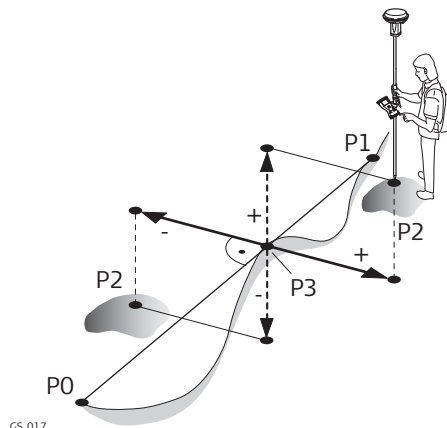
In these cases, the field values relating to the difference in coordinates between the point being staked and the current position, are shown as -----.



Azimuth is used throughout this chapter. This term must always be considered to mean also **Bearing**.

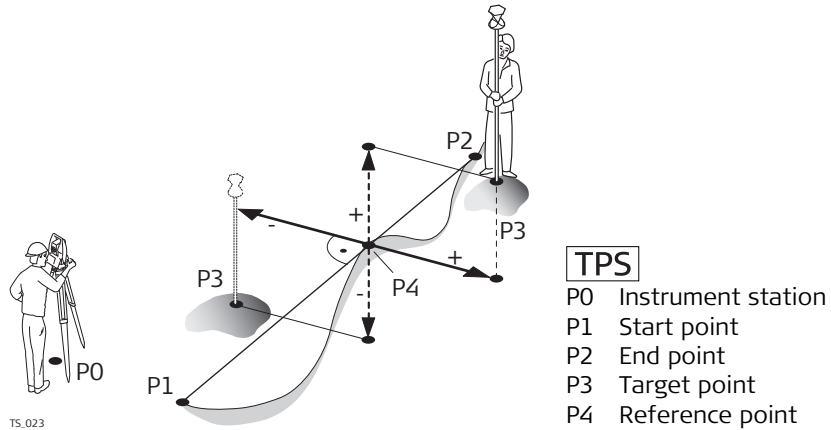
Direction of values

The following diagram shows the direction of positive and negative values for distance and height differences between the target point and the reference point for reference lines.



GPS

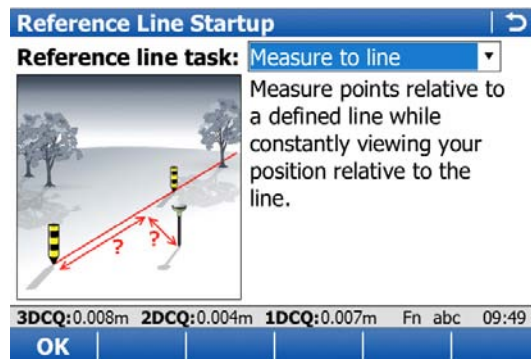
- P0 Start point
- P1 End point
- P2 Target point
- P3 Reference point



Access

- For measuring tasks:
Select **Main Menu: Go to Work!\Survey+\Measure to ref line.**
- For staking tasks:
Select **Main Menu: Go to Work!\Stakeout+\Stake to ref line.**

Reference Line Startup

**OK**

To select the highlighted option and to continue with the subsequent screen.

Fn Config..

To configure the Reference Line application.

Fn Quit

To exit the screen.

Description of the Reference Line tasks

Reference line task	Description
Measure to line or Measure to arc	Calculates the coordinates of a point from its position relative to the reference line/arc.
Stake to line or Stake to arc	Allows points to be staked relative to the reference line/arc.

Reference line task	Description
Stake grid from line or Stake grid from arc	Allows a grid to be staked out relative to the reference line/arc.
Stake alignment	Allows points to be staked relative to an alignment. This option uses line and area data from CAD as simply as possible.

Next step

IF	THEN
Reference line task: Stake alignment	OK accesses Stake alignment . Refer to "33.8 Staking to Alignment".
Reference line task is NOT Stake alignment	OK accesses Choose Control Job . Refer to "Choose Control Job".

Choose Control Job

Choose Control Job | ↻

Height to use:

Choose control job:

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m Fn abc 09:55

OK | | | | |

OK

To select the highlighted option and to continue with the subsequent screen.

Fn Config..

To configure the Reference Line application.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Height to use	Selectable list	Depending on the task chosen this parameter controls the following: • When measuring to a line/arc, it determines the delta height value which is displayed when points are being measured. • When staking to or gridstaking a line/arc, it determines the height value to be staked out.
	Reference line	Heights are computed along the reference line/arc.
	Start point	Heights are computed relative to the height of the starting point.
	DTM	The stakeout height is computed from the DTM being used.
Choose control job	Selectable list	The original points to be staked and the reference lines/arcs are stored in this job.

Next step

OK and continue with the subchapters for the various Reference Line tasks.

33.3

Configuring Reference Line

Access

Press **Fn Config..** in the **Reference Line Startup, Choose Control Job** or the **Choose Alignment** screen.

Configuration, General page

Configuration | ↻

General | Heights | Report sheet

☒ **Show additional page from My Survey Screen**

Page to show: Code ▾

☐ **Use chainages**

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m Fn abc 09:51

OK | Config.. | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Fn About

To display information about the application name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Show additional page from My Survey Screen	Check box	Shows a selectable list for the survey screen pages.
Page to show	Selectable list	The user-defined survey screen page to be shown. All survey screens defined in My Survey Screen Settings be selected.

Field	Option	Description
Use chainages	Check box	Activates the use of chainages within the reference line application.

Next step

For all reference line tasks except for **Stake alignment**, **Page** changes to the **Quality control** page.

For **Reference line task: Stake alignment**, page changes to the **Key points** page.

Configuration, Key points page

This page is only available for **Reference line task: Stake alignment**.

On this page, the type of horizontal points to be staked is set. Refer to "33.8 Staking to Alignment" for a graphic and an explanation of the abbreviations.

Description of fields

Field	Option	Description
PC, PT, AP - Start/end of a curve & angle point where two straights meet	Check box	Only these horizontal key points are calculated for staking, skipping the radius and midpoints of arcs and the angle bisector point on lines.
RP - Radius point of a curve	Check box	Additional to other options checked, the radius point is calculated for staking.
MP - Mid point of a curve	Check box	Additional to other options checked, the mid point is calculated for staking.
BP - Point where two offset lines bisect	Check box	Additional to other options checked, the bisected point is calculated for staking.

Field	Option	Description
Vertical key points (VPI, Low, High)	Check box	Additional to other options checked, the vertical point of intersection, and the low and high points of the vertical alignment are calculated for staking.

Configuration, Alignment options page

This page is only available for **Reference line task: Stake alignment**.

Description of fields

Field	Option	Description
After storing point automatically select		Sets behaviour of the chainage after a point is stored.
	Current point	Does not change the chainage after a point is stored.
	Previous point (Ch-)	Proceeds to the next key point down chainage after each stored staked point.
	Next point (Ch+)	Proceeds to the next key point up chainage after each stored staked point.
Tangent to use in void areas	Back tangent or Forward tangent	Defines which tangent is used in those areas of the alignment which does not have points.
Use a different chainage increment on curves	Check box	Option to use a different chainage increment along a curve.
Increment	Editable field	Available when Use a different chainage increment on curves is checked. Chainage increment to be used along the small radius curve.

Field	Option	Description
For radius under	Editable field	Available when Use a different chainage increment on curves 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

Page changes to the **Quality control** page.

Configuration, Quality control page

This page is only available for staking operations.

Description of fields

Field	Option	Description
Check distance before storing	Check box	Allows a check to be made on the horizontal coordinate difference between the staked point and the point to be staked. If the defined Limit is exceeded, the stakeout can be repeated, skipped or stored.
Limit	Editable field	Sets the maximum horizontal coordinate difference which is accepted in the position check.
Check cut/fill before storing	Check box	Allows a check to be made on the vertical difference between the manually measured staked point and the point to be staked. If the defined Limit is exceeded, the stakeout can be repeated, skipped or stored.

Field	Option	Description
Limit	Editable field	Sets the maximum vertical difference accepted in the height check.

Next step

Page changes to the **Heights** page.

Configuration, Heights page

Description of fields

Field	Option	Description
Allow design height of point to be edited	Check box	The design height is the height of the point to be staked. The initial value is as configured in the heights field. The value for the design height can be changed.

Next step

Page changes to the **Graphics** page.

Configuration, Graphics page

This page is only available for staking operations.

Description of fields

Field	Option	Description
Navigate direction		The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Reference Line application are based on this selection.

Field	Option	Description
	From instrument	TPS The direction of the orientation is from the instrument to the point to be staked.
	To instrument	TPS The direction of the orientation is from the point to be staked to the instrument.
	To north	GPS The North direction shown in the graphical display based on the active coordinate system.
	To sun	GPS The position of the sun calculated from the current position, the time and the date.
	To last point	GPS Time-wise, the last recorded point. If no points are yet staked, To north is used for the first point to be staked.
	To point (cntrl job)	GPS A point from Control job selected in Choose Control Job .
	To point	GPS A point from the working job.
	To reference line	The direction of the orientation is parallel to the reference line or the reference arc.
	Following arrow	The direction of the orientation is from the current position to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked.

Field	Option	Description
Point	Selectable list	Available for Navigate direction: To point (cntrl job) and Navigate direction: To point . To select the point to be used for orientation.
Navigate using	Direction & distance In/out, left/right	The method of staking out. The direction from the orientation reference, the horizontal distance and the cut/fill is displayed. The distance forwards/backwards to the point, the distance right/left to the point and the cut/fill is displayed.
Switch to bulls eye when 0.5m from target	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.
Beep faster when getting close to point	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 Start within .
Distance to use	Elevation Horizontal distance Position & height	The distance in height is used as indicator. The distance from Easting and Northing is used as indicator. The distance from Easting, Northing and Height is used as indicator.
Start within	Editable field	The horizontal radial distance from the current position to the point to be staked when a beep will be heard.

Configuration, Report sheet page

Next step

Page changes to the **Report sheet** page.

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

Page changes to the first page on this screen.

33.4

33.4.1

Choosing Reference Lines/Arcs

Overview

Description

There are two ways by which a reference line/arc can be defined.

Manually Enter

- A reference line/arc can be defined by manually entering known parameters.
- The line is only temporary and is not stored once the Reference Line application has been exited.

Select from Job

- Reference lines/arcs can be created, edited, stored and deleted in the **Choose Control Job**.
 - The reference lines/arcs can be recalled for use later.
-

Access

Press **OK** in **Choose Control Job**.

Reference Line To Use/
Reference Arc To Use,
Reference page

The explanations for the softkeys given here are valid as indicated.
For all point fields, the MapView interactive display can be used to select the desired point.

Reference Line To Use

ReferenceSlopeLine shiftsMap

Create line using:2 points

Start point:101

End point:102

Line length:17.692m

3DCQ:0.010m2DCQ:0.005m1DCQ:0.008mFn abc09:56

OKPage

- OK**
To accept changes and continue with the subsequent screen.
- Survey..**
To manually measure a point. Available when a point field is highlighted.
- Page**
To change to another page on this screen.
- Fn Config..**
To configure the Reference Line application.
- Fn Quit**
To exit the screen.

Description of fields

Field	Option	Description
Create line using	2 points	Select one of the following options to enter a reference line manually. For lines. Uses two known points to define the reference line.

Field	Option	Description
	Pt, brng, dist, grade	For lines. Defines the reference line using a known point, a distance, an azimuth and the gradient of the line.
	Pt, brng, dist, Δht	For lines. The same as Pt, brng, dist, grade but uses the difference in height instead of the gradient.
	3 points	For arcs. Defines the reference arc using three known points.
	2 points/radius	For arcs. Defines the reference arc with two known points and a known radius.
	Select existing line or Select existing arc	Refer to "33.4.3 Selecting a Reference Line/Arc from the Job"
Δ height	Editable field	For lines: Available for Create line using: Pt, brng, dist, Δht . The difference in height from the start point to the end point of the reference line.
Arc distance	Display only	Available for arcs. The horizontal grid distance along the arc between the three points. If the distance cannot be calculated, ----- is displayed.
Azimuth	Editable field	For lines: Available for Create line using: Pt, brng, dist, grade and Create line using: Pt, brng, dist, Δht . The azimuth of the reference line.

Field	Option	Description
Chainage	Editable field	Available when Use chainages in Configuration, General page is checked. Defines the chainage of the start point of the reference line/arc. The input format depends on the selection for Chainage format in Regional Settings, Distance page.
End point	Selectable list	For lines: Available for Create line using: 2 points . For arcs: Available for Create line using: 2 points/radius . The last point forming the reference line/arc.
Grade	Editable field	For lines: Available for Create line using: Pt, brng, dist, grade . The gradient of the line from the start point to the end point of the reference line.
Horiz distance	Editable field	For lines: Available for Create line using: Pt, brng, dist, grade and Create line using: Pt, brng, dist, Δht . The horizontal grid distance from the start point to the end point of the reference line.
Line length	Display only	For lines. The horizontal grid distance between the two points of the line. If the distance cannot be calculated, ----- is displayed.
Radius	Editable field	For arcs: Available for Create line using: 2 points/radius . The radius of the reference arc.
Second Point	Selectable list	For arcs: Available for Create line using: 3 points . The medium point forming the reference arc.

Field	Option	Description
Start point	Selectable list	For lines: Available for Create line using: 2 points and Create line using: Pt, brng, dist, grade . For arcs: Available for Create line using: 2 points/radius and Create line using: 3 points . The first point forming the reference line/arc.

Next step

Page changes to the **Slope** page, **Line shifts** page and the **Map** page. For information on the **Slope** and **Line shifts** pages, refer to "33.4.4 Defining Reference Line/Arc Slopes" and "33.4.5 Defining Reference Line/Arc Shifts".

33.4.3

Selecting a Reference Line/Arc from the Job

Access

Press **OK** in **Choose Control Job**.

Description

New reference lines/arcs can be created, existing reference lines/arcs can be edited and previously entered reference lines/arcs can be selected from the control job.

Reference Line To Use/ Reference Arc To Use, Reference page

Refer to "33.4.2 Manually Entering a Reference Line/Arc" for a description of softkeys.

Description of fields

Field	Option	Description
Create line using / Create arc using	Select existing line or Select existing arc	Select these options to enter a reference line/arc manually. For the other available options refer to "33.4.2 Manually Entering a Reference Line/Arc".
Reference line	Selectable list	The reference line to be used. If the desired reference line must be created, edited or selected, highlight this field and press  .
Reference arc	Selectable list	The reference arc to be used. Open the list to select an arc. If the desired reference arc must be created, edited or selected, highlight this field and press  .

Next step

For a description of the other pages refer to "33.4.4 Defining Reference Line/Arc Slopes" and "33.4.5 Defining Reference Line/Arc Shifts".

Highlight **Reference line** or **Reference arc** and press  to access **Manage Reference Lines/Manage Reference Arcs**.

Manage Reference Lines/Manage Reference Arcs

Apart from the screen name the appearance of the screen and the functionality of the softkeys is the same for reference lines and arcs.

Manage Reference Lines	
Name	Date
RL_001	14.05.04
RL_002	14.05.04
RL_003	14.05.04

3DCQ:0.009m	2DCQ:0.005m	1DCQ:0.007m	Fn abc	09:58
OK	New..	Edit..	Delete	

OK

To select the highlighted reference line/arc and to return to the screen from where this screen was accessed.

New..

To create a reference line/arc. The fields are the same as for manually creating a reference line/arc. Refer to "33.4.2 Manually Entering a Reference Line/Arc".

Edit..

To edit a reference line/arc. The fields are the same as for manually creating a reference line/arc. "33.4.2 Manually Entering a Reference Line/Arc".

Delete

To delete a reference line/arc.

Fn Quit

To exit the screen.

Description of columns

Column	Description
Name	Names of all the reference lines/arcs available in the control job.
Date	Date that the reference line/arc was created.

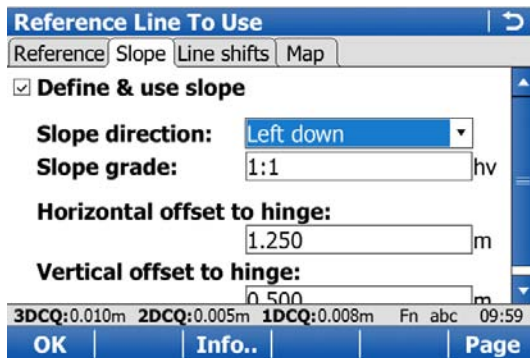
33.4.4

Defining Reference Line/Arc Slopes

Description

It is possible to measure points and stake points on slopes related to a reference line/arc. A slope can be defined and cut/fill values can then be displayed to the slope when measuring along the reference line/arc. The slope is a plane from the reference line/arc and extends along the length of the reference line/arc. Slopes can be used when, measuring to a reference line/arc, staking a point relative to a reference line/arc, or performing a grid stakeout relative to a reference line/arc.

Reference Line To Use/ Reference Arc To Use, Slope page



OK

To confirm the selections and to return to the previous screen.

Info..

To edit the screen page which will be displayed for slopes.

Page

To change to another page on this screen.

Fn Config..

To configure the Reference Line application.

Fn Quit

To exit Reference Line application.

Description of fields

Field	Option	Description
Define & use slope	Check box	Check to define a slope.
Slope direction		The method how the slope is created.

Field	Option	Description
	Left down	Creates a downward plane extending to the left of the defined reference line/arc.
	Right down	Creates a downward plane extending to the right of the defined reference line/arc.
	Left up	Creates an upward plane extending to the left of the defined reference line/arc.
	Right up	Creates an upward plane extending to the right of the defined reference line/arc.
Slope grade	Editable field	Inclination of the slope.
Horizontal offset to hinge	Editable field	Horizontal offset from the line/arc that sets where the slope starts.
Vertical offset to hinge	Editable field	Vertical offset from the line/arc that sets where the slope starts.

Next step

Info.. to edit the screen page.

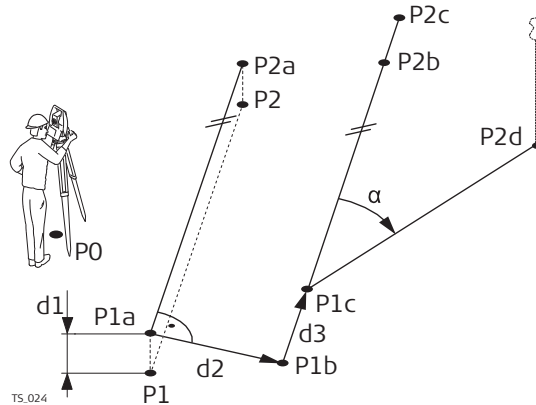
Slope Information to Show

Description of all values which can be displayed on the Slope screen page

Field	Description
Antenna height	GPS To enter the antenna height.
Chainage	Displays the current chainage.
Current slope	Displays the current slope of the target position to the hinge.

Field	Description
Design slope	Displays the slope grade as defined by the user.
Easting	Displays the Easting coordinate of the current target position.
Elevation	Displays the Height value of the current target position.
Line space full	Insert full line space.
Line space half	Insert half line space.
Northing	Displays the Northing coordinate of the current target position.
Point ID	To enter the point ID.
Quality 2D	GPS Display only field for the current 2D coordinate quality of computed position.
Quality 3D	GPS Display only field for the current 3D coordinate quality of computed position.
RTK positions	GPS Display only field for the number of positions recorded over the period of point measurement. Appears in the survey screen page of real-time rover configurations.
SD to hinge	Displays the slope distance offset from the hinge to measured point.
SD to line	Displays the slope distance offset from line/arc to measured point.
Slope cut/fill	Displays the value of the difference between the actual target elevation to the slope elevation at that position. A cut is above the slope. A fill is below the slope.
Start chainage	Displays the starting chainage as defined by the user.
Target height	TPS To enter the target height.

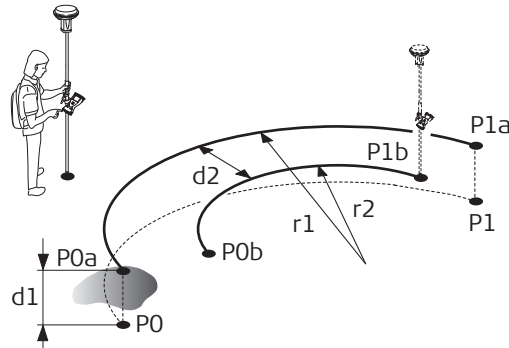
Field	Description
Δ end of line/arc	Displays the horizontal distance from the end point of the line/arc to the base point of the measured point, along the line/arc.
Δ ht hinge	Displays the delta height from the current position to the hinge.
Δ ht line	Displays the delta height from the current position to the line/arc.
Δ line/arc	Displays the horizontal distance from the start point of the line/arc to the base point of the measured point, along the line/arc.
Δ offset	Displays the perpendicular offset from the line/arc to measured point.
Δ offset hinge	Displays the perpendicular offset from the hinge to measured point.



TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- P1a Start point with **Height offset**
- P2a End point with **Height offset**
- P1b Start point with **Shift line left/right**
- P2b End point with **Shift line left/right**
- P1c Start point with **Shift line forward/back**
- P2c End point with **Shift line forward/back**
- P2d End point with **Rotate line**
- d1 **Height offset**
- d2 **Shift line left/right**
- d3 **Shift line forward/back**
- α **Rotate line**

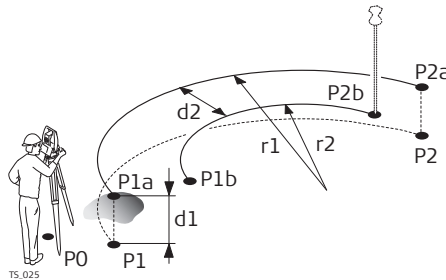
Reference arc shifts



GS_019

GPS

- P0 Start point
- P1 End point
- P0a Start point with **Height offset**
- P1a End point with **Height offset**
- P0b Start point with **Shift arc left/right**
- P1b End point with **Shift arc left/right**
- d1 **Height offset**
- d2 **Shift arc left/right**
- r1 Radius before shift
- r2 Radius after shift



TS_025

TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- P1a Start point with **Height offset**
- P2a End point with **Height offset**
- P1b Start point with **Shift arc left/right**
- P2b End point with **Shift arc left/right**
- d1 **Height offset**
- d2 **Shift arc left/right**
- r1 Radius before shift
- r2 Radius after shift

**Reference Line To Use/
Reference Arc To Use,
Line shifts page**

OK

To confirm the selections and to return to the previous screen.

Page

To change to another page on this screen.

Fn Config..

To configure the Reference Line application.

Fn Quit

To exit Reference Line application.

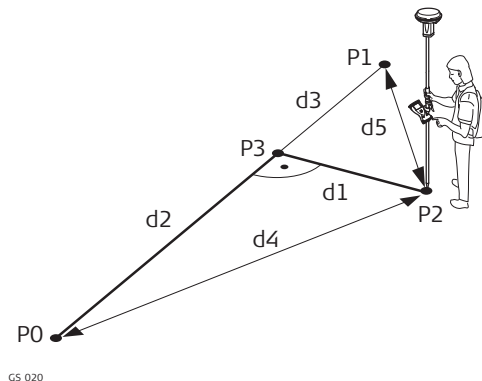
Description of fields

Field	Option	Description
Shift line	Check box	Check to define an offset.
Shift line left/right or Shift arc left/right	Editable field	Distance to offset the reference line/arc horizontally to the left or right.  When an offset is applied to an arc the radius of the arc changes.
Shift line forward/back	Editable field	Available for lines unless Height to use: Reference line in Choose Control Job . Distance to shift the reference line horizontally forward or back.
Vertical shift	Editable field	Available for Height to use: Start point and Height to use: Reference line . The vertical offset of the reference line/arc.

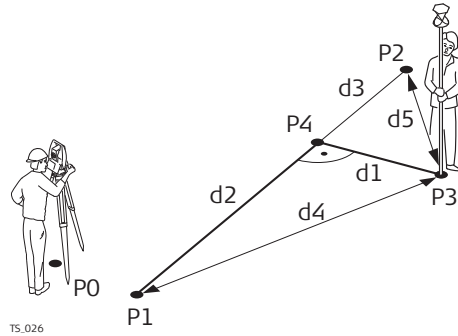
Field	Option	Description
Rotate line	Editable field	Available for lines unless Height to use: Reference line in Choose Control Job . Angle by which to rotate the reference line.
DTM Offset	Editable field	Available for Height to use: DTM . The vertical offset of the DTM model.

Description

The horizontal and vertical position and the chainage of a manually measured point can be calculated relative to the defined reference line/arc.

Measure to line - horizontal measurements**GPS**

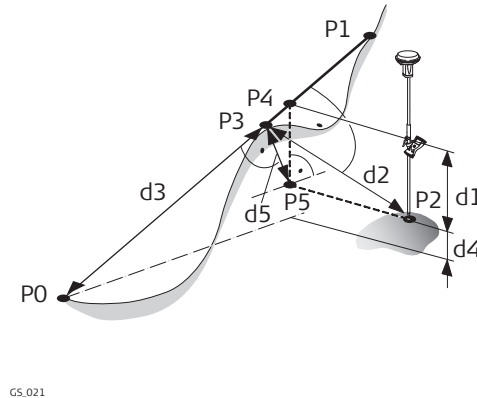
- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 Δ **offset**
- d2 Δ **line**
- d3 Δ **end of line**
- d4 **Check Dist 1**
- d5 **Check Dist 2**



TPS

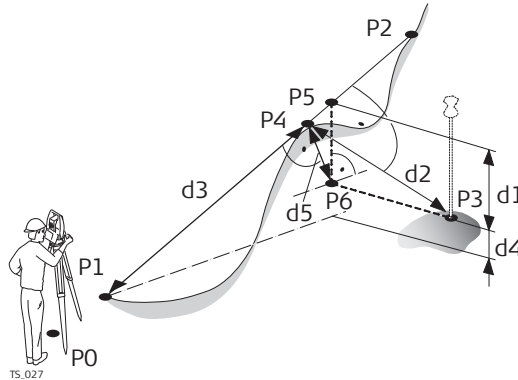
- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- d1 Δ **offset**
- d2 Δ **line**
- d3 Δ **end of line**
- d4 **Check Dist 1**
- d5 **Check Dist 2**

Measure to line - vertical measurements



GPS

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- P4 Temporary point
- P5 Horizontal base point
- d1 Δ **ht line**
- d2 Δ **perp dist**
- d3 Δ **spatial dist**
- d4 Δ **ht start of line**
- d5 Δ **perp height**

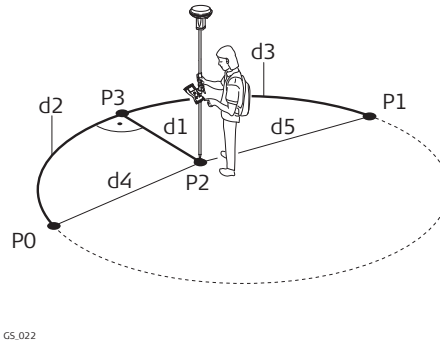


TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- P5 Temporary point
- P6 Horizontal base point
- d1 Δ **ht line**
- d2 Δ **perp dist**
- d3 Δ **spatial dist**
- d4 Δ **ht start of line**
- d5 Δ **perp height**

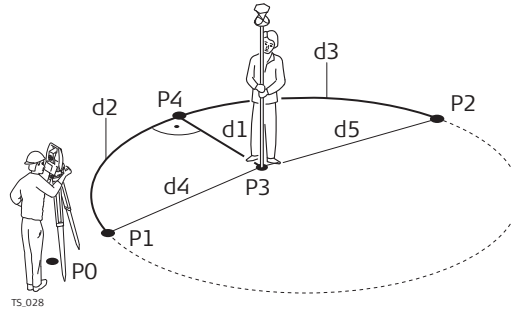
Measure to arc - horizontal measurements

Target point inside arc



GPS

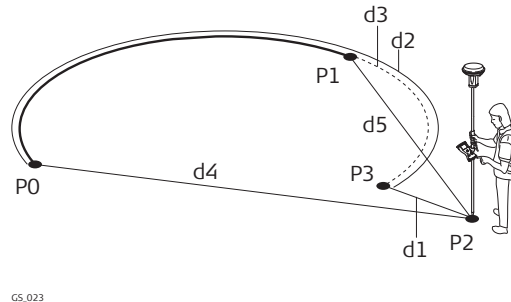
- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 Δ **offset**
- d2 Δ **arc**
- d3 Δ **end of arc**
- d4 **Check Dist 1**
- d5 **Check Dist 2**



TPS

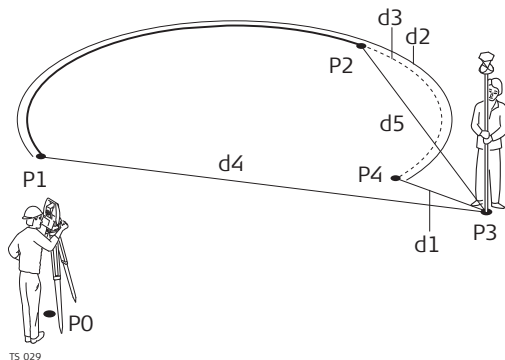
- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- d1 Δ **offset**
- d2 Δ **arc**
- d3 Δ **end of arc**
- d4 **Check Dist 1**
- d5 **Check Dist 2**

Target point outside arc



GPS

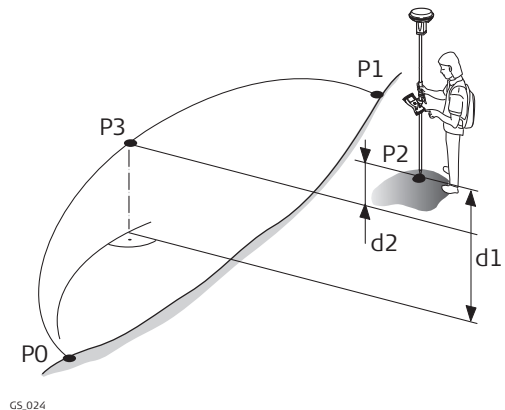
- P0 Start point
- p1 End point
- P2 Measured point
- P3 Reference point
- d1 Δ **offset**
- d2 Δ **arc**
- d3 Δ **end of arc**
- d4 **Check Dist 1**
- d5 **Check Dist 2**



TPS

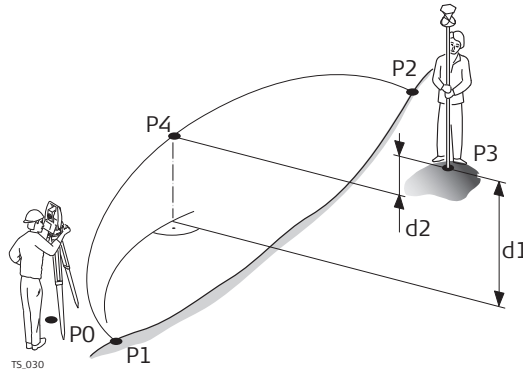
- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- d1 Δ **offset**
- d2 Δ **arc**
- d3 Δ **end of arc**
- d4 **Check Dist 1**
- d5 **Check Dist 2**

Measure to arc - vertical measurements



GPS

- P0 Start point
- P1 End point
- P2 Measured point
- P3 Reference point
- d1 Δ **ht start of line**
- d2 Δ **ht arc**



TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Measured point
- P4 Reference point
- d1 Δ ht start of line
- d2 Δ ht arc

Measure Points, Ref Line/Ref Arc page

An additional page is available when a user-defined survey screen page is used.

Measure Points	
Ref Line	Code Slope Map
Point ID:	RP101
Antenna height:	2.000 m
Δ offset:	1.454m
Δ line:	15.071m
Δ ht design:	0.237m
Design Ht:	19.659 m
Δ nern dist:	1.473m
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 09:57	
Meas	Line.. Stake.. Page

Meas

GPS To start measuring the point being staked. The key changes to **Stop**. The difference between the current position and the point being staked is still displayed.

TPS To measure a distance and store distance and angles.

Stop GPS

To end measuring the point being staked. When **Automatically stop point measurement** is checked in **Quality Control, General** page recording of positions ends automatically as defined by the stop criteria. The position mode icon changes to the moving icon. The key changes to **Store**.

Store

GPS To store the measured point. When **Automatically store point** is checked in **Quality Control, General** page, the measured point is stored automatically. The key changes to **Meas**.

TPS To store angles and distance. Distance must be measured before.

Dist TPS

To measure a distance.

Line..

To define/select a reference line/arc.

Stake..

To define reference line offsets to be staked out in relation to the reference line.

Page

To change to another page on this screen.

Fn Config..

To configure the Reference Line application. Available when **Meas** is displayed. Refer to "33.3 Configuring Reference Line".

Fn Conect and **Fn Disco** GPS

To dial the number of the base station configured in the active working style and to hang up immediately after the survey is completed. Available when **Meas** or **Store** is displayed and for real-time devices of type digital cellular phone or modem. Available when **Auto connect when measuring** is not checked in **RTK Rover Settings, General** page.

Fn Init GPS

To select an initialisation method and to force a new initialisation. Available when **Meas** or **Store** is displayed and for working styles allowing phase fixed solutions. Refer to "44.4 Initialisation for Real-Time Rover Operations".

Fn IndivID and **Fn Run**

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 "19.1 ID templates".

Fn Quit

To exit the screen.

The fields available depend on the options chosen for **Height to use** in **Choose Control Job** and the **Reference line task** selected in **Reference Line Startup**. The following fields are always available:

Description of fields

Field	Option	Description
Point ID	Selectable list	The point ID of the point to be measured.
Antenna height	Editable field	GPS The default antenna height. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.
Target height	Editable field	TPS The last used target height is suggested. An individual target height can be typed in.
Δ offset	Display only	Perpendicular offset from the reference line/arc measured from the reference point to the measured point. For reference arcs, Δ offset , Δ arc and Δ end of arc values are always calculated to produce the smallest Δ offset possible. To ensure the smallest Δ offset possible, the arc will be extended if necessary. Refer to paragraph "Measure to arc - horizontal measurements".
Chainage	Display only	Chainage of the current position along the line/arc. This value is the chainage of the start of the reference line/arc plus Δ line/Δ arc .
Check Dist 1	Display only	Horizontal distance from start point to measured point.

Field	Option	Description
Check Dist 2	Display only	Horizontal distance from end point to measured point.

For task Measure to line
Description of fields

Field	Option	Description
Δ line	Display only	Horizontal distance along the reference line from the start point to the reference point.
Δ end of line	Display only	Horizontal distance along the reference line from the end point to the reference point.

For task Measure to arc
Description of fields

Field	Option	Description
Δ arc	Display only	Horizontal distance along the reference arc from the start point to the reference point.
Δ end of arc	Display only	Horizontal distance along the reference arc from the reference point to the end point.

For task Measure to line/Measure to arc, Height to use: Start point and Allow design height of point to be edited is not checked in the Configuration Heights page.

Description of fields

Field	Option	Description
Δ ht start of line	Display only	Height difference between the start point and the measured point.
Elevation	Display only	Height of measured point.

For task Measure to line, Height to use: Reference line and Allow design height of point to be edited is not checked in the Configuration Heights page.

Description of fields

Field	Option	Description
Δ ht line	Display only	Height difference between the temporary point on the reference line and the measured point.
Elevation	Display only	Height of measured point.
Δ perp dist	Display only	Slope distance between the reference point and the measured point, perpendicular to the reference line.
Δ perp height	Display only	Slope distance between the reference point and the horizontal base point.
Δ spatial dist	Display only	Slope distance between the start point and the reference point.

For task Measure to arc, Height to use: Reference line and Allow design height of point to be edited is not checked in the Configuration Heights page.

Description of fields

Field	Option	Description
Δ ht arc	Display only	Height difference between the reference point on the arc and the measured point.
Elevation	Display only	Height of measured point.

For task Measure to line, Height to use: DTM and Allow design height of point to be edited is not checked in the Configuration Heights page.

Description of fields

Field	Option	Description
Δ ht DTM	Display only	Height difference between the measured point and the DTM.
Elevation	Display only	Height of measured point.

For any task and height type and Allow design height of point to be edited is checked in the Configuration Heights page.

Description of fields

Field	Option	Description
Design Ht	Editable field	The design height of the target point can be entered.
Δ ht design	Display only	Height difference between the Design Ht: and the height of the measured point.

Next step

Page changes to the **Map** page. Displayed is

- the horizontal distance or chainage along the reference line/arc from the start point to the reference point.
 - the perpendicular offset from the reference line/arc measured from the reference point to the measured point.
-

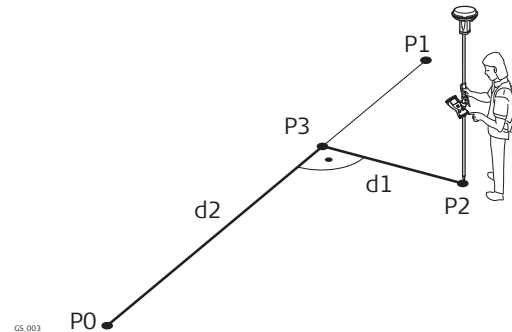
33.6

Staking to a Reference Line/Arc

Description

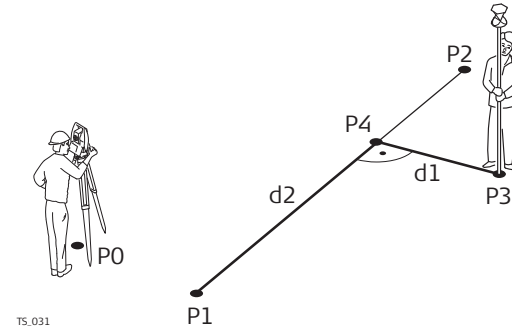
Allows for the position of a point to be defined relative to a reference line/arc and then staked.

Stake to line - horizontal measurements



GPS

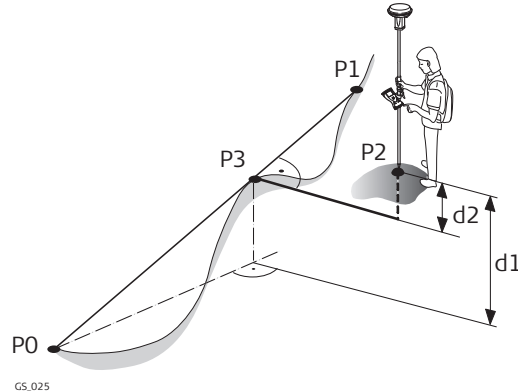
- P0 Start point
- P1 End point
- P2 Target point
- P3 Reference point
- d1 **Offset**
- d2 **Dist along line**



TPS

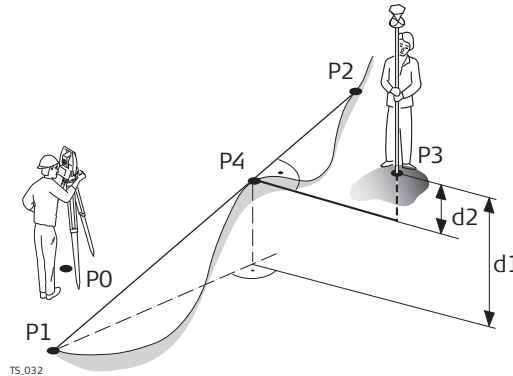
- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Target point
- P4 Reference point
- d1 **Offset**
- d2 **Dist along line**

Stake to line - vertical measurements



GPS

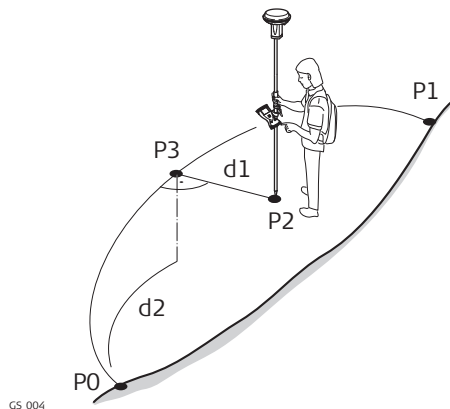
- P0 Start point
- P1 End point
- P2 Target point
- P3 Reference point
- d1 **Height offset**, for **Height to use: Start point**
- d2 **Vertical shift**, for **Height to use: Reference line**



TPS

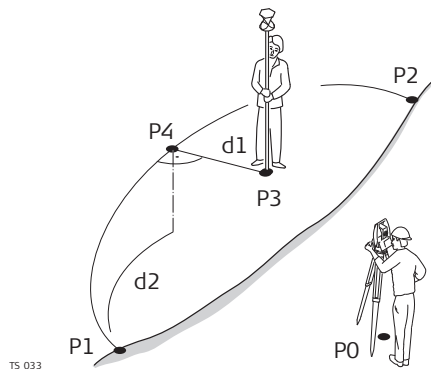
- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Target point
- P4 Reference point
- d1 **Height offset**, for **Height to use: Start point**
- d2 **Vertical shift**, for **Height to use: Reference line**

Stake to arc - horizontal measurements



GPS

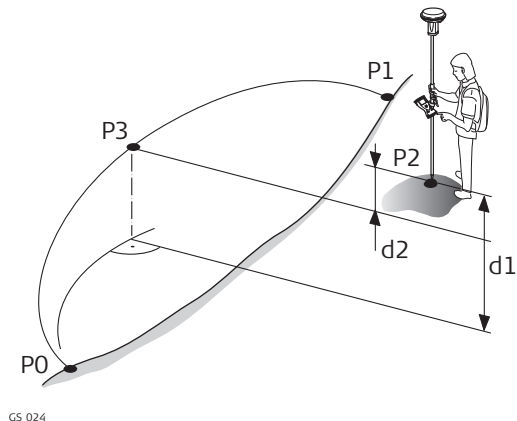
- P0 Start point
- P1 End point
- P2 Target point
- P3 Reference point
- d1 **Offset**
- d2 **Along arc**



TPS

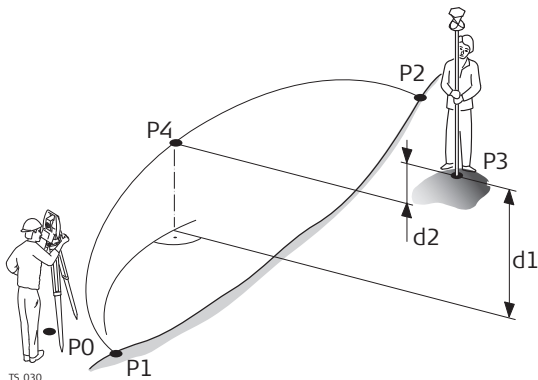
- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Target point
- P4 Reference point
- d1 **Offset**
- d2 **Along arc**

Stake to arc - vertical measurements



GPS

- P0 Start point
- P1 End point
- P2 Target point
- P3 Reference point
- d1 **Vertical shift, for Height to use: Start point**



TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- P3 Target point
- P4 Reference point
- d1 **Vertical shift, for Height to use: Start point**

Define Point to Stake

This screen is for typing in the stakeout values for a point relative to the reference line/arc. The fields available depend on the options chosen for **Height to use** in **Choose Control Job** and the **Reference line task** selected in **Reference Line Startup**. The following fields are always available:

The explanations for the softkeys given here are valid in all cases.

Define Point to Stake		↩
Point ID:	RP102	
Dist along line:	5.500	m
Offset:	0.500	m
Design Ht:	10.000	m

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:03				
OK			Line..	Survy..

OK

To confirm the selections and to continue with the subsequent screen.

Line..

To define/select a reference line/arc.

Survy..

To measure a point relative to the reference line/arc.

Fn Config..

To configure the Reference Line application. Available when **Meas** is displayed. Refer to "33.3 Configuring Reference Line".

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Editable field	The point ID of the target point to be staked.
Offset	Editable field	The offset from the reference point to the target point.
Dist along line	Editable field	Available for Reference line task: Stake to line . Horizontal distance from the start point to the reference point along the reference line.
Along arc	Editable field	Available for Reference line task: Stake to arc . Horizontal distance from the start point to the reference point along the reference arc.
Chainage	Editable field	Chainage along the line/arc. This value is the chainage of the start of the reference line/arc plus Dist along line/Along arc .
Height offset	Editable field	Available when Allow height of point being staked to be edited is not checked unless Height to use: DTM. The height offset of the target point. • For Height to use: Start point The height of the target point is calculated as the height of the start point plus Height offset. • For Height to use: Reference line The height of the target point is calculated as the height of the reference point plus Height offset.

Field	Option	Description
Design height	Editable field	Available when Allow height of point being staked to be edited is checked. The design height of the target point. • For Height to use: Start point The suggested height is the height of the start point. • For Height to use: Reference line The suggested height is the height of the reference point.

Next step

OK to accept changes and continue to **Stakeout**. Refer to "42.4 Staking Out".

33.7

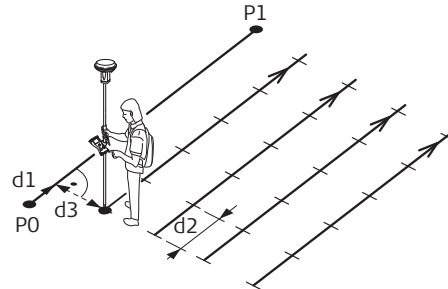
Gridstaking to a Reference Line/Arc

Description

A grid can be defined relative to a reference line/arc and points staked out in that defined grid.

Stake grid from line

Start at Begin



GS.026

GPS

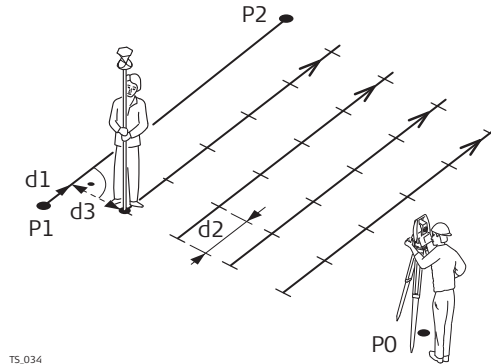
P0 Start point

P1 End point

d1 **Distance along line to first grid point**

d2 **Grid spacing along line**

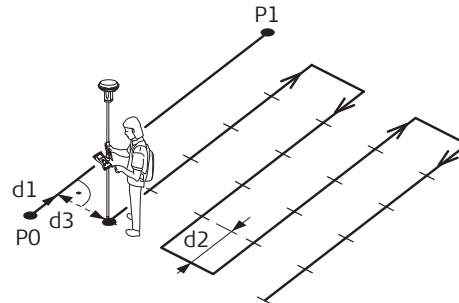
d3 **Grid spacing across line**



TPS

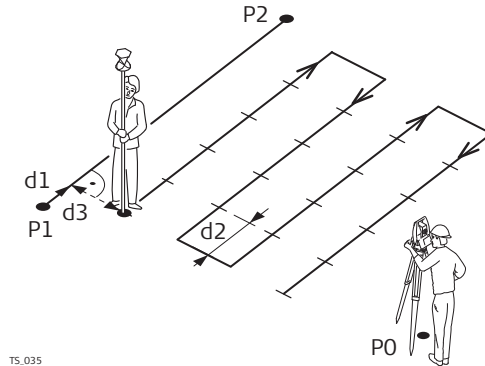
- P0 Instrument station
- P1 Start point
- P2 End point
- d1 **Distance along line to first grid point**
- d2 **Grid spacing along line**
- d3 **Grid spacing across line**

Current Grid Pt



GPS

- P0 Start point
- P1 End point
- d1 **Distance along line to first grid point**
- d2 **Grid spacing along line**
- d3 **Grid spacing across line**

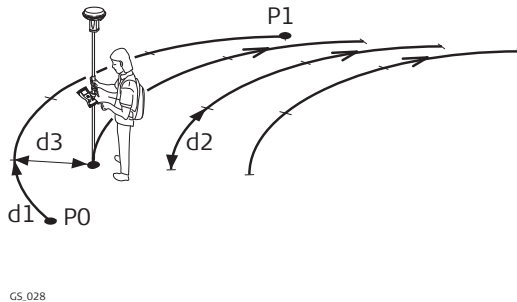


TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- d1 **Distance along line to first grid point**
- d2 **Grid spacing along line**
- d3 **Grid spacing across line**

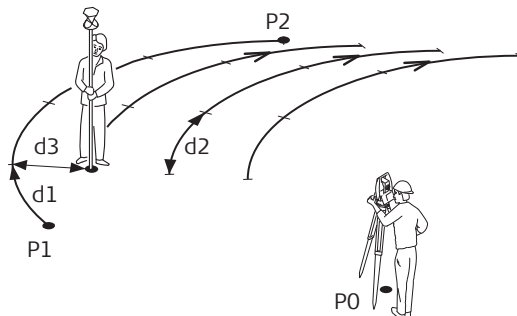
Stake grid from arc

Start at Begin



GPS

- P0 Start point
- P1 End point
- d1 **Distance along line to first grid point**
- d2 **Grid spacing along line**
- d3 **Grid spacing across line**

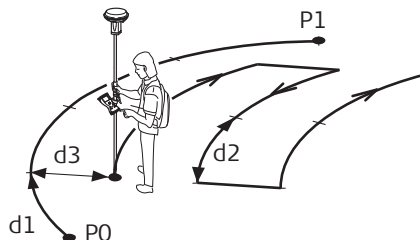


TS_036

TPS

- P0 Instrument station
- P1 Start point
- P2 End point
- d1 **Distance along line to first grid point**
- d2 **Grid spacing along line**
- d3 **Grid spacing across line**

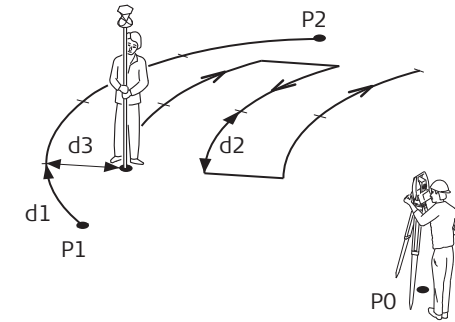
Current Grid Pt



GS_029

GPS

- 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_037

TPS

P0 Instrument station

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 to be Staked

Define Grid to be Staked

Distance along line to first grid point: 0.000 m

Grid spacing along line: 2.000 m

Grid spacing across line: 1.500 m

Stake next grid line: In same direction

3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Fn abc 10:05

OK Line..

OK

To confirm the selections and to continue with the subsequent screen.

Line..

To return to the **Reference Line To Use/Reference Arc To Use** screen.

Fn Config..

To configure the Reference Line application. Available when **Meas** is displayed. Refer to "33.3 Configuring Reference Line".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Distance along line to first grid point	Editable field	Distance along the reference line/arc from the start point to the first target point to be staked.
Chainage	Editable field	Chainage of the first target point to be staked along the line/arc. This value is the chainage of the start of the reference line/arc plus the Distance along line to first grid point .
Grid spacing along line	Editable field	Spacing between points on the grid line.
Grid spacing across line	Editable field	Spacing between grid lines.
Stake next grid line	In same direction In reverse direction	Method by which the grid will be staked out. Each new grid line is started at the same end as where the previous grid line started. Each new grid line is started at the same end as where the previous grid line finished.
Store point using	Grid reference	Determines the format of the point ID for grid points. 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.

Field	Option	Description
	Pt ID template	The point ID template as defined in the active working style is used. The point ID template can be defined in Main Menu: User\Work settings .

Next step

OK to accept changes and continue to the stakeout screen.

Stake +yyy.yy +xxx.xx

The title of this screen 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 screen is similar to the **Stakeout** screen. Differences between the two screens are outlined here. Refer to paragraph "42.4 Staking Out" for all other key and field explanations.

Skip

To skip the currently displayed chainage and increment to the next chainage. Available when **Meas** is displayed.

Line+

To start staking the next grid line. The position of the first point on the new line is determined by the option selected for **Stake next grid line**. Available when **Meas** is displayed.

Description of fields

Field	Option	Description
First field on the screen	Editable field	The point ID of the grid point to be staked. The point ID is based on the selection for Store point using in Define Grid to be Staked . If a different point ID is typed in, the next point ID will still be shown as the next automatically computed point ID.
Elevation	Display only	Available when Allow height of point being staked to be edited is not checked in the configuration. The orthometric height of the current position 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.
Design Ht	Editable field	Available when Allow height of point being staked to be edited is checked in the configuration. The design height, which is the orthometric height of the target 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. If a design height has been entered and Skip or Line+ is used, the true grid height for the next point is shown as the suggested height.

Next step

Page changes to the **Map** page. Displayed is

- 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.
-

33.8

33.8.1

Staking to Alignment

Overview

Description

The reference line task **Stake alignment** allows points to be staked relative to an alignment. This option uses line and area data from CAD as simply as possible.

Preparing the data

Line data can be created by one of the following methods:

Method	Description
Data from CAD	Selecting the alignments in the drawing that you want to stake in the field and saving them into a DXF file.
Manually creating lines with existing points	In some cases, DXF files are not available to create lines and areas. If so, the lines can be created from uploaded points using the line management function. Refer to "5.4.3 Editing a Line/Area".
Measuring lines in the field	It is also possible to create the lines to be staked by measuring points in the field. Lines can be made using the linework commands in the Survey page. Also, taking measurements with line objects open as well using the Data, Lines page or line codes can create lines. Any line that is listed in the Data, Lines page can be used for staking in this application.
Using Design to Field	Using the Design to Field tool of LEICA Geo Office, the user is able to bring in lines from multitudes of formats. For example, XML, DXF, Microstation XML and many more. Refer to LGO Online Help for information on Design to Field.

Method	Description
Using Alignment Editor	Using the Alignment Editor application, a simple center-line alignment can be created and be imported in Stake alignment .  Only straight and curve elements are supported. The alignment created with the Alignment Editor application has to be converted to a RoadRunner Job.
Creating Lines in LGO	It is possible as well to create the necessary lines in LGO. Refer to LGO Online Help.

Options to convert the DXF file to a job

To help with the electronic transfer of lines, from the plans to the surveying instrument, different tools have been created to read DXF format into a SmartWorx Viva job.

DXF Import: Copy the DXF files to the \Data directory on the data storage device of the Viva Series instrument. Once the card is back in the instrument the DXF import program can be used to bring the lines into the job.

Design to Field: This module is included in LEICA Geo Office and allows the conversion of DXF files into a SmartWorx Viva job. This method makes the task of transferring several lines into a single job quick and efficient.



Refer to "Appendix C Directory Structure of the Memory Device" for the placements of the data files on the data storage device.

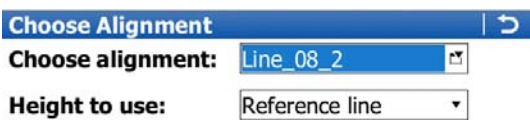
33.8.2

Accessing Staking an Alignment & Choosing an Alignment

Access step-by-step

Select the task **Stake alignment** in **Reference Line Startup** and press **OK**.

Choose Alignment



OK
To select the highlighted alignment and to continue with the subsequent screen.

Rprt..
To view an alignment report.

Fn Config..
To configure the Reference Line application. Available when **Meas** is displayed. Refer to "33.3 Configuring Reference Line".

Fn Quit
To exit the screen.



Description of fields

Field	Option	Description
Choose alignment	Selectable list	The alignment to use.
Height to use	Reference line	Heights are computed along the reference line/arc.
	Start point	Heights are computed relative to the height of the starting point.
	DTM	The stakeout height is computed from the DTM being used.

Alignment Report, Points page

Next step

Rprt.. to access **Alignment Report**.

Lines can be either 2D or 3D depending on the input data and are shown as such.

Alignment Report: Straight		
Points	Map	
Msd chainage	Msd offset	Cut/Fill
15.069	1.454	F0.009
15.069	1.454	F0.010
15.069	1.454	F0.010

3DCQ:0.008m	2DCQ:0.004m	1DCQ:0.007m	Fn abc	10:02
OK	Edit..	Save..	More	Page

OK

To return to the screen from which this screen was accessed.

Edit..

To edit details of the highlighted point.

Save..

To save the alignment report.

More

To change the values displayed between **Msd offset**, **Cut/fill**, **Msd elevation**, **Design elevation**, **Point ID** and **Pt code**.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Next step

Page changes to the **Map** page.

Description	This screen allows defining operating parameters while the Coords and Map pages allow validating the points to be staked.	
Access	OK in Choose Alignment .	
Stake, Parameters page		OK To accept the parameters and to continue with the subsequent screen. Rprt.. To view an alignment report. Ch- To decrease the chainage value, down chainage, by the defined chainage interval Chainage incremnt. Ch+ To increase the chainage value, up chainage, by the defined chainage interval Chainage incremnt. Page To change to another page on this screen. Fn BOP To return the chainage value to the beginning of the project. Fn EOP To send the chainage value to the end of project. Fn Quit To exit the screen.

Description of fields

Field	Option	Description
Alignment name	Display only	The name of the selected alignment.
Start chainage	Display only	The beginning chainage of the line.  The start chainage can be edited from Line Selection, Lines page with Edit...
Length	Display only	The length of the line.
End chainage	Display only	The chainage of the end of the line.
Chainage	Editable field	The chainage to be staked initially. Any chainage can be entered.
Offset	Editable field	The distance to stake off the line. Any value between -2000 m and 2000 m can be entered.
Vertical shift	Editable field	To shift the line vertically. The best example of the use of this feature is a situation where all grades of the line are finish grade, but the stakes are set referenced to subgrade.
Chainage increment	Editable field	The interval at which chainages will be staked. Incrementing begins from Chainage .

Next step

Page changes to the **Coords** page. This page allows validation of the coordinate values of the point to be staked.

Page changes to the **Map** page. This page allows visualisation of the position of the points. Top line shows the current horizontal geometry as well as any horizontal or vertical key points.

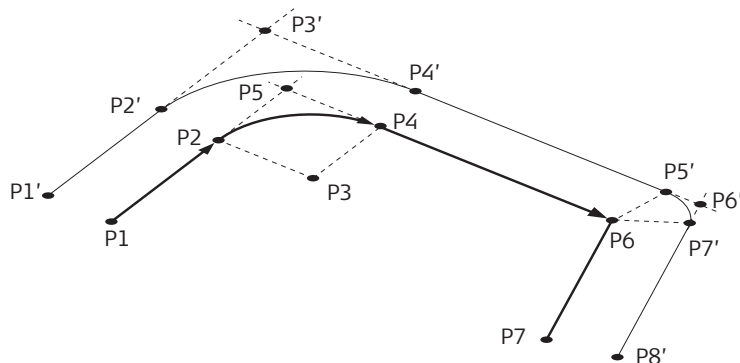
33.8.4

Staking Operation

Description

Once in the **Stakeout** screens, the user is guided to reach design positions.

Basic rules for polyline stakeout



SYS13_010

- P1 BOP - Beginning of project
- P2 PC - Beginning of curve
- P3 RP - Radius point
- P4 PT - End of curve
- P5 PI - Point of intersection
- P6 AP - Angle point
- P7 EOP - End of project

- P1' BOP - Beginning of project
- P2' PC - Beginning of curve
- P3' PI - Point of intersection
- P4' PT - End of curve
- P5' AP-B - Angle point, back tangent
- P6' BP - Bisected point
- P7' AP-F - Angle point, forward tangent
- P8' EOP - End of project

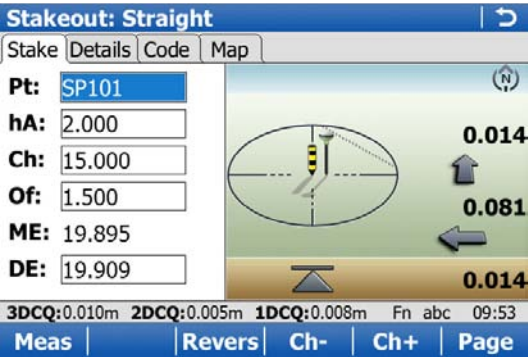
- a) General terms:
- b) Curve - Curve segment
- c) Extension - Line extension
- d) MCP - Mid curve point
- e) Straight - Straight segment

Access

Stakeout,
Stake page

OK in Stake.

The functionality of this screen is similar to the **Stakeout** screen. Differences between the two screens are outlined here. Refer to paragraph "42.4 Staking Out" for all other key and field explanations.



- Ch-**
To decrease the chainage value, down chainage, by the defined chainage interval **Chainage incremnt.**
- Ch+**
To increase the chainage value, up chainage, by the defined chainage interval **Chainage incremnt.**
- Fn Quit**
To exit the screen.

Description of fields

Field	Option	Description
Pt	Editable field	The point ID of the point to be staked.
hA	Editable field	GPS The default antenna height as defined in the active working style is suggested.

Field	Option	Description
Hr	Editable field	TPS The last used target height as defined is suggested. An individual target height can be typed in.
Ch	Editable field	The current chainage to be staked.
Of	Editable field	Current offset being staked.
ME	Display only	Measured elevation. The orthometric height of the current position is displayed.
DE	Display only	Design elevation. The orthometric height of the point to be staked is displayed.

Next step

Page changes to the **Details** page.

Stakeout, Details page

This page shows a live version of more information regarding the staked point.

Description of fields

Field	Option	Description
Pt	Editable field	Point ID of the point being staked.
Antenna height	Editable field	GPS The height of the antenna.
Target height	Editable field	TPS The height of the target.
Design Chainage	Editable field	The design chainage to be staked.
MsD chainage	Display only	The chainage of the current position.
Design offset	Editable field	The design offset to be staked.

Field	Option	Description
Msd offset	Display only	The offset of the current position from the alignment.
Design elevation	Editable field	The design elevation, which is the orthometric height of the point to be staked, is displayed.
Msd elevation	Display only	The height of the current position.
Cut/Fill	Display only	The height difference from the height of the current position to the height of the point to be staked.
Fill	Display only	The positive height difference from the height of the current position to the height of the point to be staked. Move up.
Go forward	Display only	The horizontal distance along the line defined by station and reflector from the current position to the point to be staked.
Go back	Display only	The horizontal distance in reverse direction from the line defined by station and reflector from the current position to the point to be staked.
Go right	Display only	The direction depends on the selection for Navigate direction in Configuration, General page. The horizontal distance orthogonal to the right of the line defined by station and reflector from the current position to the point to be staked.

Field	Option	Description
Go left	Display only	The direction depends on the selection for Navigate direction in Configuration, General page. The horizontal distance from the current position to the point to be staked orthogonal to the left of the line defined by station and reflector.
Measured slope	Display only	The slope between the current position and the alignment.

Next step

Page changes to the **Map** page.

33.8.5

Results of Stakeout

Access

This screen opens automatically once a point is measured and stored

Results, General page

The screenshot shows a software interface titled 'Results: Straight'. It has a tabbed menu with 'General', 'Coords', 'Code', and 'Map'. The 'General' tab is active, displaying the following fields: 'Point ID:' with a value of 'SP101' in a blue selection box; 'Msd chainage:' with '15.069m'; 'Msd offset:' with '1.454m'; 'Design elevation:' with '19.909m'; 'Msd elevation:' with '19.899m'; 'Fill:' with '0.010m'; and 'Annot 1:' with 'STA15.07 R1.45 F0.01'. At the bottom, there is a status bar with '3DCQ:0.011m', '2DCQ:0.005m', '1DCQ:0.009m', 'Fn abc', and '09:54'. Below the status bar are four buttons: 'OK', 'Elev..', 'Page', and 'Fn Quit'.

OK

To return to the **Stake** screen.

Elev..

To add a vertical offset to the design height and to display the new height.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Editable field	The point ID of the point staked.
Msd chainage	Display only	The chainage measured at the staked point.
Msd offset	Display only	The offset from the alignment measured at the staked point.
Design elevation	Display only	The entered design elevation.
Msd elevation	Display only	The height measured at the staked point.

Field	Option	Description
Cut/Fill	Display only	The height difference between the Design elevation and the Msd elevation .
Annot 1	Display only	Fixed value recorded for certain software packages.
Annot 2 to Annot 4	Editable field	Available for additional 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.

Page changes to the **Map** page. This page provides an interactive display of the data.

34

34.1

Reference Plane

Overview

Description

The Reference Plane application can be used to measure points relative to a reference plane.

TPS A reference plane can also be scanned in a predefined grid.

Reference plane tasks

The Reference Plane application 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.
- **TPS** Scanning a defined area.



Planes can only be computed with grid coordinates.



TPS Face scan is available for motorised instruments with reflectorless EDM.

Activating the application

The Reference Plane application must be activated via a licence key. Refer to "24.3 Load licence keys" for information on how to activate the application.

Properties of measured points

The properties stored with measured points are:

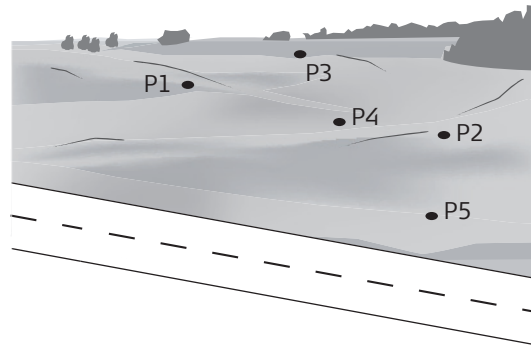
- Class: Either **Meas** or for **GPS** also **Nav** depending on the position status when the point was measured.
- Sub class:
 - **GPS** Code only, GPS code only, GPS fixed, GNSS Code Only or GNSS Fixed.
 - **TPS** TPS
- Source:
 - Ref Plane (Meas)

- **TPS** for Scan: **Ref Plane (Scan)**
- Instrument source: **GPS** or **TPS**

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:

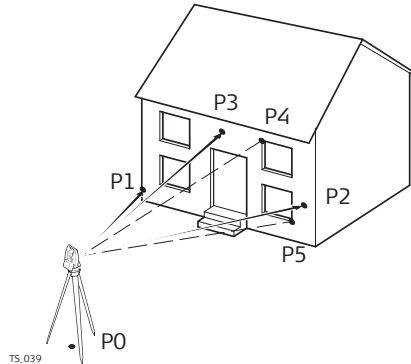
- vertical
- tilted
- horizontal



GS_058

GPS

- 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



TPS

- P0 Instrument station
- P1 Point defining reference plane
- P2 Point defining reference plane
- P3 Point defining reference plane
- P4 Measured point
- P5 Measured point



- **GPS**: The Reference Plane application is applicable for tilted and horizontal plane definitions.
- **TPS**: The Reference Plane application is applicable for tilted, horizontal and vertical plane definitions.

Tilted plane

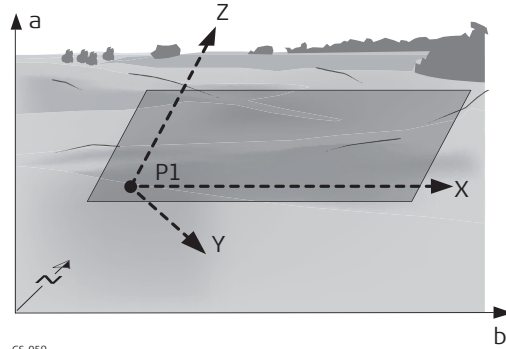
Any number of points define the plane. The axes of the tilted reference plane are:

- X axis: Horizontal and parallel to the plane
- Z axis: Defined by steepest direction of the plane
- Y axis: Perpendicular to the plane; increases in the direction as defined



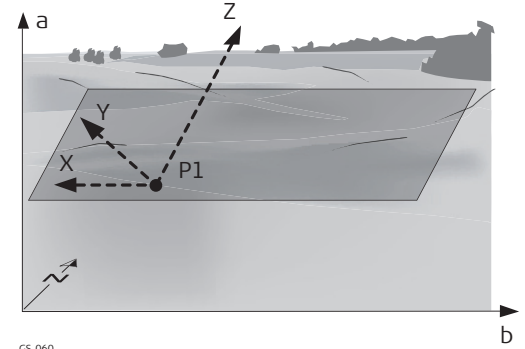
Offsets are applied in the direction of the Y axis.

For **GPS**:

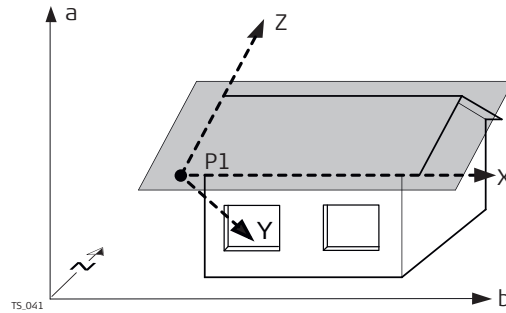


GS_059

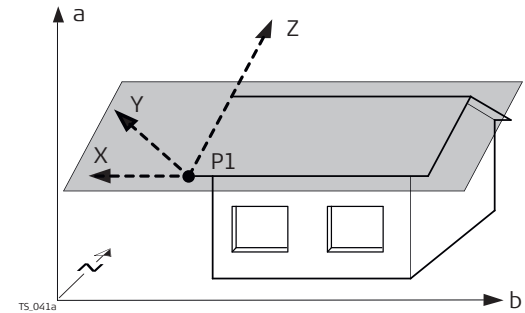
For TPS:



GS_060



TS_041



TS_041a

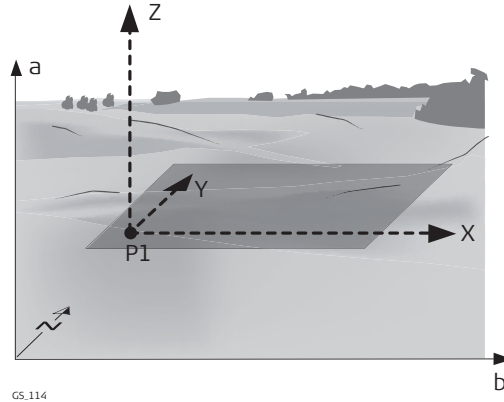
a Height
b Easting
N Northing
P1 Origin of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane

Horizontal plane

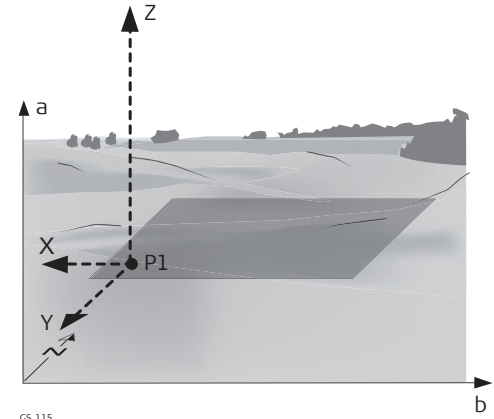
The axes of the horizontal reference plane are:

X axis: Horizontal and parallel to the plane
Z axis: Perpendicular to the plane; increases in the direction as defined
Y axis: Parallel to the plane
👉 Offsets are applied in the direction of the Z axis.

For **GPS**:



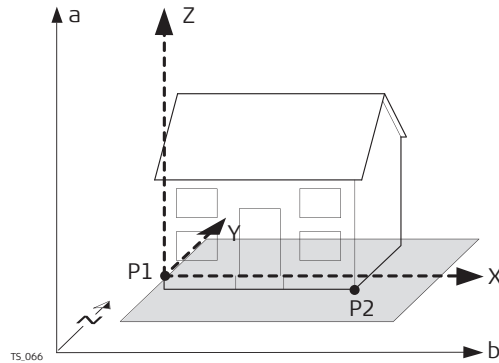
GS_114



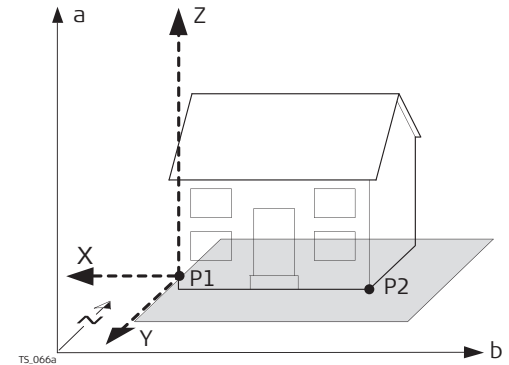
GS_115

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 **TPS**:



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 TPS

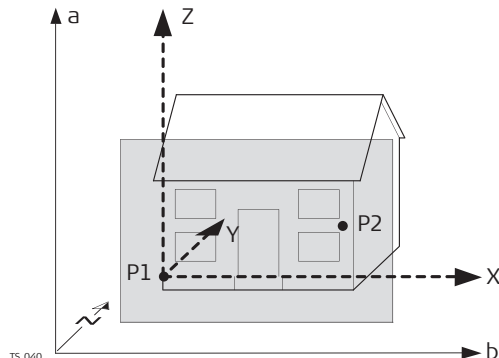
The axes of the vertical reference plane are:

X axis: Horizontal and parallel to the plane; X axis starts in point defined as origin point

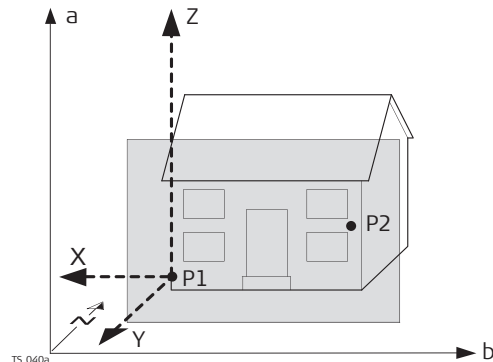
Z axis: Parallel to the instrument zenith and parallel to the plane

Y axis: 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.

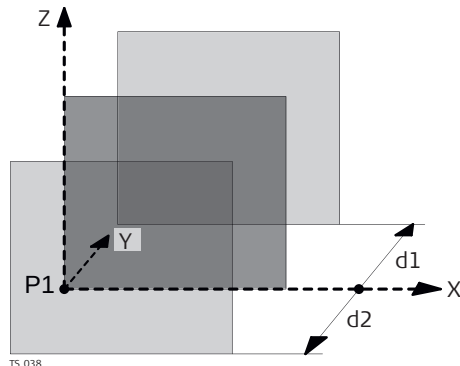
Origin

The origin of the reference plane can be defined to be in the plane coordinates or in relation to the national coordinate system.

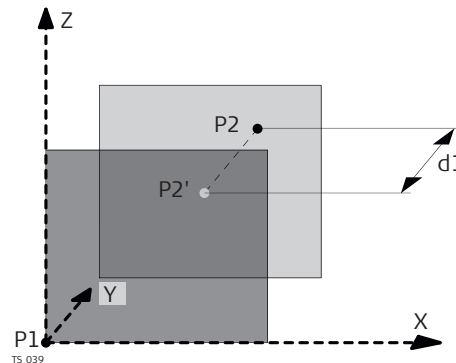
Positive direction of plane

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

Access

Select **Main Menu: Go to Work!\ Survey+\ Reference plane.**

Choose Task & Plane

OK

To accept changes and to continue with the subsequent screen.

Fn Config..

To configure the reference plane. Refer to "34.5 Configuring Reference Plane".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Task	Measure to plane	The coordinates of measured points are calculated relative to the reference plane.
	Scan	TPS Measures a sequence of points along a vertical, tilted or horizontal face.
Plane to use	Create new plane	Defines a new reference plane.
	Select from job	Reference plane is selected in Ref plane name .

Field	Option	Description
Ref plane name	Selectable list	Available for Plane to use: Select from job . The reference plane to be used. Accesses Manage Reference Planes .
No. of points	Display only	Available for Plane to use: Select from job . Number of points used for plane definition for the plane shown in Ref plane name .
Std deviation	Display only	Standard deviation of used points for plane definition. ----- is displayed for less than four points.
Max Δd	Display only	Maximum distance between a point and the calculated plane. ----- is displayed for less than four points.
Offset	Display only	The offset method used as defined in New Reference Plane/Edit Reference Plane, Offset page.
Origin	Display only	The origin method used as defined in New Reference Plane/Edit Reference Plane, Offset page.

Next step

IF	THEN
a new plane is to be created	OK accesses New Reference Plane, General page. Refer to "34.3 Creating/Editing a Reference Plane".
a new plane is to be selected	open the selectable list for Ref plane name . Refer to "34.4 Selecting a Reference Plane from a Job".

IF	THEN
points are to be measured to a plane	OK accesses Measure Points to Plane, Reference page. Refer to "34.6 Measuring Points to a Reference Plane".

Access

- In **Choose Task & Plane**, select **Plane to use: Create new plane**. Press **OK**.
- In **Manage Reference Planes**, press **New..** or **Edit...**

**New Reference Plane,
General page**

New Reference Plane | ↶

General | Points | Origin | Offset | Plot

Ref plane name: Reference Plane

No. of points: 0

Std deviation: -----

Max Δd: -----

3DCQ:0.009m 2DCQ:0.004m 1DCQ:0.007m Fn abc 09:52

Store | Page | Quit

Store

To compute and store the reference plane.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Ref plane name	Editable field	The name of the new reference plane.
No. of points	Display only	Number of points used for plane definition.
Std deviation	Display only	Standard deviation of used points for plane definition. ----- is displayed unless more than four points are used to define the plane.

Field	Option	Description
Max Δd	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 Reference Plane, Points page

- An * is shown to the right of the point for a point which will be used as origin of the plane.
- An ! is shown to the left of the point if the point is outside maximum distance between a point and the calculated plane as defined on the **General** page.
- The column **Δd** displays the perpendicular distance of the point from the definition of the plane.

New Reference Plane				
↩				
General	Points	Origin	Offset	Plot
!	Point ID	$\Delta d(m)$	Use	
	P1005	0.000	Yes	
	P1004	-0.000	Yes	
	P1003	-0.000	Yes	
	P1002	0.000	Yes	
	P1001	0.000	Yes	
	P1000	*	0.000	Yes
3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Fn abc 09:54				
Store	+Point	Use	Delete	Survvy.. Page

Store

To compute and store the reference plane.

+Point

To add points from the working job to define the reference plane.

Use

To change between **Yes** and **No** in the **Use** for the highlighted point.

New Reference Plane, Origin page

Next step

Page changes to the **Origin** page.

New Reference Plane | ↩

General | **Points** | Origin | Offset | Plot

Use as origin: Plane coordinates ▾

Enter local coordinates of origin point (point with *)

X coordinate: 0.000 m

Z coordinate: 0.000 m

Point defining direction of Y-axis

Point: P1002 ▾

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m Fn abc 09:55

Store | | | Survey.. | Page

Delete

To remove the highlighted point from the list.

Survey..

To measure a point to be used for the plane.

Page

To change to another page on this screen.

Fn Origin

To use the highlighted point as the origin of the plane.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Use as origin	Plane coordinates	Point results are additionally stored with X, Y, Z coordinates based on the local plane coordinate system.
	Instrument coords	Points on the plane are transformed into the national coordinate system.
X coordinate	Editable field	Available for Use as origin: Plane coordinates . 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	Available for Use as origin: Plane coordinates . 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.

Next step

Page changes to the **Offset** page.

New Reference Plane, Offset page

Store

To compute and store the reference plane.

Survey..

Available when **Offset pt ID** is highlighted. To measure a point to define the offset point.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Offset plane	Selectable list	An offset can be defined by a point or a distance. The defined plane is shifted along the Y axis by the offset.
Offset pt ID	Selectable list	Available for Offset plane: Offset to a point . Point ID of offset point.
Offset	Display only	Distance by which to offset the plane along the Y axis. For Offset plane: Offset by distance , the distance can be entered. For Offset plane: Offset to a point , the calculated distance to the adjusted plane is displayed. ----- if no values are available.

New Reference Plane, Plot page

Next step

Page changes to the **Plot** page.

Points displayed depend on the settings in **Configuration, Parameters** page. Points defining the plane are displayed in black, the other points are displayed in grey.



Select the icon to change between the face view and the plan view of the plane.

Access

In **Choose Task & Plane**, select **Plane to use: Select from job**. Highlight **Ref plane name**. Press **ENTER**.

Manage Reference Planes

Manage Reference Planes	
Name	Date
Plane name	14.05.04
Reference Plane	14.05.04
TPS plane	14.05.04

3DCQ:0.009m	2DCQ:0.005m	1DCQ:0.007m	Fn abc	10:33
OK	New..	Edit..	Delete	More

OK

To select the highlighted reference plane.

New..

To create a new reference plane. Refer to "34.3 Creating/Editing a Reference Plane".

Edit..

To edit the highlighted reference plane. Refer to "34.3 Creating/Editing a Reference Plane".

Delete

To delete the highlighted reference plane.

More

To display information about date and time of when the reference plane was created and the number of points defining the plane.

Fn Quit

To exit the application.

Description

Allows options to be set which are used within the Reference Plane application. These settings are stored within the working style.

Access

Select **Main Menu: Go to Work!\ Survey+\ Reference plane**. Press **Fn Config...**

**Configuration,
Parameters page**
OK

To accept changes and return to the screen from where this screen was accessed.

Config..

To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "19.3 My Survey Screen"

Page

To change to another page on this screen.

Fn About

To display information about the application name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Page to show	Selectable list	The names of the available survey screen pages.
Max +/- Δd for Defining plane	Editable field	The maximum perpendicular deviation of a point from the calculated plane.
Face scan	Editable field	TPS The maximum perpendicular deviation of a measured point in face scan from defined plane. Scanned points outside the defined limit are not stored.
Display	All points Pts within slice	This parameter defines the points displayed in the Plot and Map pages of the Reference Plane application in the plan view. Displays all points in the plan view. Displays points within the defined Slice width in the plan view.
Slice width	Editable field	Available for Display: Pts within slice. This parameter defines the distance from the plane in which points are displayed. This distance is applied to both sides of the plane. If lines and areas are displayed in a Map page, then the parts of lines and areas that fall within the defined slice are also displayed.

Next step

Page changes to the **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

Page changes to the first page on this screen.

34.6

Measuring Points to a Reference Plane

Access

In **Choose Task & Plane** select **Task: Measure to plane**. Press **OK**.

Measure Points to Plane, Reference page

Measure Points to Plane

Reference Code Map

Point ID: P1001

Antenna height: 2.000 m

Offset perp dist: -1.501m

Offset ht: 3.417m

X coordinate: -0.001m

Y coordinate: -0.001m

Z coordinate: 0.003m

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.007m Fn abc 10:33

Meas Cmpare Plane Page

Meas **GPS**

To start measuring the point. The key changes to **Stop**. The difference between the current position and the adjusted plane is displayed.

Stop **GPS**

To end measuring the point. The key changes to **Store**. After ending the measurement, the differences between the measured point and the adjusted plane are displayed.

Meas **TPS**

To measure a distance and store distance and angles.

Dist **TPS**

To measure a distance.

Store

To store the point information.

Cmpare

To calculate offsets to previously measured points.

Plane

To edit the selected reference plane.

Page

To change to another page on this screen.

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	The number of the measured point.
Target height	Editable field	The target height.
Offset perp dist	Display only	The perpendicular distance between the measured point and the adjusted plane.
Offset ht	Display only	The vertical distance between the measured point and the adjusted plane.
X coordinate, Y coordinate, Z coordinate	Display only	For Use as origin: Plane coordinates .

Field	Option	Description
Easting, Northing, Elevation	Display only	For Use as origin: Instrument coords.

Next step

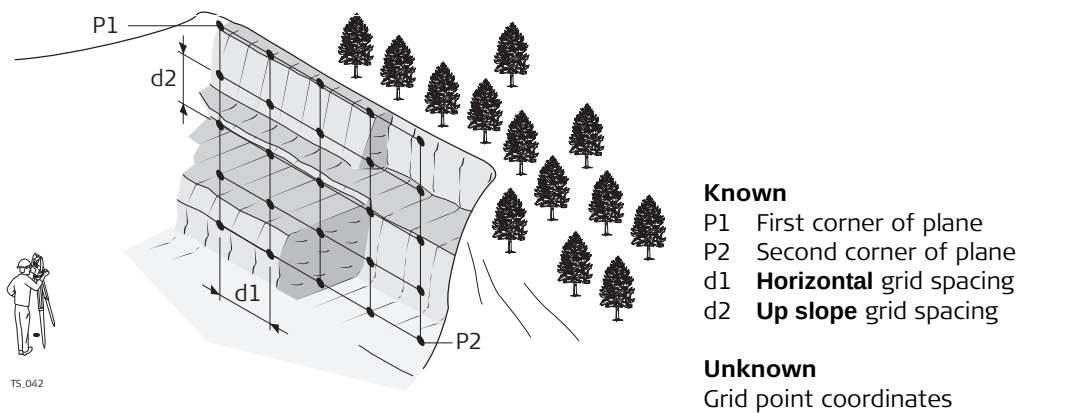
Page changes to the **Map** page.

Select the  icon to change between the face view and the plan view of the plane.

Description

Face Scan automates the process of measuring a sequence of points along the defined vertical, tilted or horizontal face. The boundaries of the window of interest and the increment values are defined by the user. Face scan can be run on motorised instruments with the option "reflectorless EDM" only.

Diagram



Access

In **Choose Task & Plane**, select **Task: Scan**. Press **OK**.

Define Scanning Parameters

Description of fields

Field	Option	Description
Horizontal	Editable field	For tilted and vertical planes. Horizontal grid distance.

Field	Option	Description
Up slope	Editable field	Up slope grid distance.
Start pt ID	Editable field	The point ID to start with.
Pt ID Inc	Editable field	The incrementation used for Start pt ID. No point ID template used • For Start pt ID: RMS and Pt ID Inc: 10 the points are RMS, RMS10, RMS20, ..., RMS100, ... • For Start pt ID: 100 and Pt ID Inc: 10 the points are 100, 110, ..., 200, 210, ... • For Start pt ID: abcdefghijklmn89 and Pt ID Inc: 10 the points are abcdefghijklmn99, point ID incrementing fails.
Scanning area	Display only	Size of the area to be scanned.
Estimated points	Display only	Estimated number of points to be scanned.

Next step

Start to access **Scanning Status**.

Scanning Status, Scanning page

Scanning Status	
Scanning	Plot
Points scanned:	31
Points remaining:	37493
Points rejected:	0
% completed:	0.083%
Time remaining:	15:53:34
Point ID:	Scan0032
Point Scan0031 has been stored	
Fn abc 10:07	
Stop	Pause
Page	

Stop

To stop the scanning of points.

Pause

To pause the scanning of points.

Scan

To continue scanning.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Points scanned	Display only	Number of points being scanned.
Points remaining	Display only	Number of points remaining to be scanned.
Points rejected	Display only	Number of skipped points.
% completed	Display only	Percentage of points scanned.
Time left	Display only	Estimated time remaining until scan is finished.
Point ID	Display only	Point ID of last stored point.

Next step

Page changes to the **Plot** page. Points currently scanned are displayed in black, previously measured points, lines and areas are displayed in grey.



Select the icon to change between the face view and the plan view of the plane.



Roads - General

Overview

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

Roads is an umbrella term for four subapplications.

Name of subapplication	Description
Alignment Editor	- Alignment Editor is an "add-on" component to the Roads application. 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 application. - This application supports the following alignment types: - Horizontal alignments - Vertical alignments - Cross section templates - Cross section assignments - Chainage equations - This application is a free application provided by Leica Geosystems AG. If the application does not appear on your menu or you are otherwise unable to access it, please contact your Leica Geosystems AG representative.
Roads	- This subapplication allows the measuring and staking of roads and other alignments. - It can be used with GPS and with total stations.

Name of subapplication	Description
	• It consists of two main functions: • Roads - As built check for checking or measuring existing stringlines, cross slopes, slopes or surfaces and comparing the measurements against design data. • Roads - Stakeout for setting or staking out and adjusting road elements during construction using design data. • The data can be typed in manually by using the Alignment Editor or data created in a design package can be converted. The Design to Field component of LEICA Geo Office offers converters from several road design and CAD packages.
Rail	• This subapplication allows the measuring and staking of railways and other alignments. • It can be used with GPS and with total stations. • It consists of two main functions: • Rail - As built check for checking or measuring an existing track and comparing the measurements against design data. • Rail - Stakeout for setting or staking out and adjusting track features during construction using design data.

Name of subapplication	Description
	- Single track or multiple track designs can be imported for use with this application. - For horizontal and vertical alignments, the data can be typed in manually by using the Alignment Editor application or data created in a design package can be converted. - For multiple track designs, it is possible to define one centreline which is common to all tracks. - A superelevation table can be created for each track using the Rail Editor computer application. This application is part of the Design to Field component in LEICA Geo Office.
Tunnel TPS	- This subapplication allows the measuring and staking of tunnels. - It is for use with total stations only. - It consists of two main functions: Tunnel - As built check for checking a built or excavated tunnel with a tunnel design. Tunnel - Stakeout for setting out tunnel features during construction. - 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 LEICA Geo Office.



Name of subapplication	Description
	Tunnel design profiles can be created using the Tunnel Profile Editor computer application. This application is integrated into the Design to Field component in LEICA Geo Office.

Roads, Rail and Tunnel subapplications are licence protected. They can be activated through a licence key which is specific to the instrument. This licence key can be entered either through **Main Menu: User\Tools & other utilities\Load licence keys** or alternatively, the first time the program is started.

35.2

Accessing Roads Applications

Access

Select **Main Menu: Go to Work!\Roads**.

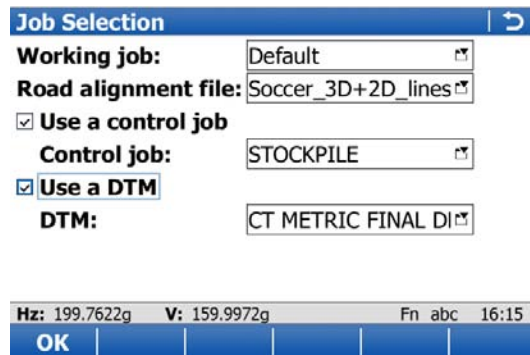
Then select the subapplication required to access **Job Selection**.

 For the **Alignment Editor**, refer to "36.2.1 Accessing Alignment Editor".

Job Selection

When the application is resumed, the last active selections are remembered and can be accessed again. This ability means the settings do not need to be reselected every time after turning off the instrument.

Every job selection field displays only the jobs that are valid.



Job Selection

Working job: Default

Road alignment file: Soccer_3D+2D_lines

☒ **Use a control job**

Control job: STOCKPILE

☒ **Use a DTM**

DTM: CT METRIC FINAL DI

Hz: 199.7622g V: 159.9972g Fn abc 16:15

OK

OK

To continue with the next screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Working job	Selectable list	The working job is where information generated in the field is recorded. All measurements, points and other values stored in the field are added to this job. This job determines the coordinate system.
Road alignment file	Selectable list	Available for Road. Contain 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. The files are stored in the \DBX folder or a subfolder of \DBX. The data is either typed in manually in the Alignment Editor application or converted from a road design package. For tunnel projects, all road design information for road data outside of the tunnel must be stored in the road job. The road job is a read-only source of information and cannot be selected as a working or control job.
Rail job	Selectable list	Available for Rail. 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.

Field	Option	Description
		The rail job is a read-only source of information and cannot be selected as a working or control job.
Tunnel job	Selectable list	Available for Tunnel. 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. The tunnel job is a read-only source of information.
Use a control job	Check box	When this box is checked, a control job can be selected. Individual points of a control job can be staked out and set in relation to the alignment by using the Tools menu.
Control job	Selectable list	The control job is the one control points are stored in. The control job holds all control point information needed in the field. For example, control points, points with known coordinates used for a TPS setup.  The same job can be used as a working and control job.
Use a DTM	Check box	Available for Roads and Rail. 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.

Field	Option	Description
DTM	Selectable list	Available for Roads and Rail. Holds DTM (Digital Terrain Model) data or TIN (Triangular Irrregular Network) data. The DTM job to be used must be stored in the \DBX directory on the active memory device. The DTM job is a read-only source of information and cannot be selected as a working or control job.  If only a DTM job is selected, then only check measurements relative to the selected DTM layer can be done.

Next step

IF you want to continue with	THEN refer to
job management	"35.4 Jobs & Design Data".
configuration	"35.3 Configuring Roads Applications".
Roads	"37 Roads - Road".
Rail	"38 Roads - Rail".
Tunnel	"39 Roads - Tunnel".

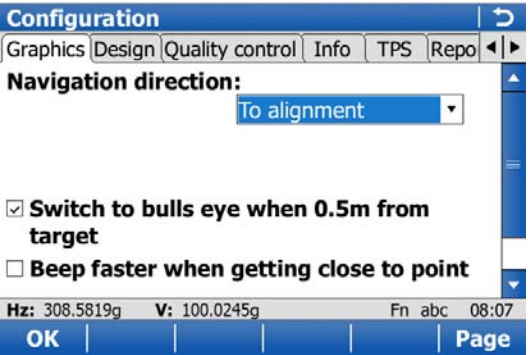
35.3
35.3.1

Configuring Roads Applications
Configuration Settings

Access

In **Job Selection** press **OK** and then, depending on the subapplication **Config..** or **Fn Config...**

Configuration,
Graphics page



- OK**
To confirm the changes and move to the previous screen.
- Page**
To change to another page on this screen.
- Fn About**
To display information about the application name, the version number, the date of the version, the copyright and the article number.
- Fn Quit**
To exit the screen.

Description of fields

Field	Option	Description
Navigation direction		The reference direction used to stakeout points. The stakeout elements and the graphics displayed are based on this selection.
	To alignment	The stake out is relative to the alignment.
	To north	The North direction shown in the graphical display based on the active coordinate system.

Field	Option	Description
	To sun	GPS The position of the sun calculated from the current position, the time and the date.
	To last point	Time-wise, the last recorded point. If no points are yet staked, Navigation direction: To north is used for the first point to be staked.
	To point (cntrl job)	A point from the control job is selected.
	Following arrow	The direction of the orientation is from the current position to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked.
	From station	TPS The reference direction is from the station to the current position.
	To station	TPS The reference direction is from the current position to the station.
Point ID	Selectable list	Available for Navigation direction: To point (cntrl job) . To select the point or line to be used for orientation.
Navigate using	Direction & distance In/out, left/right	The method of staking out. The direction from the orientation reference, the horizontal distance and the cut/fill is displayed. The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed.

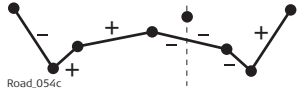
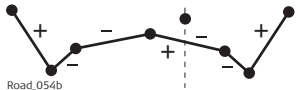
Field	Option	Description
Switch to bulls eye when 0.5m from target	Check box	When this box is checked, a bulls eye bubble is shown in the stakeout graphic when less than half a metre from the point being staked.
Beep faster when getting close to point	Check box	The instrument beeps when the distance from the current position to the point to be staked is equal to or less than defined in Start within . The closer the instrument is to the point to be staked the faster the beeps will be.
Distance to use	Height, Horizontal distance or Position & height	Available when Beep faster when getting close to point is checked. The type of distance to use for the stake beep.
Start within	Editable field	Available when Beep faster when getting close to point is checked. The horizontal radial distance, from the current position to the point to be staked, when a beep is to be heard.

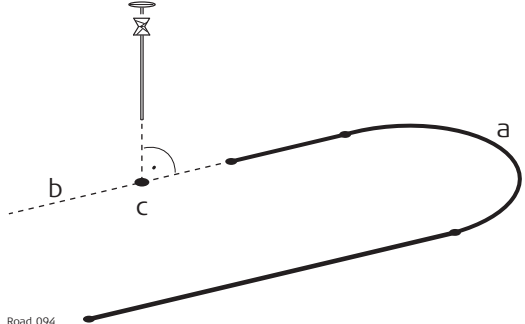
Next step

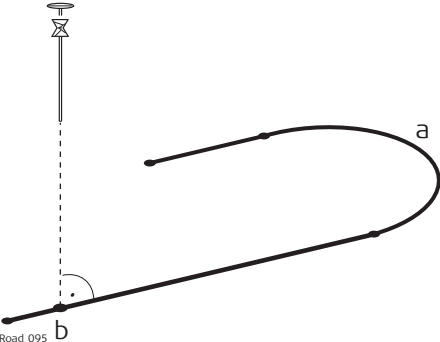
Page changes to the **Design** page.

Description of fields

Field	Option	Description
Working corridor	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. Refer to "35.7 Understanding Terms and Expressions" for more information on the working corridor.
Show tangent points	Check box	When this box is checked, a message box is shown when a tangent point has been detected within the chainage increment range. This tangent point can be selected for stakeout. Refer to "37.3.1 The Stake/Check Screen" for further details. When this box is not checked, no tangent points are indicated.
Type	Horizontal Vertical Horizontal & vertical	Available when Show tangent points is checked. Indicates tangent points of the horizontal alignment only. Indicates tangent points of the vertical alignment only. Indicates all tangent points.
Slope signs		Available for Road only. Selects sign definition method for slopes and cross slopes.

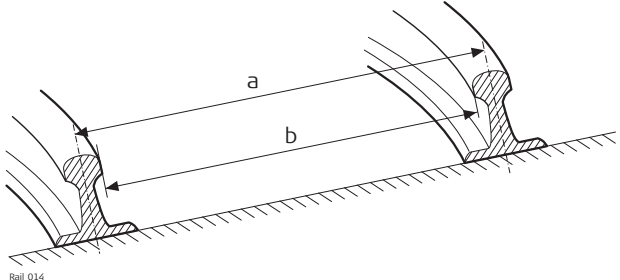
Field	Option	Description
	Mathematical	All slopes sign defines from left to right, independent of whether left or right of the centreline.  Road_054c
	Relative to CL	Slope signs defined relative to the centreline.  Road_054a
	Relative from CL	Slope signs defined relative from the centreline.  Road_054b
Extend slopes	Yes (with warning) Yes No	Available for Road only. To configure the warning handling for slope stakeout. This configuration allows the workflow of slope stakeout to be optimised. The slope is expanded beyond and above or below the hinge point. A warning is shown as soon as leaving the defined slope. The slope is expanded beyond and above or below the hinge point. No warning is when leaving the defined slope. The slope is not expanded beyond and above or below the hinge point.

Field	Option	Description
Extend lines	Check box	Extend each stringline at its beginning and end with a tangent. The extension is used for projecting a point to the stringline and for intersecting the stringline.
	Checked	☞ Intersection points on extended stringlines are not shown in cross-sections and cannot be staked out.  Road_094 a) Centreline b) Extended centreline c) Projected point on extended centreline

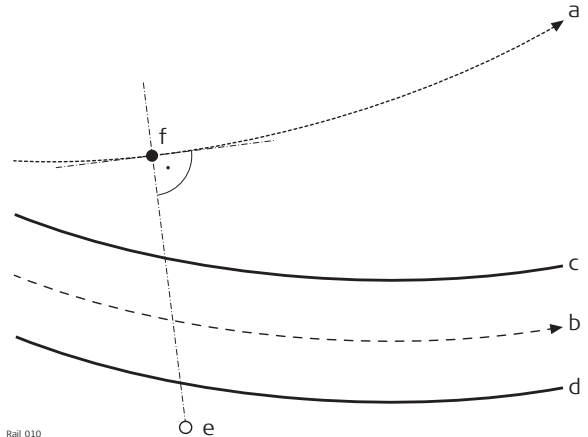
Field	Option	Description
	Not checked	 This option is recommended when working with closed alignments (for example roundabout, slip road, motorway exit).  a) Centreline b) Projected point on centreline

Next step

IF you work with	THEN Page changes to the
Road	Quality control page.
Rail	Rail design page.
Tunnel TPS	Tunnel design page.

Field	Option	Description
Nominal gauge	Editable field	Nominal distance between the active (internal) faces of the left and right rails.  The diagram shows a cross-section of two rails on a sloped track bed. The track bed is represented by a line with diagonal hatching. The rails are shown in profile. Two horizontal dimension lines are drawn between the inner faces of the rails. The upper dimension line is labeled 'a' and represents the 'Superelevation base'. The lower dimension line is labeled 'b' and represents the 'Nominal gauge'. Below the diagram, the text 'Rail_014' is visible. a) Superelevation base b) Nominal gauge
Superelevatn base	Editable field	Distance over which the superelevation is to be applied. This distance normally corresponds to the distance between the rail axes.
Superelevation	Design Manual None	To use the superelevation values from the design. If these values don't exist in the design, then all superelevation values are ignored. To ignore all superelevation values from the design and to enter them manually. All superelevation values are ignored.

Field	Option	Description
CL height	CL geometry	The centreline height is taken from the alignment centreline.
	Rail interpolated	The centreline height is interpolated between the left rail height and right rail height.
	Lower rail	The height of the lower rail is used as centreline height.
Calculate chainage directly onto chainage centerline	Check box	Chainage calculation method when checking points of multiple tracks with respect to a chainage centreline. 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.  Rail 010 a) Chainage centreline b) Track centreline c) Left rail d) Right rail e) Measured point f) Direct chainage

Field	Option	Description
	Not checked	Project measured point onto track centreline and then make a second projection onto the chainage centreline. a) Chainage centreline b) Track centreline c) Left rail d) Right rail e) Measured point f) Indirect chainage g) Measured point projected onto track centreline
Disable chainage centerline	Check box	Only affecting multiple track designs. The defined chainage centreline is disabled and the track centreline is used for chainage calculations.

**Configuration,
Tunnel design page**

TPS

Next step

Page changes to the **Quality control** page.

Available for Tunnel only.

Description of fields

Field	Option	Description
Theoretical profile direction	Clockwise	Defines the direction in which the design profile is considered. The setting has an influence on the profile offset sign. The design profile is defined in a clockwise direction. In underbreak areas the profile offset values are negative where as in overbreak areas they are positive.
	Counter-clockwise	The design profile is defined in a counter-clockwise direction. In underbreak areas the profile offset values are positive where as in overbreak areas they are negative.
Profile definition	Vertical	Profiles are always defined as vertical.
	Tilted	Profiles are always defined perpendicular to the vertical alignment of the tunnel axis.

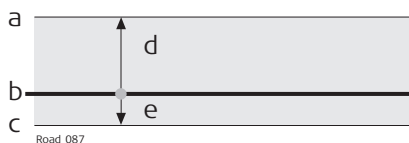
Next step

Page changes to the **Quality control** page.

Description

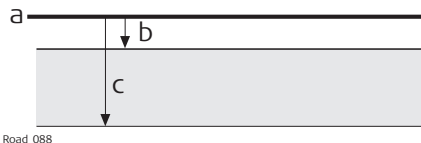
Especially when checking points in an as-built control or when staking out it is useful to enable the **Quality control** criteria available. For every point stored the chosen parameters are checked and if the check limits are exceeded a warning is shown. This function guarantees a higher productivity as it is no longer necessary to check the values for every shot taken. When checking layers of a road, a too thick layer 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) **Height limit** ↑
- e) **Height limit** ↓

Height limits below the design surface are entered as negative values (for example, the **Height limit** ↓ with -10 mm in the previous diagram). By 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) **Height limit** ↑
- c) **Height limit** ↓

Description of fields

Field	Option	Description
Check deltas to point before storing	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.
Delta values	Ch, offset & height Ch & offset Position & height Position Height Profile	 Depending on this selection the following lines are enabled/disabled. Check for chainage, horizontal offset and height. Check for chainage and horizontal offset. Check for 2D position and height. Check for 2D position. Check for height. Available for Tunnel. Check for distance from design profile.
Chainage limit	From 0.001 to 100	Maximum difference in chainage.
Offset limit	From 0.001 to 100	Maximum horizontal offset from defined position.
Position tolerance	From 0.001 to 100	Maximum radial horizontal distance.

Field	Option	Description
Height limit ↑	From -100 to +100	Maximum height difference.
Height limit ↓	From -100 to +100	Maximum height difference.
Profile tolerance	From 0.001 to 100	Available for Tunnel. Permitted distance from design profile.

Next step

Page changes to the **Info** page.

Configuration, 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 **Info** 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 **Info** page.
- 2) If and which additional user-defined survey screen page is displayed.

Configuration

Graphics Design Quality control Info TPS Repo

☒ **Show additional page from My Survey Screen**

Page to show: Survey

Method: Stake stringline

1st line: Chainage

2nd line: CL offset

3rd line: Strgl offset

Hz: 399.7614g V: 99.9996g Fn abc 16:45

OK Clear Default Page

OK

To confirm the changes and continue.

Clear

To clear all parameters from all lines.

Default

To set the default value for all lines.

Fn About

To display information about the application name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Show additional page from My Survey Screen	Check box	The user-defined survey screen page to be shown in the stake or check screen.
Page to show	Selectable list	The names of the available survey screen pages.

Field	Option	Description
Method	Display only	The method is based on the selected subapplication and, if available, the setting for Method to use. The settings in the following lines can only be changed for the current method. The method defines the parameters available to view on the Info page of the application. Different combinations of the parameters to view can be stored
1st line to 16th line	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 ENTER key. Use the arrow keys to select the required parameter and press the ENTER key to confirm the choice. Define which parameters are viewed on each line. Up to 16 lines of parameters can be defined. The available parameters depending on the Method selected are explained separately: • For Road Stringline, refer to "35.3.2 Road Stringline - Info Page". • For Road Individual stringline, refer to "35.3.3 Road Individual Stringline - Info Page". • For Road Cross slope, refer to "35.3.4 Road Cross Slope - Info Page".

Field	Option	Description
		• For Road Manual slope and Slope, refer to "35.3.5 Road Manual Slope and Slope - Info Page". • For Road Crown, refer to "35.3.6 Road Crown - Info Page". • For Road Layer, refer to "35.3.7 Road Layer - Info Page". • For Road DTM, refer to "35.3.8 Road DTM - Info Page". • For Rail refer to "35.3.9 Rail - Info Page". • For Tunnel refer to "35.3.10 Tunnel - Info Page".

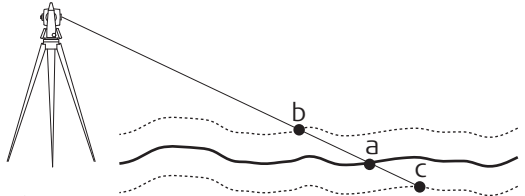
Next step

TPS Page changes to the **TPS** page.

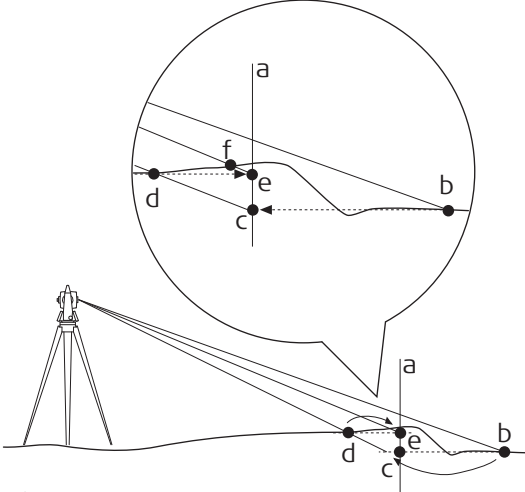
GPS Page changes to the **Report sheet** page.

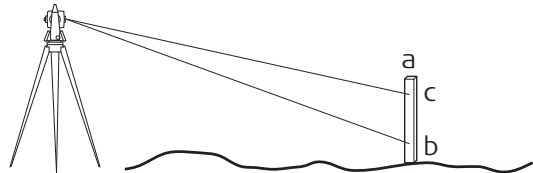
Description of fields

Field	Option	Description
Only update stakeout values when distance is measured	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 Target aiming: Lock 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.
Turn to point	Check box	Available for Road and Rail. To make stake out of points even more efficient, a motorised instrument offers you the possibility to aim automatically at the stakeout position.
Turn to	Position only	Available for Road and Rail and when Turn to point is checked. 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.

Field	Option	Description
		 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 base on height of d. The measured position for this point is within the defined tolerance, the correct position is found.

Field	Option	Description
	Prompt before turn	The method how the instrument turns is not fixed but is selected when pressing Positn. 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
Position limit	From 0.001 to 10	Maximum permitted radial horizontal distance. Available for Tunnel and for Road/Rail with Turn to: Position & measure or Turn to: Prompt before turn .
Height limit	From 0.001 to 10	Maximum height difference. Available for Road and Rail.
Chainage limit	From 0.001 to 10	Chainage tolerance of the position to stake out. Available for Tunnel and for Road/Rail with Turn to: Position & measure or Turn to: Prompt before turn .

Field	Option	Description
Offset limit	From 0.001 to 10	Maximum horizontal offset from defined position. Available for Road and Rail.
Red laser pointer	Always off On at point only Always on	Defines when the visible red laser beam is turned on during the automatic search of the position. Available for Tunnel and for Road/Rail with Turn to: Position & measure or Turn to: Prompt before turn. Visible red laser is turned off. Visible red laser is turned on as soon as the point is found. Visible red laser is turned on during the whole search.  The laser can also be permanently turned on by using the instrument settings. Refer to "10.6 Lights" for more information.
Max iterations	From 2 to 10	Maximum number of iterations for the distance measurement before stopping. Available for Tunnel and for Road/Rail with Turn to: Position & measure or Turn to: Prompt before turn .

Next step

Page changes to the **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

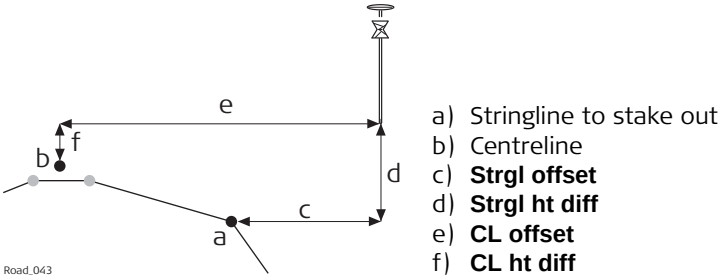
Next step

Page changes to the first page on this screen.

Description

This info page is used for staking and checking Road stringlines.

Available fields

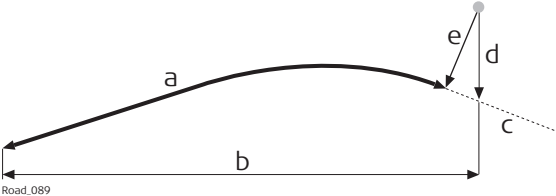


The following parameters are available. All fields are display only.

Field	Description
Strgl task	Name defined for the stringline task.
Δ offset	Horizontal offset between the defined position and the current position.
Δ height	Vertical offset between the defined position and the current position.
Δ chainage	Difference between the defined chainage Stake chainage on the General page and the current chainage Chainage shown on the Stake page.

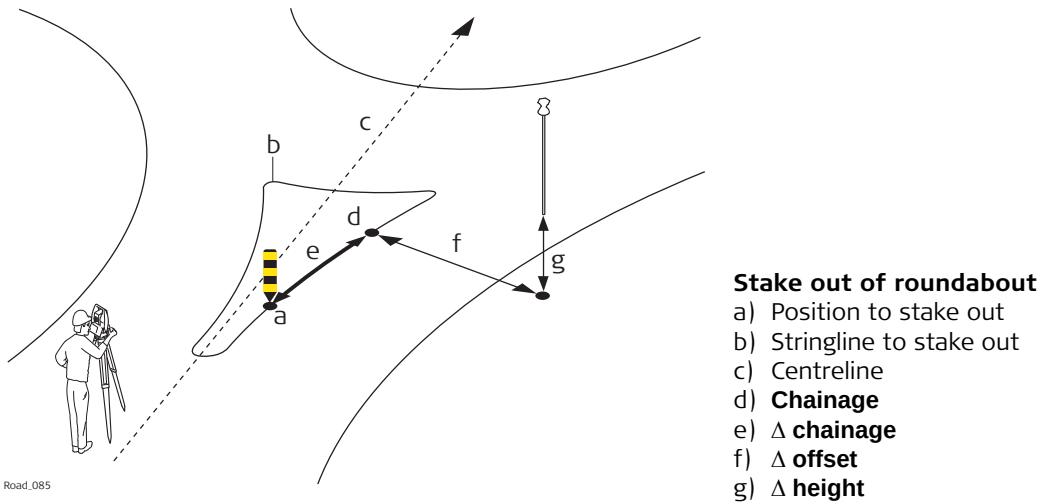
Field	Description
	 If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: ----- .
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
Stake chainage	Chainage to stake out.
Strgl offset	Horizontal offset from the stringline.
Strgl ht diff	Height difference from the defined stringline.
Strgl name	Name of the stringline to stake out or the stake out is relative to.
Additional line	The name of an additional line.
Additnl line chnge	Current local chainage of additional line.
Additnl line offset	Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the Offsets page.
Additnl line ht diff	Current height difference to the additional line including the defined stake/check height difference of the additional line of Offsets page.
CL ht diff	Height difference from the centreline.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Element type of the centreline.

Field	Description
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL tangent	Tangent direction of the centreline at the current chainage.
Offset angle	The current angle to alignment.
Nearest hz tngnt pt	Refer to "37.3.1 The Stake/Check Screen" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
Vertical sqr offset	Offset perpendicular to the vertical component of the selected line. This value can be useful when dealing with pipelines, cables and in the construction segment.
Vertical chainage	Chainage of the measured point is projected perpendicular to the vertical component of the selected line.

Field	Description
	 a) Vertical chainage b) Chainage c) Centreline d) Centreline height difference e) Vertical square offset
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Current dsgn east	Easting of the design for the current position (relevant point at the selected line).
Current dsgn north	Northing of the design for the current position (relevant point at the selected line).
Current dsgn ht	Height of the design for the current position (relevant point at the selected line).

Field	Description
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.

Available fields

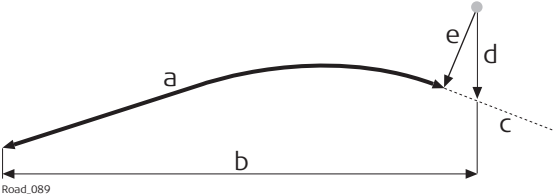


The following parameters are available. All fields are display only.

Field	Description
Strgl task	Name defined for the individual stringline task.
Additional line	The name of an additional line.
Additnl line chnge	Current local chainage of additional line.

Field	Description
Additnl line offset	Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the Offsets page.
Additnl line ht diff	Current height difference to the additional line including the defined stake/check height difference of the additional line of Offsets page.
Δ offset	Horizontal offset between the defined position and the current position.
Δ height	Vertical offset between the defined position and the current position.
Δ chainage	Difference between the defined chainage Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: ----- .
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
Stake chainage	Chainage to stake out.
Strgl offset	Horizontal offset from the stringline.
Strgl ht diff	Height difference from the defined stringline.
Strgl name	Name of the stringline to stake out or the stake out is relative to.

Field	Description
CL ht diff	Height difference from the centreline.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Element type of the centreline.
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL tangent	Tangent direction of the centreline at the current chainage.
Offset angle	The current angle to alignment.
Nearest hz tngnt pt	Refer to " Stake screen, Stake page" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
Vertical sqr offset	Offset perpendicular to the vertical component of the selected line. This value can be useful when dealing with pipelines, cables and in the construction segment.
Vertical chainage	Chainage of the measured point is projected perpendicular to the vertical component of the selected line.

Field	Description
	 The diagram illustrates the geometry of a vertical curve. A solid parabolic curve is shown. A horizontal dashed line represents the original ground surface. A solid line represents the new parabolic grade. The horizontal distance from the start of the curve to the point of tangency is labeled 'a'. The horizontal distance from the point of tangency to the end of the curve is labeled 'b'. The vertical distance from the original ground surface to the new grade at the end of the curve is labeled 'c'. The vertical distance from the original ground surface to the new grade at the point of tangency is labeled 'd'. The vertical distance from the new grade to the original ground surface at the point of tangency is labeled 'e'. The label 'Road_089' is at the bottom left of the diagram. a) Vertical chainage b) Chainage c) Centreline d) Centreline height difference e) Vertical square offset
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.
Current dsgn east	Easting of the design for the current position (relevant point at the stringline).

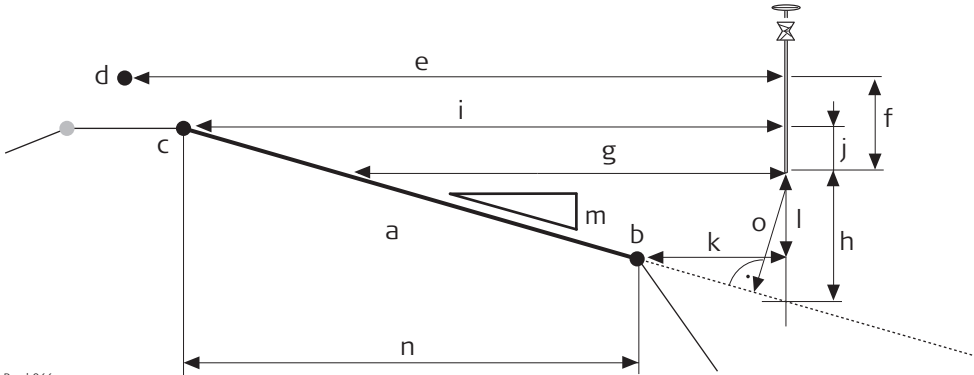
Field	Description
Current dsgn north	Northing of the design for the current position (relevant point at the stringline).
Current dsgn ht	Height of the design for the current position (relevant point at the stringline).
Ht end vert align	Height at the endpoint of the vertical alignment of the stringline.
Δ ht end of v align	Height difference to the endpoint of the vertical alignment of the stringline.
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	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 **Info** page items for individual stringlines enable the height difference to be added to the end of the vertical alignments **Δ ht end of v align** and **Ht end vert align**.

Available fields



- a) Cross slope to stake out
- b) Right stringline of the cross slope **Right name**
- c) Left stringline of the cross slope **Left name**
- d) Centreline
- e) **CL offset**
- f) **CL ht diff**
- g) **Cross slope offset**
- h) **Cross slope ht diff**
- i) **Left offset**
- j) **Left ht diff**
- k) **Right offset**
- l) **Right ht diff**
- m) **Cross slope ratio**
- n) **Width**
- o) **Square offset**

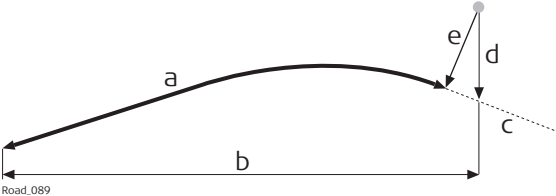
The following parameters are available. All fields are display only.

Field	Description
Cross slope task	Name defined for the cross slope task.
Additional line	The name of an additional line.

Field	Description
Additnl line chnge	Current local chainage of additional line.
Additnl line offset	Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the Offsets page.
Additnl line ht diff	Current height difference to the additional line including the defined stake/check height difference of the additional line of Offsets page.
Δ offset	Horizontal offset between the defined position and the current position.
Δ height	Vertical offset between the defined position and the current position.
Δ chainage	Difference between the defined chainage Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: -----.
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
Stake chainage	Chainage to stake out.
Cross slope offset	Horizontal offset from the cross slope.
Cross slope ht diff	Height difference to the cross slope. If no stake height difference is used Cross slope ht diff = Δ height .

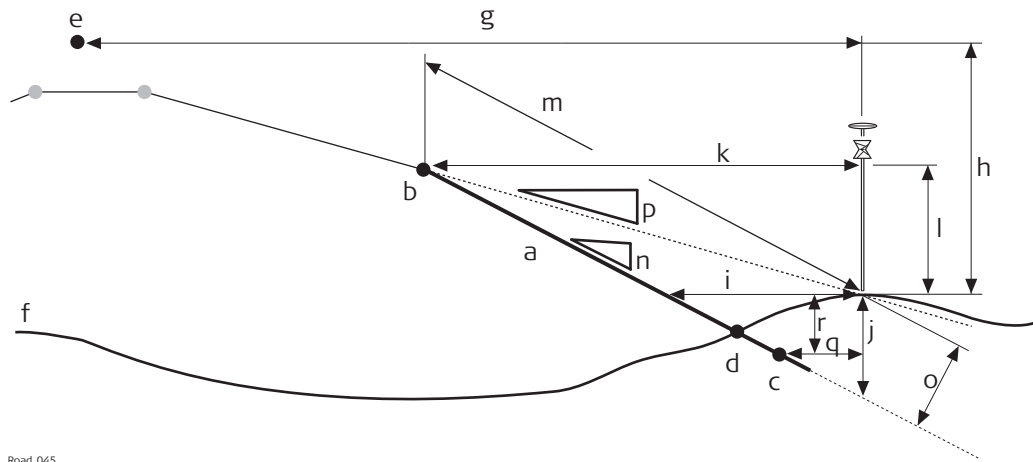
Field	Description
Left name	Name of the left stringline defining the cross slope.
Left offset	Horizontal offset from the left point of the cross slope.
Left ht diff	Height difference from the left point of the cross slope.
Right name	Name of the right stringline defining the cross slope.
Right offset	Horizontal offset from the right point of the cross slope.
Right ht diff	Height difference from the right point of the cross slope.
Ref line	Indicates which side of the cross slope the stake out is relative to.
Ref offset	Horizontal offset from the stringline of the cross slope used as reference. Depends on Ref line and is identical to Right offset or Left offset .
Ref ht diff	Height difference from the stringline of the cross slope used as reference. Depends on Ref line and is identical to Right ht diff or Left ht diff .
Cross slope ratio	Slope ratio of the cross slope.
Square offset	Offset from the cross slope, perpendicular to the cross slope.
CL ht diff	Height difference from the centreline.
CL ht diff	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Element type of the centreline.

Field	Description
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL tangent	Tangent direction of the centreline at the current chainage.
Width	Horizontal width of the cross slope.
Nearest hz tngnt pt	Refer to "37.3.1 The Stake/Check Screen" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
CL grade	Grade of the centreline at the current position.
Vertical sqr offset	Offset perpendicular to the vertical component of the selected line. This value can be useful when dealing with pipelines, cables and in the construction segment.
Vertical chainage	Chainage of the measured point is projected perpendicular to the vertical component of the selected line.

Field	Description
	 a) Vertical chainage b) Chainage c) Centreline d) Centreline height difference e) Vertical square offset
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.
Current dsgn east	Easting of the design for the current position (relevant point on the cross slope = Actual easting).
Current dsgn north	Northing of the design for the current position relevant point on the cross slope = Actual easting).

Field	Description
Current dsgn ht	Height of the design for the current position (relevant point on the cross slope).
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.

Available fields



Road_045

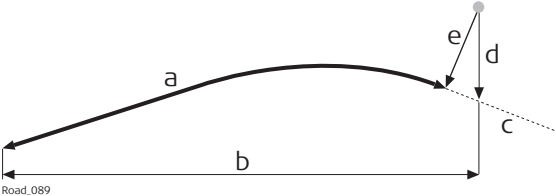
a) Slope to stake out/check	g) CL offset	n) Slope ratio
b) Hinge point Hinge name , reference line	h) CL ht diff	o) Square offset
c) Second stringline of slope Additnl line name	i) Slope offset	p) Current ratio
d) Real catch point	j) Slope height diff	q) Additnl line offset
e) Centreline	k) Hinge offset	r) Additnl line ht diff
f) Natural surface	l) Hinge ht diff	
	m) Slope dist hinge	

The following parameters are available. All fields are display only.

Field	Description
Slope task	Name defined for the slope task.
Δ offset	Horizontal offset between the defined position and the current position.
Δ height	Vertical offset between the defined position and the current position.
Δ chainage	Difference between the defined Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: -----.
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
Stake chainage	Chainage to stake out.
Slope offset	Horizontal offset from the slope.
Slope height diff	Height difference from the slope. If no stake height difference is used Slope height diff = Δ height .
Ht diff rail	Height difference from the batter rail to mark the slope (for Type: Batter rail in Slope Stakeout Settings).
Hinge name	Name of the stringline defining the hinge of the slope.
Hinge offset	Horizontal offset from the hinge point of the slope.

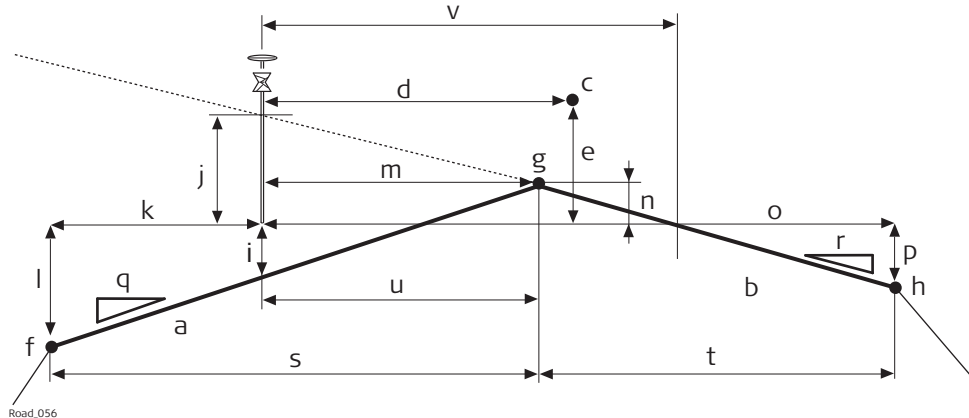
Field	Description
Hinge ht diff	Height difference from the hinge point of the slope.
Additnl line name	Name of the second stringline defining the slope.
Additnl line offset	Horizontal offset from the second stringline of the slope.
Additnl line ht diff	Height difference from the second stringline of the slope.
Slope ratio	Ratio of the slope.  The display format is defined as system setting in Regional Settings, Slope page.
Slope dist hinge	Slope distance to the hinge point.  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.
Slope ratio gon	Slope ratio in gon.
Slope ratio degree	Slope ratio in decimal degrees.
Slope ratio %	Slope ratio in percent.
Current ratio	Ratio of the slope from the current position to the hinge.  For the catch point the Current ratio is identical to the Slope ratio .
Square offset	Offset from the slope, perpendicular to the slope.
CL ht diff	Height difference from the centreline.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Element type of the centreline.

Field	Description
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL tangent	Tangent direction of the centreline at the current chainage.
Offset angle	Available for manual slope. The defined value for the angle to alignment.
Traveler height	Height of the traveller in use. Refer to "37.2.3 Advanced Slope Settings" for information on the different methods of slope staking.
Nearest hz tngnt pt	Refer to "37.3.1 The Stake/Check Screen" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
Vertical sqr offset	Offset perpendicular to the vertical component of the selected line. This value can be useful when dealing with pipelines, cables and in the construction segment.
Vertical chainage	Chainage of the measured point is projected perpendicular to the vertical component of the selected line.

Field	Description
	 a) Vertical chainage b) Chainage c) Centreline d) Centreline height difference e) Vertical square offset
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.
Current dsgn east	Easting of the design for the current position (relevant point on the slope = Act Easting).

Field	Description
Current dsgn north	Northing of the design for the current position relevant point on the slope = Act Northing).
Current dsgn ht	Height of the design for the current position (relevant point on the slope).
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.

Available fields



a) Left cross slope of road crown	g) Middle stringline of the crown Mid name	o) Right offset
b) Right cross slope of road crown	h) Right most stringline of the crown Right name	p) Right ht diff
c) Centreline	i) L cross slope ht diff	q) L cross slope ratio
d) CL offset	j) R cross slope ht diff	r) Rt cross slope ratio
e) CL ht diff	k) Left offset	s) Left width
f) Left most stringline of the crown Left name	l) Left ht diff	t) Right width
	m) Mid offset	
	n) Mid ht diff	

The following parameters are available. All fields are display only.

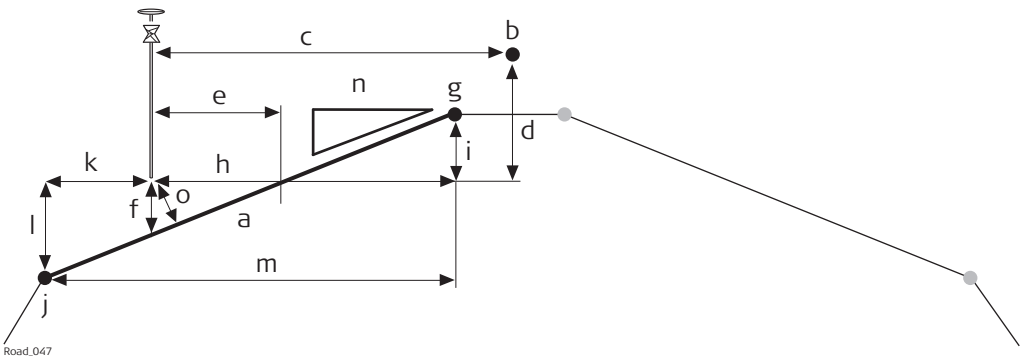
Field	Description
Crown task	Name defined for the road crown task.
Additional line	The name of an additional line.
Additnl line chnge	Current local chainage of additional line.
Additnl line offset	Current perpendicular offset to the additional line including the defined stake/check offset of additional line of the Offsets page.
Additnl line ht diff	Current height difference to the additional line including the defined stake/check height difference of the additional line of Offsets page.
Δ offset	Horizontal offset to the stringline of the crown defined as the reference line. If working in the toggle offset left/right mode, the correct stringline is automatically selected as the reference depending on whether the measured point is to the left or right of the middle stringline. Refer to "37.3.7 Measuring Road Crowns" for more information on the toggle offset left/right mode.
Δ ht left	Vertical offset to the left/right cross slope defining the road crown.
Δ ht right	Vertical offset to the left/right cross slope defining the road crown.

Field	Description
Δ chainage	Difference between the defined Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: ---- .
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
Stake chainage	Chainage to stake out.
L cross slope ht diff	Height difference from the road crowns left cross slope.
R cross slope ht diff	Height difference from the road crowns right cross slope.
Ht diff crown	Height difference from Active cross slope of the crown.
Active cross slope	Indicates if you are on the left or right cross slope of the road crown.
Actv cross slp ratio	Slope ratio of Active cross slope . This value is equal to L cross slope ratio or Rt cross slope ratio depending on the value of Active cross slope .
Left name	Name of the left most stringline defining the road crown.
Left offset	Horizontal offset from the left stringline of the road crown.
Left ht diff	Height difference from the left stringline of the road crown.
Right name	Name of the left most stringline defining the road crown.
Right offset	Horizontal offset from the right stringline of the road crown.

Field	Description
Right ht diff	Height difference from the right stringline of the road crown.
Mid name	Name of the mid stringline defining the road crown.
Mid offset	Horizontal offset from the mid stringline of the road crown.
Mid ht diff	Height difference from the mid stringline of the road crown.
L cross slope ratio	Slope ratio of the road crowns left cross slope.
Rt cross slope ratio	Slope ratio of the road crowns right cross slope.
Left width	Horizontal width of the road crowns left cross slope.
Right width	Horizontal width of the road crowns right cross slope.
CL ht diff	Height difference from the centreline.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Curve type of the centreline.
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL tangent	Tangent direction of the centreline at the current chainage.
Nearest hz tngnt pt	Refer to "37.3.1 The Stake/Check Screen" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.

Field	Description
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.
Current dsgn east	Easting of the design for the current position (relevant point on the crown = Actual easting).
Current dsgn north	Northing of the design for the current position relevant point on the crown = Actual northing).
Current dsgn ht	Height of the design for the current position (relevant point on the crown).
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.

Available fields



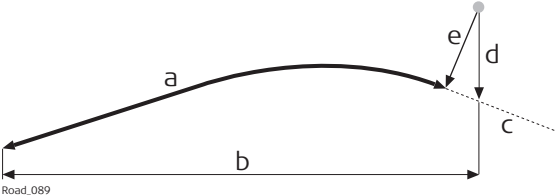
- a) Relevant part of the layer
- b) Centreline
- c) CL offset
- d) CL ht diff
- e) Slope offset
- f) Layer ht diff
- g) Right name
- h) Right offset
- i) Right ht diff
- j) Left name
- k) Left offset
- l) Left ht diff
- m) Width
- n) Slope ratio or Cross slope ratio
- o) Square offset

The following parameters are available. All fields are display only.

Field	Description
Layer task	Name defined for the layer task.
Layer name	Name of the layer to check.
Chainage	Chainage of the current measured position.

Field	Description
Δ chainage	Difference between the defined Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: ---- .
Stake chainage	Chainage to stake out.
Layer offset	Horizontal offset from the layer. Surface between Left line and Right line .
Layer ht diff	Height difference of the measured position to the layer
Δ height	Height difference to the layer, including the stake or check height difference.
Left name	Name of the stringline next to the current position on the left side.
Left offset	Horizontal offset from the left stringline Left name .
Layer ht diff	Height difference to the left stringline Left name .
Right name	Name of the stringline next to the current position on the right side.
Right offset	Horizontal offset from the right stringline Right name .
Right ht diff	Height difference to the right stringline Right name .
Slope ratio	Ratio of the slope between the left stringline Left name and the right stringline Right name .

Field	Description
	 The display format is defined as system setting in Regional Settings, Slope page.
Cross slope ratio	Ratio of the cross slope between the left stringline Left name and the right stringline Right name .  The display format of the Cross slope ratio depends on the type chosen for Cross slope on Regional Settings, Slope page.
Square offset	Offset from the slope, perpendicular to the slope.
CL ht diff	Height difference from the centreline.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Curve type of the centreline.
CL offset	Horizontal offset from the centreline at the current chainage.
CL tangent	Tangent direction of the centreline at the current chainage.
Traveler height	The height of the traveller.
Nearest hz tngnt pt	Refer to "37.3.1 The Stake/Check Screen" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
Vertical sqr offset	Offset perpendicular to the vertical component of the selected line. This value can be useful when dealing with pipelines, cables and in the construction segment.

Field	Description
Vertical chainage	Chainage of the measured point is projected perpendicular to the vertical component of the selected line.  a) Vertical chainage b) Chainage c) Centreline d) Centreline height difference e) Vertical square offset
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.

Field	Description
Current dsgn east	Easting of the design for the current position (relevant point on the crown = Actual easting).
Current dsgn north	Northing of the design for the current position relevant point on the crown = Actual northing).
Current dsgn ht	Height of the design for the current position (relevant point on the crown).
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.

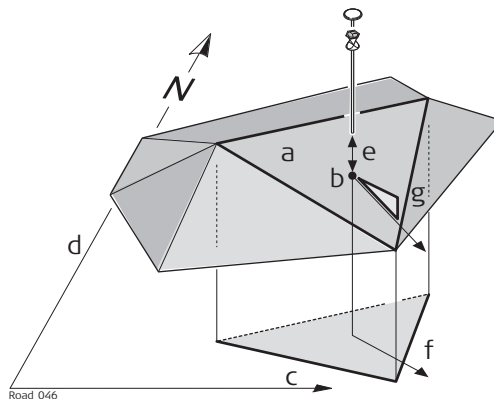
35.3.8

Road DTM - Info Page



Available fields

An **Info** page for Road DTM is only available for **Roads - As built check**.



- 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
DTM task	Name defined for the DTM task.
DTM height diff	Vertical height difference to the DTM.
Δ height	Height difference to the layer including the stake or check height difference.
DTM height	Height of the DTM at the current measured position.

Field	Description
Flow direction	Direction of maximum slope ratio on the current DTM triangle. This direction is the direction water would flow toward from the projected point.
Flow ratio	Slope ratio of the DTM. This ratio is the maximum slope ratio of the triangle.
DTM name	Name of the DTM surface.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Actual height	Height of the current position.
Current dsgn east	Easting of the DTM for the current position (= Actual easting).
Current dsgn north	Northing of the DTM for the current position (= Actual northing).
Current dsgn ht	Height of the DTM for the current position.
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.

Available fields

The following parameters are available. All fields are display only.

Field	Description
Δ offset	Distance from the measured point to the point to set out in a direction perpendicular to the horizontal alignment.
Δ height	Vertical offset between the defined position and the current position.
Δ chainage	Difference between the defined Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: ----- .
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL ht diff	Height difference from the centreline.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the horizontal alignment at the chainage of the measured point.
CL type	Element type of the centreline.
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.

Field	Description
CL tangent	Tangent direction of the centreline at the current chainage.
Nearest hz tngnt pt	Refer to " Stake screen, Stake page" for details on this field.
Nearst vt tngnt pt	Distance to the nearest vertical tangent point of the design.
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the current position.
Actual northing	Northing of the current position.
Current dsgn east	Easting of the design for the current position (relevant point at the selected line).
Current dsgn north	Northing of the design for the current position (relevant point at the selected line).
Current dsgn ht	Height of the design for the current position (relevant point at the selected line).
Quality 3D	Standard deviation of the point measurement.
Ht diff lower rail	Height difference between the measured point and the lower rail.
Ht lower rail	Height of the lower rail at current chainage.
Current design cant	Design cant at the current position.

Field	Description
Ref offset	Horizontal distance between the measured point and the rail or centreline being used as a reference.
Ref ht diff	Height difference between the measured point and the rail or centreline being used as a reference.
Offset (using cant)	Offset calculated regarding the cant.
Ht diff (using cant)	Height difference calculated regarding the cant.
Rail task	Name of the current task.
Rail name	Name of the centreline or rail being used as a reference.
Defined design cant	Design cant at the defined chainage.
Pendular length	The pendulum length as distance value: The difference in elevation of the pendulum centre on the original track and above the axis point.
Def pendulum displacement	The defined horizontal displacement for the track.
Def pendulum angle	The pendulum angle is defined by the pendulum displacement and the superelevation (cant).
Actl pendulum displacement	The current horizontal displacement for the track.
Line space half and Line space full	Empty line.
Current cant	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 Tools menu.

Available fields

The following parameters are available. All fields are display only.

Field	Description
Strgl task	Name of the current task.
Δ offset	Horizontal offset between the defined position and the current position.
Δ height	Vertical offset between the defined position and the current position.
Δ chainage	Difference between the defined chainage Stake chainage on the General page and the current chainage Chainage shown on the Stake page.  If no defined chainage exists, for example if staking out random chainages or checking, this field reads Δ chainage: ----.
Chainage	The current chainage. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
Strgl offset	Horizontal offset from the stringline.
Strgl ht diff	Height difference from the defined stringline.
Strgl name	Name of the stringline to stake out or the stake out is relative to.
CL ht diff	Height difference from the centreline.

Field	Description
Vertical sqr offset	Offset perpendicular to the vertical component of the selected line. This value can be useful when dealing with pipelines, cables and in the construction segment.
CL height	Height of the centreline at the current chainage.
CL radius	Radius of the centreline at the current chainage.
CL type	Element type of the centreline.
CL offset	Perpendicular horizontal offset from the centreline. This field is independent of the chosen settings for Navigation direction and Navigate using in Configuration, Graphics page.
CL tangent	Tangent direction of the centreline at the current chainage.
Nearest hz tgnt pt	Refer to " Stake screen, Stake page" for details on this field.
Nearst vt tgnt pt	Distance to the nearest vertical tangent point of the design.
CL grade	Grade of the centreline at the current position.
Direction to point	Direction from the current position to the point to stake out.
Distance to point	Distance from the current position to the point to stake out.
Defined easting	Easting of the point to stake out.
Defined northing	Northing of the point to stake out.
Defined height	Height of the point to stake out.
Actual easting	Easting of the design for the current position (relevant point at the selected line).

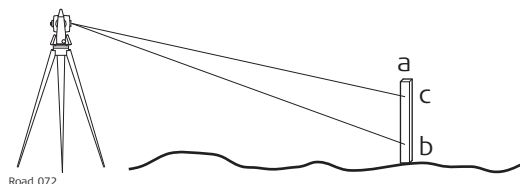
Field	Description
Actual northing	Northing of the design for the current position (relevant point at the selected line).
Actual height	Height of the design for the current position (relevant point at the selected line).
Quality 3D	Standard deviation of the point measurement.
Line space half and Line space full	Empty line.
ΔProf	Distance from the design profile to the measured point.
Profile element no.	Element number of the closest design profile element to the measured point.
Profile element(%)	Distance in percentage terms of the measured point along the design profile element.
Dist along profile	Distance of the measured point along the design profile starting at the origin of the profile.
Top distance	Distance of the measured point along the design profile starting at the top of the profile.

35.3.11

Workflow for Height (aim to stake ht) TPS

Step-by-step

In this example, the height of the cross slope 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

Step	Description
1.	In the Configuration, TPS page, select Turn to: Prompt before turn .
	Make sure that the instrument uses the reflectorless EDM mode.
2.	After staking out the peg at the correct position with Stake Cross Slope , aim the instrument at the peg.
3.	Press Fn Positn to open the Configuration screen.
4.	Configuration 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 Height limit ↑/Height limit ↓ from Configuration, Quality control is reached, the instrument stops.

Step	Description
	Depending on the settings chosen, the instrument turns on the red laser to mark the height.

35.4

35.4.1

Jobs & Design Data

Choosing a Job

Access

Start the Roads subapplication required.

In **Job Selection** open the selectable list for **Road alignment file**, **Rail job** or **Tunnel job**.

Road Jobs/Rail jobs/Tunnel jobs

This screen is similar to the system job selection. Refer to "4.4 Choosing a Job" for a description of the screen.

35.4.2

Working with a DTM Job

Access

Start the Roads or Rail subapplication.

In **Job Selection** check **Use a DTM**.

Open the selectable list for **DTM**.

DTM

DTM (SD card)		↩
Name	Date	
Soccer DTM	31.03.04	

OK

To select the highlighted DTM job and continue.

Layrs..

To view the DTM layers and the number of triangles of the highlighted DTM job.
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.

Delete

To delete the highlighted DTM job.

CF card, SD card, USB or Intrnl

To change between viewing jobs stored on another data storage device or internal memory.

Fn Quit

To exit the application.

Hz: 399.7618g	V: 99.9997g	Fn abc	14:48
OK	Layrs..	Delete	USB

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 stringlines, individual stringlines, manual slope or layer. If the design consists of 2D lines, heights can be considered manually.

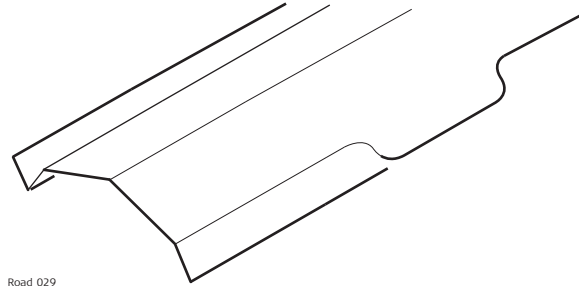
3D lines are required when working with slope, cross slope or crown. 3D lines can also be used when working with stringlines, individual stringlines, manual slope or layer.

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.

Stringlines

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.



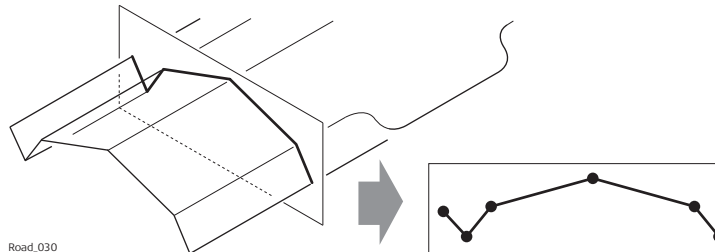
Road_029

Stringline representation of a road design.

In **Roads**, such lines defining the design are called stringlines. Stringlines are the base elements used for stakeout and check activities. Stringlines 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 stringlines are generated automatically in the background.



A cross section can be derived from the stringline model by slicing the group of stringlines with a vertical plane orthogonal to the centreline.



Road_030

Vertical cut of a stringline group defines a cross section.



Stringlines 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** application, or converted from a rail design package using the Design To Field component within the LEICA Geo Office program.

Horizontal alignments can consist of straights, circular curves, clothoides, parabolic curves and blossom curves.

Vertical alignments can consist of straights, circular curves and parabolic curves.

If a design comprises of multiple tracks, one horizontal alignment can be defined as the chainage centreline. From the chainage centreline all chainages will be calculated and additional horizontal and vertical alignments can be used to define each track.

Rail definition

Rails can be defined by:

- entering the design data manually in the field
- by using the **Alignment Editor**
- by converting data from a rail design package using the Design To Field component and if required the Rail Editor (for defining the superelevation) component within the LEICA Geo Office program

Rails are stored as stringlines (continuous 2D or 3D lines) within the rail job.

Tracks

Tracks are used to group related stringlines (centreline and rails) together.

In the case of a single track, the track centreline and the two rails are grouped together in one track.

In the case of multiple tracks where one chainage centreline is used for all tracks, each track consists of four stringlines: the track centreline, the chainage centreline and the left and right rails.

In the case of 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. This data can be converted from a road design package using the Design To Field component within the LEICA Geo Office application.

Profiles

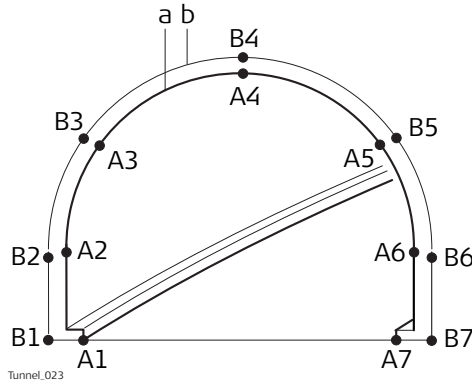
Depending on the complexity of the tunnel job, the design data can vary from a single horizontal and vertical alignment to a design containing many different design profiles with dozens of defined vertices.

Design profiles can be defined and edited using the Design To Field component within the LEICA Geo Office application.

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 together design profiles that will be used at the same chainage.



- a) The vertices **A1-A7** could be grouped together in a layer (**a**) and represent the final lining of the tunnel.
- b) The vertices **B1-B7** could be grouped together 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 set out or check can be defined when creating a task.

35.4.4

Viewing and Editing the Design Data

Access

Start the Roads subapplication required.

In **Job Selection** highlight **Road Jobs**, **Rail job** or **Tunnel job**. Open the selectable list
In **Road Jobs/Rail jobs/Tunnel jobs** 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 stringlines 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 screen.

View & Edit Data		↩
Job name:	road	
Layer:	Test Strings	
No. of stringlines:	9	
Centreline:	Centreline	
Chainage:	100.0000	m
Ch increment:	10.0000	m

Hz: 399.7618g	V: 99.9997g	Fn abc	16:22
OK	Edit..	View	

OK

To return to the job selection.

Edit..

To edit the general job details and the start chainage of the centreline of the selected layer.

For Road additionally to select another centreline and include/exclude stringlines from the selected layer.

View

To view geometry details of the stringlines and to view cross-section plots.

For Road and Rail additionally to view the list of all stringlines in the layer.

Fn Config..

To access the configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Quit

To exit the application.

Description of fields

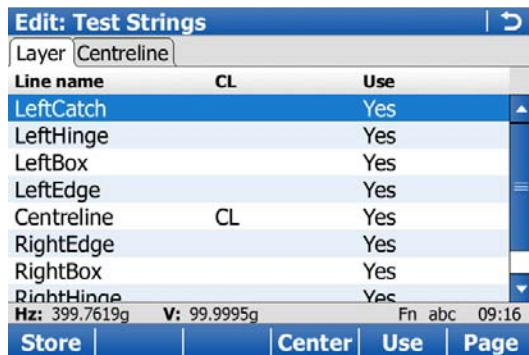
Field	Option	Description
Job name	Display only	The name of the active road/rail/tunnel job, as selected in Job Selection .
Layer	Display only	To select a layer from the active road/rail/tunnel job. All layers within the active road/rail/tunnel job can be selected.
No. of string-lines	Display only	Available for Road and Rail. The number of stringlines from the selected layer.
Number of profiles	Display only	Available for Tunnel. The number of profiles from the selected layer.
Centreline	Display only	The name of the layer centreline.  Every layer must have a centreline.
Chainage	Editable field	To enter chainage to use when viewing the data. The default value is the start chainage of the layer centreline.
Ch increment	Editable field	To enter a chainage increment to use when stepping through the data.

Next step

IF you want to	THEN press
edit data	Edit.. to access the screen Edit.. . Refer to "Edit:, Layer page".
view data	View to access the screen View at . Refer to "View at, Line Info page".

Edit:, Layer page

Only available for Road.



Edit: Test Strings		
Layer Centreline		
Line name	CL	Use
LeftCatch		Yes
LeftHinge		Yes
LeftBox		Yes
LeftEdge		Yes
Centreline	CL	Yes
RightEdge		Yes
RightBox		Yes
RightHinge		Yes

Hz: 399.7619g V: 99.9995g Fn abc 09:16

Store Center Use Page

Store

To store data and return to the previous screen.

Centre

To set the highlighted line as centreline.

Use

To set **Yes** or **No** in the **Use** column for excluding/including the highlighted line of selected layer.

Page

To change to the next page.

Fn Quit

To exit the application.

Description of columns

Column	Description
Line name	Displays the name of all the lines in the layer.
CL	Shows CL for the line selected as centreline.
Use	For Yes : The selected line is used for stake/check. For No : The selected line is not used for stake/check.

Next step

Page changes to the **Centreline** page.

Edit:, Centreline/Chainage stringline page

Edit: Test Strings

Layer: Centreline

Centreline: Centreline

Set start chainage: 100.0000 m

End chainage: 285.7462m

Hz: 399.7614g V: 99.9995g Fn abc 09:20

Store Reset Page

Store

To store changes and return to the previous screen.

Reset

To clear all changes made and to reset to the original start chainage. The original start chainage is always remembered.

Page

To change to the next page.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Centreline/Chainage stringline	Display only	The name of the centreline.
Set start chainage	Editable field	To enter a start chainage for the layer centreline.
End chainage	Display only	The end chainage of the layer centreline. By using the centreline length, the end chainage is automatically calculated.

Next step

Store to store the changes.

View to access the screen **View at**.

View at, Line Info page

If a value is unavailable in the design data, the field is shown as -----.

View at 100.0000

Line Info | Lines | Plot

Line name: Centreline

Easting: -19846.7901m

Northing: 5301045.9737m

Height: -----

Hz tangent: 374.7362g

Hz radius: -----

Hz type: Straight

Hz: 399.7612g V: 99.9996g Fn abc 09:23

OK | Ch- | Ch+ | Segmnt | Vt | Page

OK

To return to the previous screen.

Ch-

To decrease the chainage by the chainage increment, as defined in the **View & Edit Data** screen.

Ch+

To increase the chainage by the chainage increment, as defined in the **View & Edit Data** screen.

Segmnt

To access **Segment Info - Start Point**.

Hz or **Vt**

To change between the vertical alignment data and the horizontal alignment data.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Line name	Selectable list	All stringlines available at the defined chainage are displayed and can be selected.

Field	Option	Description
Easting, Northing and Height	Display only	The East/North coordinate and height of the stringline at defined chainage.
Hz tangent	Display only	The tangent direction of the stringline at defined chainage.
Grade	Display only	The grade of the stringline at defined chainage.
Hz radius	Display only	The horizontal radius of the stringline segment at defined chainage.
Vertical radius	Display only	The vertical radius of the stringline segment at defined chainage.
Hz type	Display only	The horizontal segment type at defined chainage.
Vertical type	Display only	The vertical segment type at defined chainage.
Hz offset	Display only	The horizontal offset to the layer centreline at defined chainage.
Vertical offset	Display only	The vertical offset to the layer centreline at defined chainage.

Next step

Page to change to the **Lines** page.

View at, Lines page

Unavailable for Tunnel.

View at 150.0000			
Line Info	Lines	Plot	
Line name	CL offset	Ht diff	
LeftCatch	-4.2375	-0.5288	
LeftHinge	-3.0000	0.0900	
LeftBox	-2.0050	0.2787	
LeftEdge	-2.0000	-0.0600	
Centreline	-0.0000	0.0000	
RightEdge	2.0000	-0.0600	
RightBox	2.0050	0.0900	
RightHinge	3.0000	0.1866	
Hz: 199.7619g V: 159.9967g Fn abc 15:46			
OK	Ch-	Ch+	Segmnt More Page

OK

To return to the previous screen.

Ch-

To decrease the chainage by the chainage increment, as defined in the **View & Edit Data** screen.

Ch+

To increase the chainage by the chainage increment, as defined in the **View & Edit Data** screen.

Segmnt

To access **Segment Info - Start Point**.

More

To change between the height differences or absolute heights at the selected chainage.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of columns

Column	Description
Line name	The name of the stringlines available at defined chainage in the selected layer.

Column	Description
CL offset	The horizontal offset of the stringline from the layer centreline.
Ht diff	The height difference of the stringline to the layer centreline.
Height	The absolute height of the stringline.

Next step

Page to change to the **Plot** page.

The **Plot** page shows a cross section, profile and planar view of the design data at the selected chainage.

Segmnt 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 -----.

OK

To return to the previous screen.

Seg-

To move to the previous segment.

Seg+

To move to the next segment.

End Pt or Start Pt

To change between the start point and the end point of the segment.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Line name	Display only	The name of the selected stringline.
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.
Hz tangent	Display only	The tangent direction at the start/end point of the segment.
Hz radius	Display only	The radius at the start/end point of the segment.
Hz 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, Hz 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 stringline.
Chainage	Display only	The chainage of start/end point of the segment.
Northing, Northing and Height	Display only	The East/North coordinate and height of the start/end point of the segment.

Field	Option	Description
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 screen.

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.

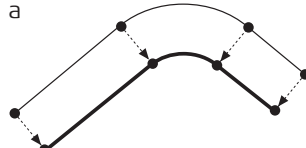
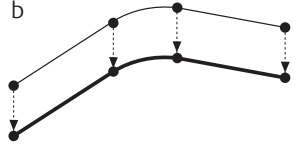
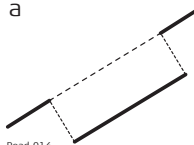
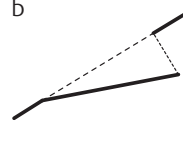
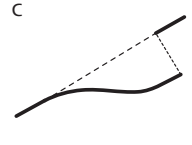
Access

Press **Shifts..** in the Define screen.

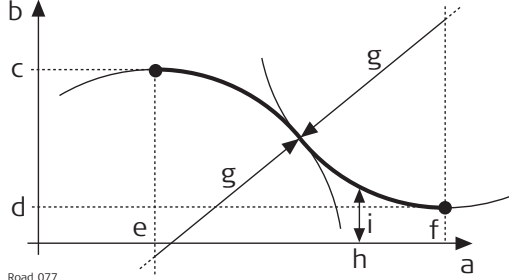
**Shift settings,
Horizontal shift/Vertical
shift/Tunnel shifts/Apply
tunnel shift page**

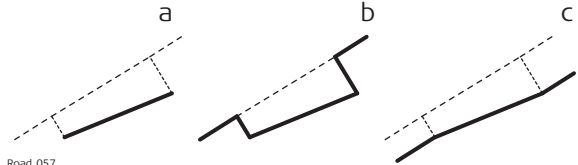
The parameters required for applying the shift are identical for all entities.

Description of fields

Field	Option	Description
Apply horizontal shift/Apply vertical shift	Check box	When this box is checked, shifts can be defined. Horizontal shifts are always rectangular to the centreline of the element being worked with. Whereas vertical shifts are defined along the plumb line. a  Road.013 b  a) Horizontal alignment with constant shift b) Vertical alignment with constant shift
Shift type		a  Road.014 b  c  a) Constant shift b) Linear shift c) Parabolic shift and reverse curve

Field	Option	Description
	Linear	The difference between the shift at the begin chainage and the shift defined at the end chainage is distributed in a linear fashion. The difference between the shift at the begin chainage and the shift defined at the end chainage is distributed in a linear fashion.
	Constant	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.
	Parabolic	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.
	Reverse curve	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.

Field	Option	Description
		 a) Chainage b) Shift c) Start shift at chainage (e) d) End shift at chainage (f) e) Start chainage of the shift f) End chainage of the shift g) Radius of the two arcs used as transition curve h) Random chainage between (e) and (f) i) Shift applied at chainage (h)
Begin chainage	Editable field	Chainage from which the shift is applied.
Begin shift	Editable field	Magnitude of the shift to apply at the begin chainage.
Shift value	Editable field	Available for Shift type: Constant . The magnitude of shift.
End chainage	Editable field	Chainage at which the shift ends.
End shift	Editable field	Magnitude of the shift to apply at the end chainage.

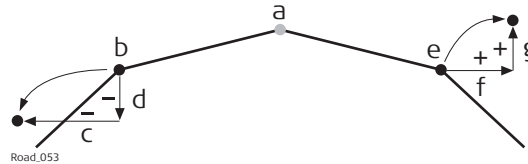
Field	Option	Description
Before / after		Available for Road and Rail. Defines the object outside of the defined shift range.  Road_057 a) None b) Step c) Parallel
	None	The object only exists within the defined shift range.
	Parallel	The begin shift and the end shift are continued parallel. The start 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.
	Step	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" will appear at the start and/or end of the shifted area.

Plot page with shifts

The application offers for all stakeout and check methods a page showing a graphical representation of the measured position in relation to the design. If shifts are applied to the design the plot shows the original unshifted cross section view of the design as well as the shifted element. The current element is shown in blue.

Sign convention for shifts

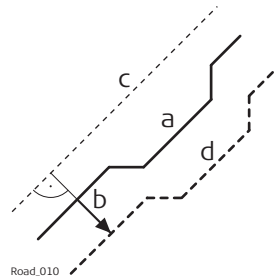
The sign convention for design shifts is identical to the convention used for stake offset and height difference.



- a) Centreline
- b) Stringline on left side
- c) Negative horizontal shift
- d) Negative vertical shift
- e) Stringline on right side
- f) Positive horizontal shift
- g) Positive vertical shift



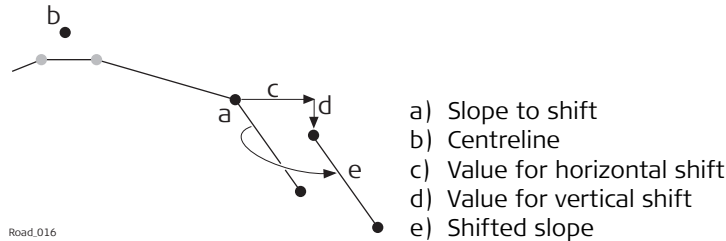
Horizontal stake offsets are always defined perpendicular to the centreline of the layer the stringline/s belongs to.



- a) Stringline the horizontal shift is applied to
- b) User defined horizontal shift for the stringline
- c) Centreline
- d) Shifted stringline

Shifts for stringlines, slopes, layers and DTMs

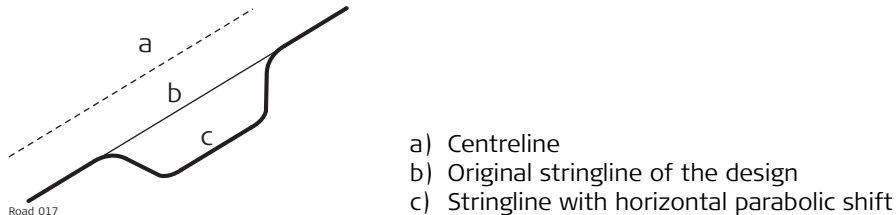
The shifts applied to stringlines, slopes, road crowns layers and DTMs are identical with one exception: Given that DTMs are not defined relative to a centreline and hold no orientation information, no horizontal shift is possible for a DTM.



Shift for cross slopes and road crowns

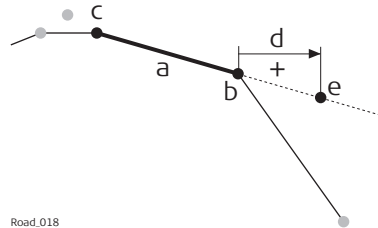
Description

To allow widening and narrowing of cross slopes and road crowns, only one of the two stringlines defining the cross slope 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.



Horizontal shift

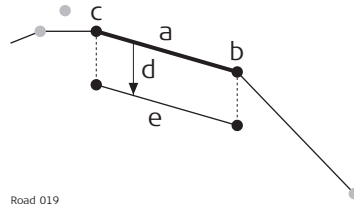
For cross slopes and crowns, the horizontal shift is added to the stringline that is defined as the reference line. To maintain the original cross slope/crown ratio the stringline is shifted along the cross slope/crown.



- a) Cross slope to shift
- b) Reference stringline of the cross slope
- c) Second stringline of the cross slope
- d) Positive horizontal shift
- e) Position of the shifted reference stringline

Vertical shift

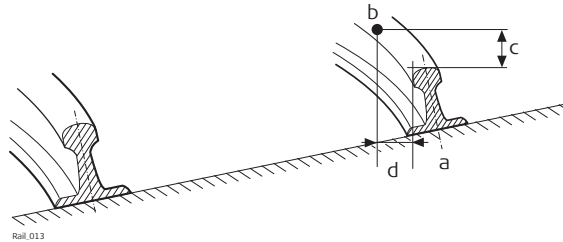
The vertical component of the shift for a cross slope or crown is applied to all stringlines.



- a) Cross slope to shift
- b) Right stringline of the cross slope
- c) Left stringline of the cross slope
- d) Negative vertical shift
- e) Shifted cross slope

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

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

Step	Description
1.	Start the Roads/Rail/Tunnel application.
2.	In the screen Job Selection , select the required jobs and press OK .
3.	Select a method, if required, and press OK .
4.	In the Define screen press Save...
5.	Type in a name for the task and press OK .

Loading a task

Access

Press **Load..** in the Define screen.

Load a Defined Task

Load a Defined Task		↩	
Name	Date		
Stringline2	18.09.09		
Stringline1	18.09.09		

Hz: 399.7616g	V: 99.9999g	Fn abc	12:13
OK		Delete	More

OK

To select the highlighted task and continue.

Delete

To delete the selected task.

More

To display information about **Date**, **Time**, **Creator** and **Description**.

Fn Name or Time

To sort task list by name or time.

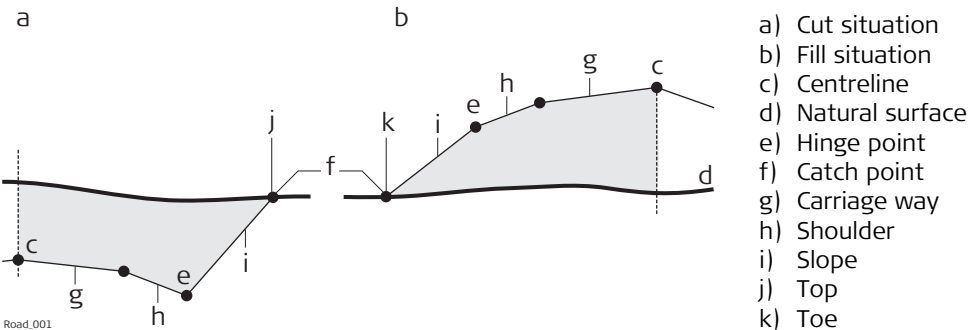
Fn Quit

To exit the application.

35.7
35.7.1

Understanding Terms and Expressions
Road - Basic Terms

Terms and expressions



Term / expression	Description
Carriage way	The part of the road on which users drive once the road is finished.
Shoulder or Verge	Often located next to the carriage way, usually with a slightly higher slope ratio than the carriage way.
Slope	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.
Natural surface or original ground	The undisturbed surface before project construction.

Term / expression	Description
Finished road level	Describes the final road surface.
Catch point or daylight point	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.
Chainage or station	The cumulative distance along the centreline, frequently but not always starting at zero.

Horizontal alignment

The application supports the following elements in the horizontal component of alignments:

- Straights
- Arcs
- Clothoids, 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 elements that cannot be described by one of the previous types are represented by discrete points along the curve. For example, a line parallel to a clothoid.

Vertical alignment

The application supports the following elements in the vertical component of alignments:

- Straights
 - Arcs
 - Quadratic parabolas
 - Multipoints, all elements that cannot be described by one of the previous types are represented by discrete points along the curve.
-

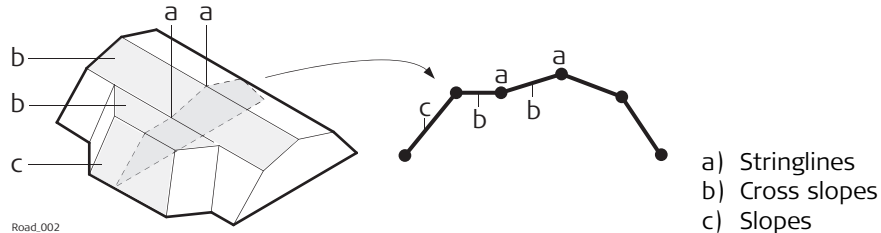
35.7.3

Road - Basic Elements for Stake and Check Measurements

Description

In general, there are four different basic stakeout and check elements:

- Cross slopes, for example, the final carriage way
- Stringlines, for example, a centreline
- Slopes, for example, the end-slopes of a cross section
- Surfaces, for example, a DTM surface

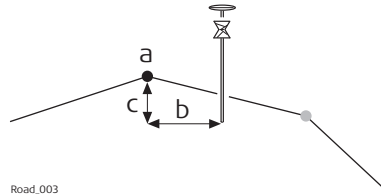


Every stakeout or check is based on one or more of these four base elements. For example, a road crown consists of two cross slopes with one common stringline.

Stringlines

The stake out of a stringline 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 alignment-related design feature

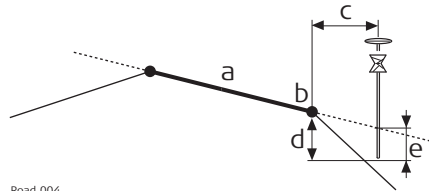


Road_003

- a) Stringline to stake out or check, in this case the centreline
- b) Stringline offset
- c) Stringline height difference

Cross slopes

Cross slopes are defined by two stringlines. The two stringlines define the right and left edge of the cross slope. One of the two stringlines is used as the reference line.

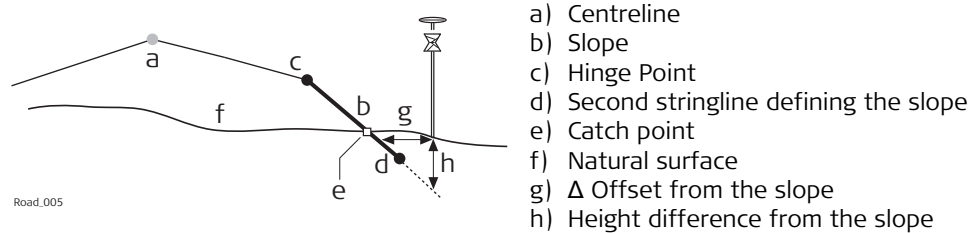


Road_004

- a) Cross slope 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 cross slope

Slopes

Slopes, like cross slopes, are defined by two stringlines. Different to cross slopes, 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.

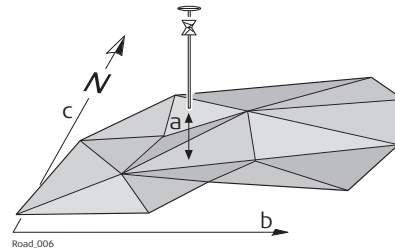


Surfaces

There are two types of surfaces supported that represent a three-dimensional design:

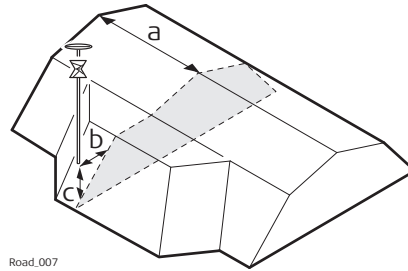
- DTM / TIN (**D**igital **T**errain **M**odel; **T**riangular **I**rrregular **N**etwork)
- Layer

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.



- 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 stringlines 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 "35.4.3 Design Data" for more information.



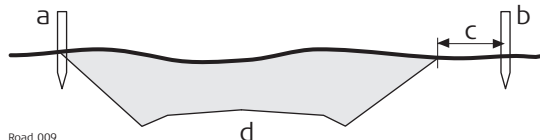
- a) Chainage or station
- b) Layer Offset
- c) Layer height difference

35.7.4

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.



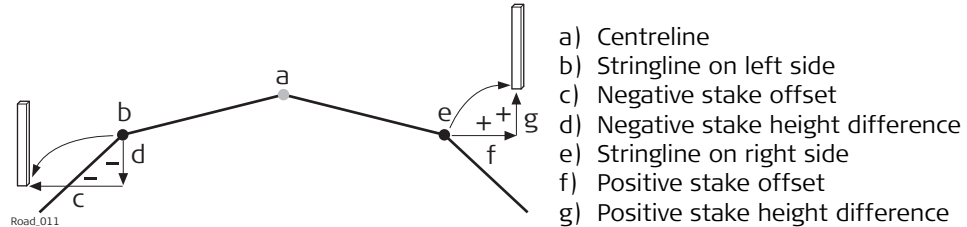
Horizontal stake offsets are, like shifts, defined perpendicular to the centreline of the layer the stringline(s) belongs to, if no offset angle on **Offsets** page has been defined. For cross slopes and road crowns, the stake offset is applied following the same rules as stated for horizontal shifts. Refer to "35.5 Working with Shifts" for more information.

Stake offset

For each stakeout method, a horizontal and/or vertical offset can be defined. The stake offset and stake height difference are defined on the **Offsets** page of the stake screen.

Sign convention for stake offset and height difference

The sign convention for stake offsets and height differences is identical to the convention used for design shifts.



Plot page with stake offset and stake height difference

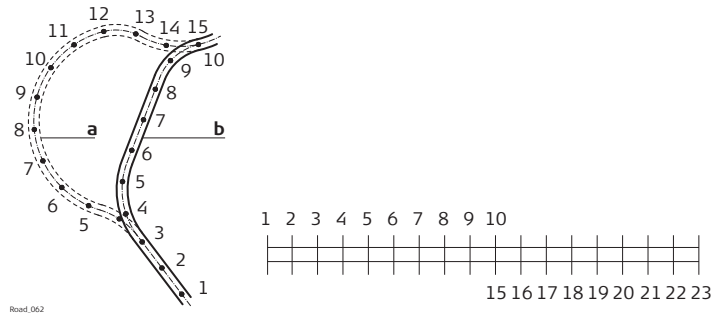
The application offers for all stake out methods a page showing a graphical representation of the measured position in relation to the design. If stake offset and/or stake height difference are used, the plot shows the original cross section view of the design as well as the position to stake out. The position to stake out is marked by a yellow/black peg.

35.7.5

Road - Chainage or Station Equations

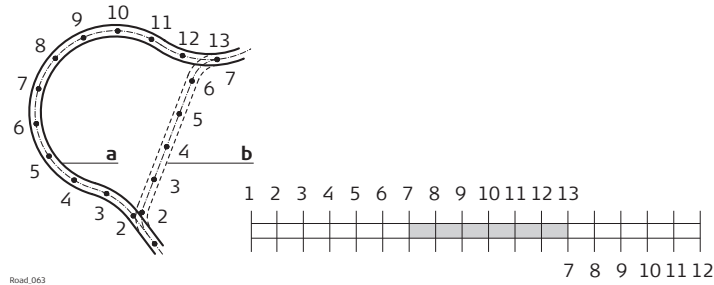
Description

Chainage or station equations are used to adjust the alignment chainage or station. The most common reason for doing so is the insertion or removal of curves during the design process. Inserting or removing a curve would require recalculating the chainage or station of an entire alignment. Using chainage or station equations eliminates this need. Chainage or station equations can create either a gap or an overlap as shown in the following diagrams.



Gap chainage or station equation. Chainage or station back 10 = chainage or station ahead 15.

- a) Old
- b) New



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.



Overlap chainage or station equation. Chainage back 13 = chainage ahead 7 and chainage back 15 = chainage ahead 11.

In this example, when chainage or station 12 is entered in **Road - Multiple Chainage**, the following screen shows how the option to select the right chainage or station is displayed:

Road - Multiple Chainage			↩
Nr.	Ahead	End	
1	70.0000	90.0000	
2	80.0000	95.0000	

OK

To select the highlighted chainage or station equation and return to the stake out screen.

More

To switch the value displayed in the last column to show the end chainage or station of the chainage or station equation.

3DCQ:-:---m	2DCQ:-:---m	1DCQ:-:---m	Fn abc	15:14
OK			More	

Description of columns

Column	Description
End	Shows the end chainage or station for the chainage or station equation. In this example, the field shows 13.000 for Nr. 1 , 15.000 for Nr. 2 and 24.000 for Nr. 3 . End shows to which chainage or station, the current chainage or station equation is valid. As for the first part of the alignment, no chainage or station equation exists, Ahead stays empty for the first row.

35.7.6

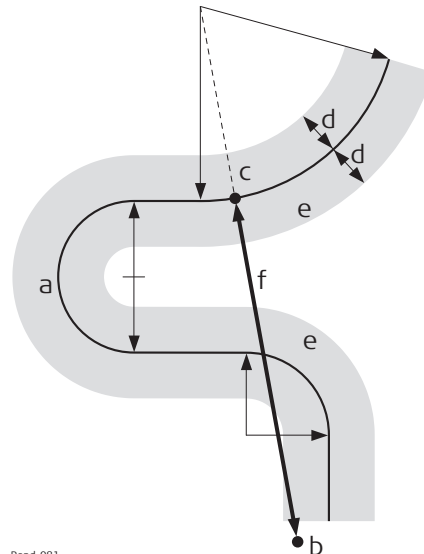
Road - Working Corridor

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 application finds the centreline point (c) with the minimum perpendicular offset (f).

With a defined working corridor (e), the application would display a message advising that the measured position is outside of the defined centreline.



Road_081

- 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 **Configuration, Design** page. Refer to "35.3 Configuring Roads Applications" for more information.

35.7.7

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 application will advise 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 application will prompt 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.

Description

Normally, heights stored with the design data are used. The Rail application offers the possibility to switch to either:

- a height which is entered manually by the user,
This option enables the manual definition of a height, which can be applied for staking out or checking. This height is entered in the General 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 Tools menu.

Understanding priorities of various heights

Type of height	Overrules	Stake Height Diff
Manually entered	All other heights	Considered
Of individual point	All other heights	Considered
From height layer of DTM	Design height	Considered
From design	No other heights	Considered

Terms and expressions

Term / expression	Description
Track	A track comprises two separate rails.
Single track	A single track is defined as one track with one centreline and two rails. All chainages are calculated from the centreline.
Track centreline	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.
Chainage or station	The cumulative distance along the centreline, frequently but not always starting at zero.
Left/right rail	Planimetric position of the left/right rail of a track.
	The sense of the left/right rail is given by the direction of increasing chainage.
	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.
Nominal gauge	The nominal distance between the active (internal) faces of the left and right rails.
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.

Term / expression	Description
Left/right superelevation Left/right cant	The superelevation or height difference of each rail with respect to the track centreline. Usually expressed in millimetres. 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. Superelevation is also known by the term cant. These two words can be interchanged.

Diagram - Plan

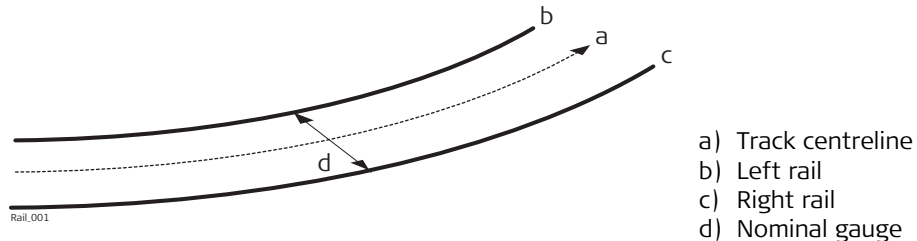
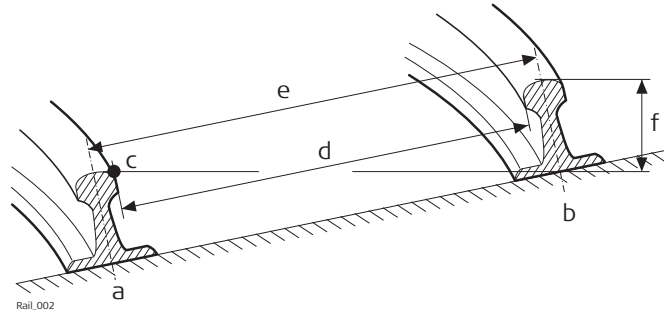


Diagram - Section

Two generic methods can be used to define the section of the track.

Method 1 - A definition using rotation around a known point

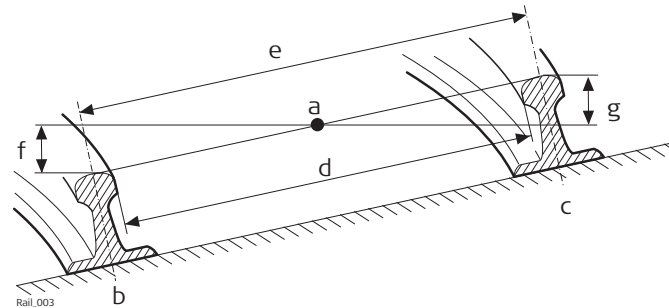
This method involves rotating the section around a known point, normally the lowest rail.



- a) Left rail
- b) Right rail
- c) Rotation point
- d) Nominal gauge
- e) Superelevation base
- f) Superelevation (cant)

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.

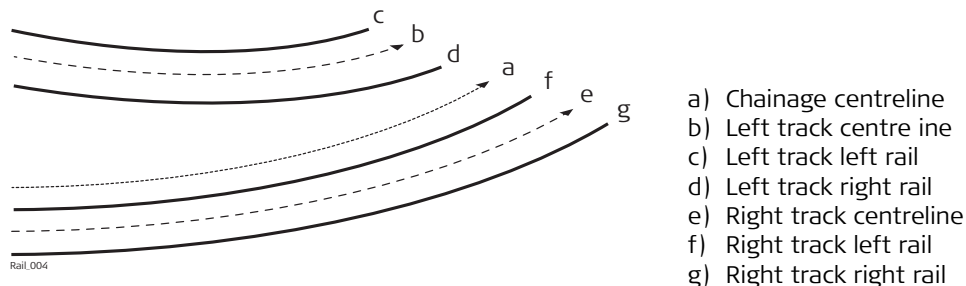
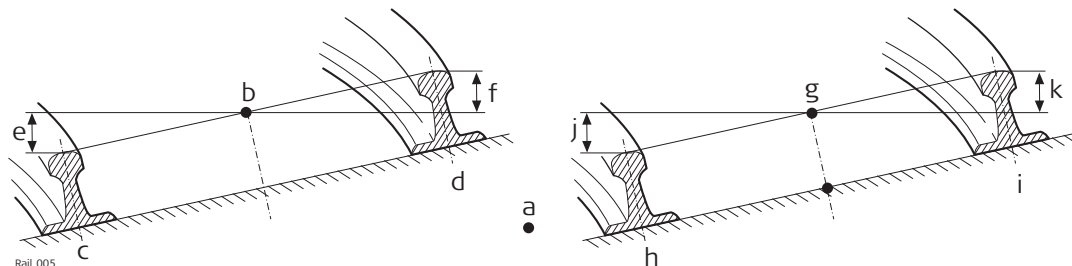


- a) Track centreline
- b) Left rail
- c) Right rail
- d) Nominal gauge
- e) Superelevation base
- f) Left superelevation (left cant)
- g) Right superelevation (right cant)

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 "35.7.9 Rail - Working with a Single Track" for details on single tracks.

Diagram - Plan**Diagram - Section**

a) Chainage centreline	g) Right track centreline
b) Left track centreline	h) Right track left rail
c) Left track left rail	i) Right track right rail
d) Left track right rail	j) Right track left rail superelevation
e) Left track left rail superelevation	k) Right track right rail superelevation
f) Left 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.

35.7.11

Rail - Check Elements and Stakeout Elements

Description

Points can be staked with respect to three basic elements of the track:

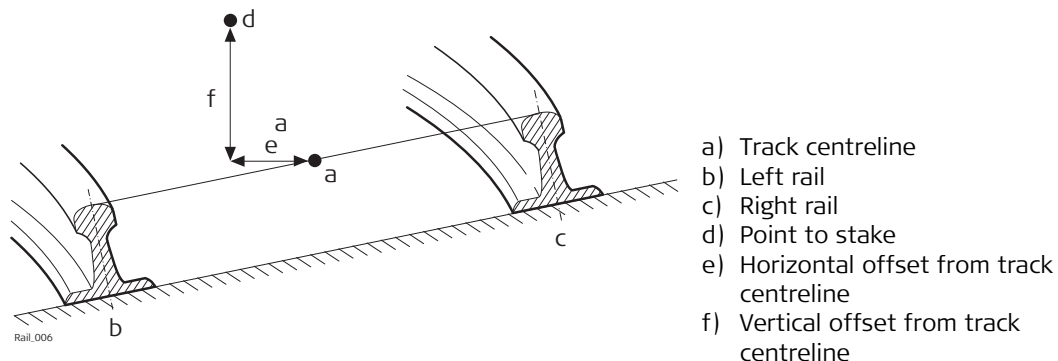
- Track centreline
- Left rail
- Right rail

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 centerline. 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



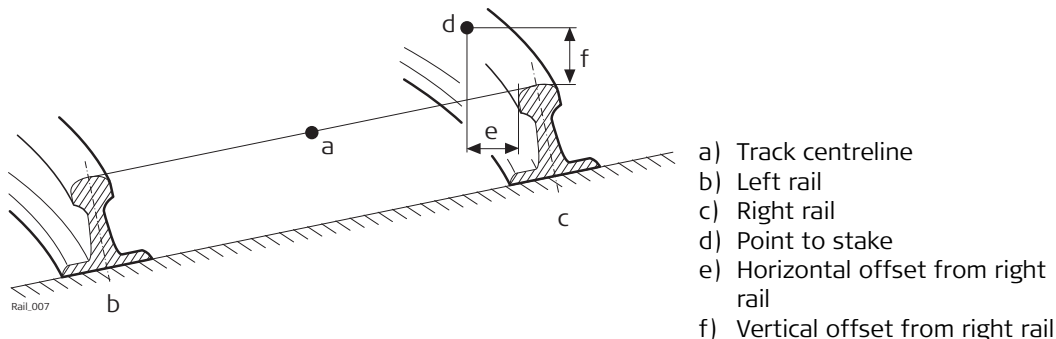
Left/right rail stakeout

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



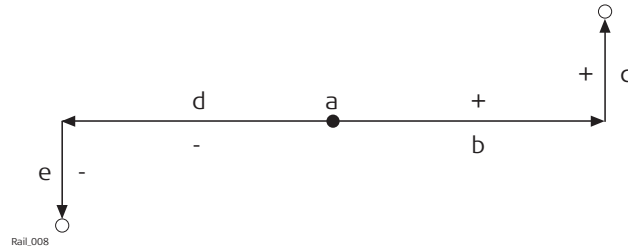
The position from which the horizontal and rail offsets will be applied depends on how the left and right rails were defined in the imported design data. Using standard practice, the horizontal offset would be defined from the active face of the rail, and the height offset would be defined from the highest part of the rail, as shown in the diagram.

35.7.12

Sign convention for offsets

Rail - Working with Offsets

The sign convention for offsets is:

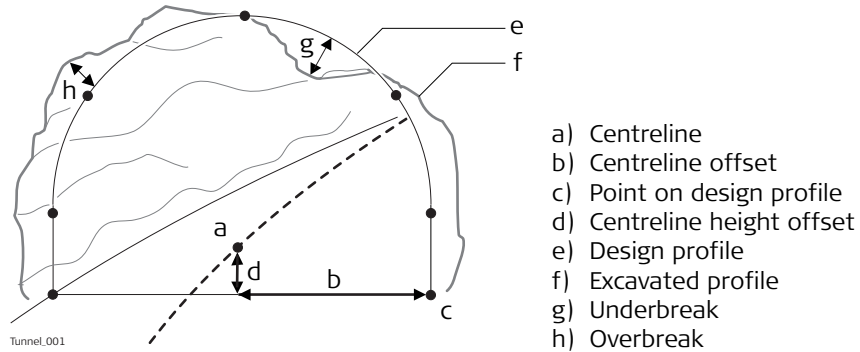


- a) Centreline
- b) Positive horizontal offset
- c) Positive vertical offset
- d) Negative horizontal offset
- e) Negative vertical offset

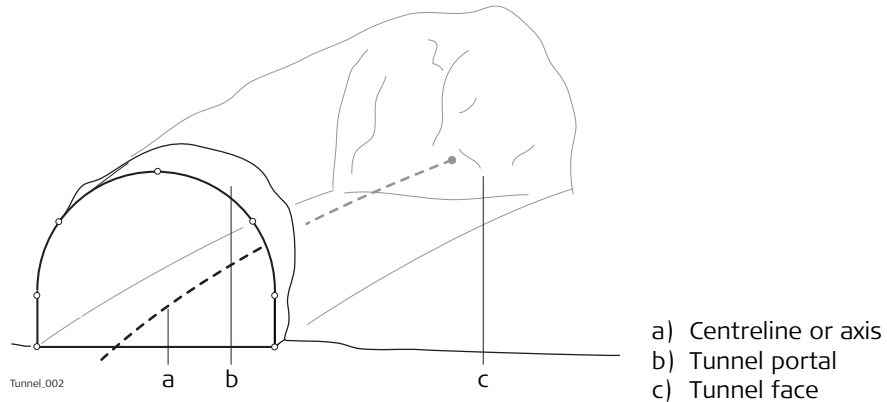
Terms and expressions

Term / expression	Description
Centreline	Geometric alignment in two or three dimensions to which all design elements of the project are referenced.
Chainage or station	The cumulative distance along the centreline, frequently but not always starting at zero.
Design Profile	Geometric description of the designed shape of the cross-section of the tunnel. The design profile can contain straight or curve elements.
Excavated Profile	Shape of the cross-section of the tunnel that has been excavated.
Underbreak	When the excavated profile is inside the design profile, the underbreak is the perpendicular distance between the design profile and the excavated profile.
Overbreak	When the excavated profile is outside of the design profile, the overbreak is the perpendicular distance between the design profile and the excavated profile.
Tunnel Portal	The open end of a tunnel.
Tunnel Face	The point where the excavated tunnel meets existing terrain.
Superelevation (Rotation)	Angle of rotation of a design profile. Used to take into account the velocity of a moving vehicle through a curve.
Rotation Point	The point about which the design profile is rotated. This point may or may not coincide with the centreline.

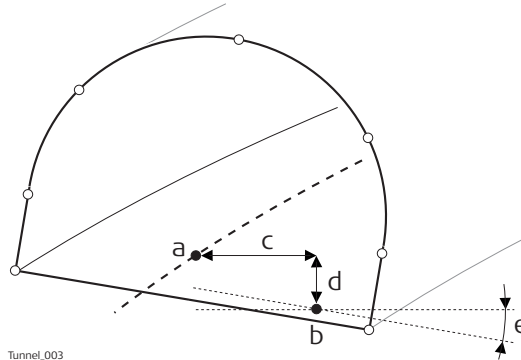
General terms



3D View



Superelevation



- a) Centreline or axis
- b) Rotation point
- c) Centreline offset
- d) Centreline height offset
- e) Superelevation (Rotation)

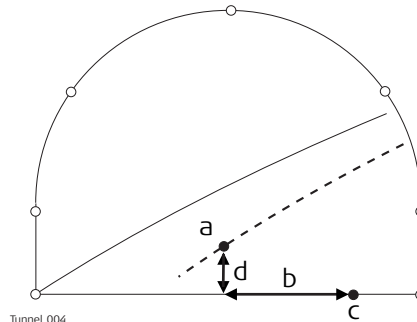
Tunnel face**Staking tunnel faces**

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 road-header.

The points to stake on the tunnel face can be defined in various ways:

Horizontal and vertical offsets

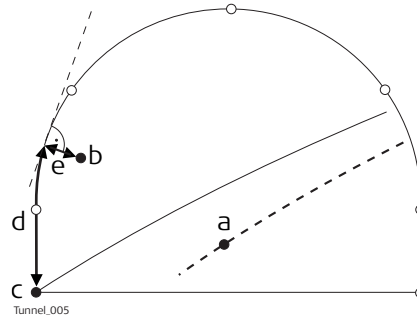
By horizontal and vertical offsets with respect to the centreline:



- a) Centreline
- b) Point on tunnel face to stake
- c) Centreline offset
- d) Centreline height offset

Distance along profile

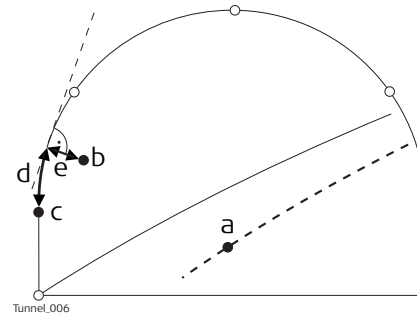
By the distance from the start of the design profile and an offset from the design profile.



- 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

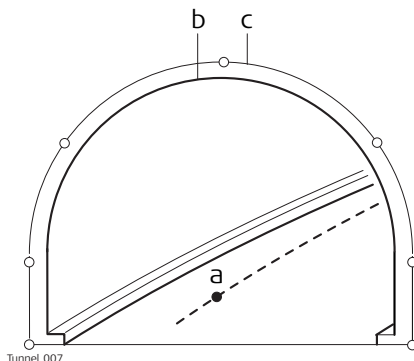
Tunnel profiles

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.



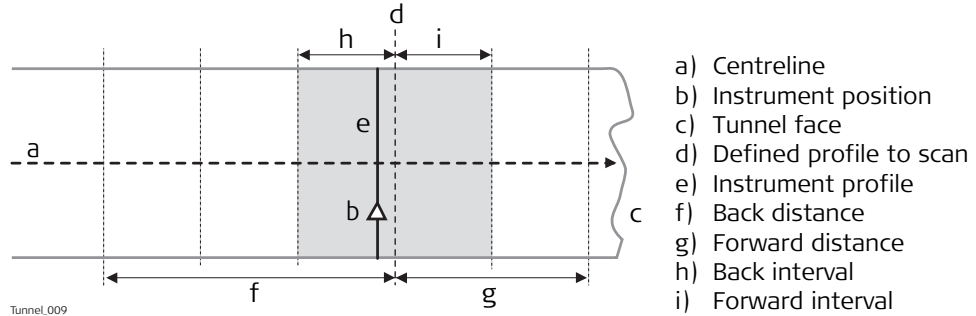
- a) Centreline or axis
- b) Final lining
- c) Shotcrete

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.

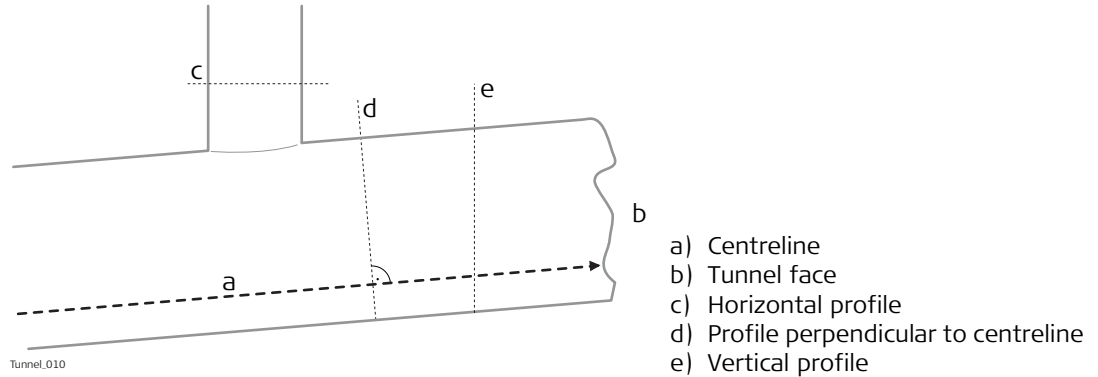
When measuring tunnel profiles, it is possible to scan various profile from one instrument position. The profiles to scan are defined with respect to a defined chainage. Profiles can be scanned at a given forward and back interval within a given forward and back distance from the defined profile.

Measuring tunnel profiles - Plan view



Profile view

Tunnel profiles can be measured vertically, horizontally or perpendicular to the tunnel centreline.



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 100 m of paving. To handle these situations, the application allows the possibility of adding shifts to the existing design data. A shift is applied when selecting the element to stake out/check.

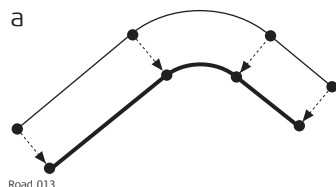


Centreline shifts

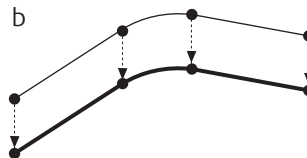
Shifts do not change the stored design. They are applied temporarily for stake out purposes.

Horizontal and vertical shifts

Horizontal shifts are always perpendicular to the centre line whereas vertical shifts are applied along the plumb line.



Road_013

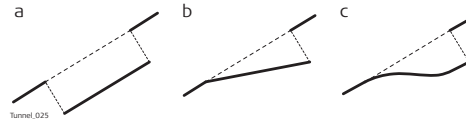


- a) Horizontal alignment with constant shift (plan view)
- b) Vertical alignment with constant shift (profile view)

Constant and linear shifts are supported

For both horizontal and vertical shifts, two different types can be applied:

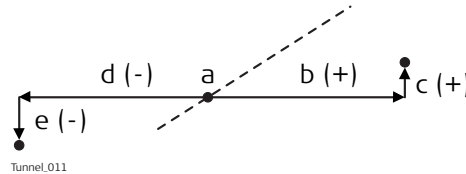
- Constant:** The shift remains the same from its start chainage or station to the end chainage or station.
- Linear:** The shift is linearly interpolated along the chainage or station.



- 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.

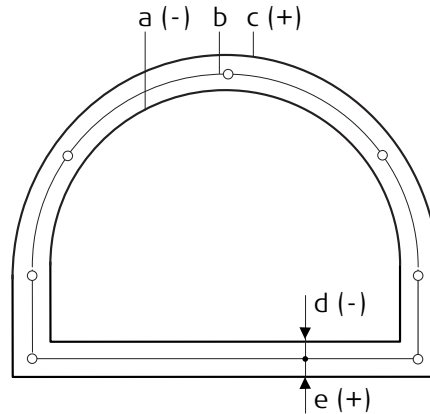


- a) Centreline
- b) Positive horizontal shift
- c) Positive vertical shift
- d) Negative horizontal shift
- e) Negative vertical shift

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

36

36.1

Roads - Alignment Editor

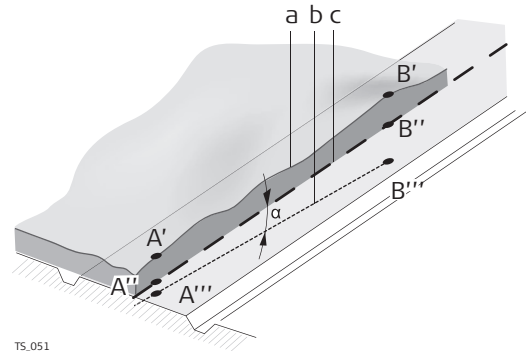
Basic Terms

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



- 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 (α).

Geometric elements

A road design is fitted to a base plan or map using the three basic geometric elements:

- Straight
- Curve
- Spiral



Refer to "Appendix H Glossary" for a definition of the terms.

36.2

36.2.1

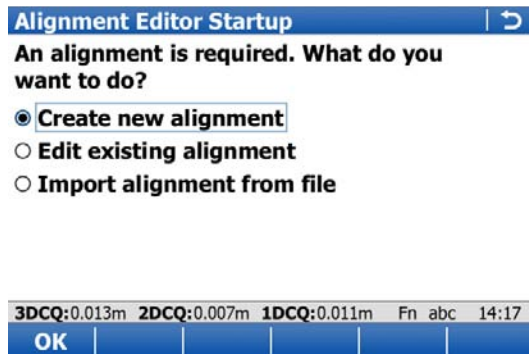
Starting Alignment Editor

Accessing Alignment Editor

Access

Select **Main Menu: Go to Work!\Roads\Alignment Editor**.

Alignment Editor Startup



OK

To select the highlighted option and to continue with the subsequent screen.

Fn Config..

To configure the Alignment editor application. Refer to "36.3 Configuring Alignment Editor".

Fn Quit

To exit the application.

Next step

Select an option and press **OK**.

Access

Select **Create new alignment** in **Alignment Editor Startup** and press **OK**.

New Alignment

New Alignment | ➔

Name:

123

Description:

Creator:

Alignment type:

Road ▾

Device:

CF card ▾

3DCQ:0.015m 2DCQ:0.008m 1DCQ:0.013m Fn abc 14:18

OK

OK

To accept the screen entries and continue.

Fn Config..

To configure the Alignment editor application. Refer to "36.3 Configuring Alignment Editor".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Name	Editable field	The name of the new Alignment editor raw alignment.
Description	Editable field	Optional description of the new raw alignment.
Creator	Editable field	Optional description of the creator of this alignment.
Alignment type	Selectable list	Defines if the alignment is for Roadrunner Road or Rail applications.
Device	Selectable list	The device on which the new Alignment editor raw alignment will be stored. Depending on the inserted memory devices, this field may be a display only field.

Next step

Press **OK** to access the **Alignment Editor Menu**. Refer to "36.2.5 Alignment Editor Menu".

36.2.3

Modifying an Existing Alignment

Access

Select **Edit existing alignment** in **Alignment Editor Startup** and press **OK**.

Select Alignment

Description of fields

Field	Option	Description
Alignment name	Selectable list	All existing Alignment editor raw alignments currently stored in the \Data\XML folder with the file extension *.xml.
Alignment type	Selectable list	Defines if the alignment is for Roadrunner Road or Rail applications.

Next step

Highlight the **Alignment name** field and press **ENTER**.

Alignments

Alignments (CF card)	
Name	Date
123	24.08.09

OK

To select the highlighted raw alignment and continue.

New..

To create a new raw alignment. Refer to "36.2.2 Creating a New Alignment".

Edit..

To edit the name and description of an existing raw alignment.

Delete

To delete an existing raw alignment.

3DCQ:0.017m 2DCQ:0.009m 1DCQ:0.014m Fn abc 14:18					
OK	New..	Edit..	Delete	More	SD card

More

To switch the last column between **Date**, **Time** and **Size**.

CF card, SD card or Intrnl

To change between viewing jobs stored on another data storage device or internal memory.

Fn Backup

To restore a raw alignment file with the extension *.xmb currently stored in the \Data\XML folder.

Fn Quit

To exit the application.

Next step

Press **OK** to select the highlighted raw alignment and return to the **Select Alignment** screen.
Press **OK** to access the **Alignment Editor Menu**. Refer to "36.2.5 Alignment Editor Menu".

Access

- 1) Select **Import alignment from file** in **Alignment Editor Startup** and press **OK**.
- 2) Create a new alignment in the **New Alignment** screen. Refer to "36.2.2 Creating a New Alignment".
- 3) Press **OK**.

Import Line

Import Line

Data source:

Survey job

From job:

Default

Coord system:

<None>

Line:

3DCQ:0.015m 2DCQ:0.009m 1DCQ:0.012m Fn abc 14:19

OK

- OK**
To import the selected alignment data to active raw alignment.
- Fn Config..**
To configure the Alignment editor application. Refer to "36.3 Configuring Alignment Editor".
- Fn Quit**
To exit the application.

Description of fields

Field	Option	Description
Data source	Survey job	The file type of the data source. To import lines or areas from the selected control job.
	Road job	To import lines from an existing Road job.
	Road+ (GSI format)	To import GSI alignment data.

Field	Option	Description
From job	Selectable list	All jobs are available for selection. Available for Survey job and Road job .
Coord system	Display only	The coordinate system currently attached to the selected Survey job or Road job .
Line	Selectable list	Line or area element from the selected job. Available for Survey job .
Alignment	Selectable list	Stringline from the selected Road job. The stringline must be stored in the \dbx folder of the memory device to be selectable. Available for Road job .
Alignment (.aln) file	Selectable list	Horizontal alignment file in GSI format. The GSI alignment file must be stored in the \GSI folder of the memory device to be selectable. Available for Road+ (GSI format) .
Vertical (.prf) file	Selectable list	Vertical alignment file in GSI format. The GSI alignment file must be stored in the \GSI folder of the memory device to be selectable. Available for Road+ (GSI format) .

Next step

OK imports the selected alignment data and accesses the **Alignment Editor Menu**. Refer to "36.2.5 Alignment Editor Menu".

36.2.5

Alignment Editor Menu

Access

This screen is always accessed after successfully creating, editing or importing an alignment file from the **Alignment Editor Startup** screen.

Alignment Editor Menu

Description of options

Option	Description
Edit horizontal alignment	To create, edit and delete elements of a horizontal alignment. Refer to "36.4 Edit Horizontal Alignments".
Edit vertical alignment	To create, edit and delete elements of a vertical alignment. Refer to "36.5 Edit Vertical Alignments".
Edit cross section templates	To create, edit and delete cross section templates. Refer to "36.6 Edit Cross Section Templates". Only available for road jobs.
Edit cross section assignments	To create, edit and delete cross section assignments. Refer to "36.7 Edit Cross Section Assignments". Only available for road jobs.
Edit chainage equation	To create, edit and delete chainage equations. Refer to "36.8 Edit Chainage Equation".
Convert to RoadRunner job	To convert existing LandXML alignments to a RoadRunner job. Refer to "36.9 Convert to RoadRunner Job".

To be able to convert alignments to a Roadrunner job, at least a horizontal alignment must exist.

Access

Select **Main Menu: Go to Work!\Roads\Alignment Editor**. Press **Fn Config...**

Configuration,
Quality control page

OK

To accept the screen entries and continue.

Page

To change to another page on this screen.

Fn About

To display information about the program name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Check horizontal deflection	Check box	Possibility to do a deflection check for the horizontal alignment.

Field	Option	Description
Horiz limit	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 actual error in deflection is greater than this value, the error will be reported.
Check vertical deflection	Check box	Possibility to do a deflection check for the vertical alignment.
Vert limit	Editable field	The deflection tolerance for vertical alignments.
Confirm end coordinates of segment before storing	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.

Configuration,
Advanced page

Description of fields

Field	Option	Description
Vertical parabola definition	Parameter p	Parameter defining the parabola.

Field	Option	Description
	K factor	K factor = Parameter p/100.

36.4

36.4.1

Edit Horizontal Alignments

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**.

Horizontal Alignment

Horizontal Alignment	
Elements	Map
Chainage	Element type
0.000	Start point
0.000	End point

3DCQ:0.020m 2DCQ:0.011m 1DCQ:0.016m Fn abc 14:21					
OK	Add	Edit..	Delete	Check	Page

OK

To accept the screen entries and return to the **Alignment Editor Menu**.

Add

To add a new horizontal element after the highlighted element.

Edit..

To edit the highlighted element of the horizontal alignment.

Delete

To delete the highlighted element of the horizontal alignment. Either all following elements or only the next element can be adjusted.

Check

To check the horizontal alignment.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

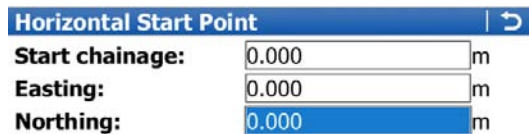
36.4.2

Editing the Start Point

Access

In **Horizontal Alignment**, highlight the start point and press **Edit...**

Horizontal Start Point



OK

To accept the screen entries and continue.

Get Pt

To apply coordinates or heights from an existing point in the working job.

Survey..

To go to **Survey** and measure a point.

Fn Config..

To configure the Alignment editor application. Refer to "36.3 Configuring Alignment Editor".

Fn Reset

To reset all screen entries.

Fn Quit

To exit the application.



Description of fields

Field	Option	Description
Start chainage	Editable field	Start chainage of the horizontal alignment.
Easting	Editable field	Easting of the start point of the horizontal alignment.
Northing	Editable field	Northing of the start point of the horizontal alignment.

Access

In **Horizontal Alignment**, 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
Element type	Straight	To insert/edit a straight to/in a horizontal alignment.
	Curve	To insert/edit a curve to/in a horizontal alignment.
	Clothoid	To insert/edit a clothoid to/in a horizontal alignment.
	Cubic parabola	To insert/edit a cubic parabola to/in a horizontal alignment.
	Bloss	To insert/edit a blossom curve to/in a horizontal alignment. Only available for rail jobs.

The options available for the field **Method** depend on the **Element type** selected.

For **Element type: Straight**

Field	Option	Description
Method	Azimuth & length	Using the azimuth and the length of the straight.

Field	Option	Description
	Azi & end chainage	Using the azimuth and the end chainage of the straight.
	End coords	Using the end coordinates of the straight.

For **Element type: Curve**

Field	Option	Description
Method	Radius & length	Using the radius of the curve and its length.
	Radius & delta	Using the radius and the delta angle of the curve.
	Radius & end chain	Using the radius of the curve and the end chainage.
	Radius & end coords	Using the radius and the end coordinates of the curve.
	Center & end coords	Using the coordinates of the centre point and the end point of the curve.
	3 points	Using three points.

For **Element type: Clothoid**

Field	Option	Description
Method	Radius & length	Using the radius of the clothoid and its length.
	Radius & end chain	Using the radius of the clothoid and the end chainage.

Field	Option	Description
	Param & length	Using the parameter A and the length of the connecting curve.
	Param & end chain	Using the parameter A and the end chainage of the spiral.
	Radius & parameter	Using the parameter A and the radius.

For **Element type: Cubic parabola**

Field	Option	Description
Method	Radius & length	Using the radius of the cubic parabola and its length.
	Radius & end chain	Using the radius of the cubic parabola and the end chainage.

For **Element type: Bloss**

Field	Option	Description
Method	Radius & length	Using the radius of the connecting curve and its length.
	Radius & end chain	Using the radius of the connecting curve and its end chainage.
	Rad,lngth,end coord	Using the radius, length and end coordinates of the blossom curve.

Horizontal Straight/Horizontal Curve/Horizontal Clothoid/Horizontal Cubic Parabola/Horizontal Bloss, Input page

Next step

OK to access the next screen.

Horizontal Straight	
Input	Details
Start chainage:	0.000m
Azimuth:	0°00'00"
Length:	m

3DCQ:0.022m	2DCQ:0.012m	1DCQ:0.018m	Fn abc	14:23
OK	Inv..	Last..		Page

OK

To accept the screen entries and continue.

Inv..

To calculate the distance and angle between two points from the working job.

Last..

To select values from the last inverse calculations.

Get Pt

To apply coordinates or heights from an existing point in the working job. Available when coordinates must be typed in.

Survey..

To go to **Survey** and measure a point. Available when coordinates must be typed in.

Page

To change to another page on this screen.

Fn Config..

To access the Alignment Editor configuration.

Fn Reset

To reset all screen entries.

Fn Quit

To exit the application.

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 Method: Azimuth & length or Method: Azi & end chainage .
End chainage	Editable field	Chainage at the end of the element. Available for Method: Azi & end chainage .
End easting	Editable field	Easting for the end chainage. Available for Method: End coords .
End northing	Editable field	Northing for the end chainage. Available for Method: End coords .
Length	Editable field	Length of the straight element. Available for Method: Azimuth & length .

For **Element type: Curve**

Field	Option	Description
Start azimuth	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 Method: Radius & length, Method: Radius & delta or Method: Radius & end chain .
CP easting	Editable field	Easting of the centre point of the curve. Available for Method: Center & end coords .
CP northing	Editable field	Northing of the centre point of the curve. Available for Method: Center & end coords .
Curve direction	Right or Left	The direction of the curve when looking in the direction of increasing chainage. Available for Method: Radius & length, Method: Radius & delta, Method: Radius & end chain or Method: Radius & end coords .
Radius	Editable field	Radius of the curve. The signs are set by the system depending on the curve direction defined in Curve direction . Available for Method: Radius & length, Method: Radius & delta, Method: Radius & end chain or Method: Radius & end coords .
Delta	Editable field	The deflection angle. Available for Method: Radius & delta .
Length	Editable field	Length from the start to the end point of the curve. Available for Method: Radius & length .

Field	Option	Description
End chainage	Editable field	The end chainage of the curve element can be typed in. Available for Method: Radius & end chain .
Int easting	Editable field	Easting of the intermediate point of the 3-pt-arc. Available for Method: 3 points .
Int northing	Editable field	Northing of the intermediate point of the 3-pt-arc. Available for Method: 3 points .
End easting	Editable field	Easting for the end chainage. Available for Method: Radius & end coords , Method: Center & end coords and Method: 3 points .
End northing	Editable field	Northing for the end chainage. Available for Method: Radius & end coords , Method: Center & end coords and Method: 3 points .

For **Element type: Clothoid**

Field	Option	Description
Start azimuth	Editable field	The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited.
Spiral direction	Right or Left	The direction of the clothoid looking in the direction of increasing chainage.
Spiral in/out	Spiral in Spiral out	For transition from tangent to curve. For transition from curve to tangent.

Field	Option	Description
Radius	Editable field	Radius of the clothoid. Available for Method: Radius & length , Method: Radius & end chain and Method: Radius & parameter .
Parameter A	Editable field	The parameter A defining the clothoids. Available for Method: Param & end chain , Method: Param & length and Method: Radius & parameter .
Length	Editable field	Length of the clothoid element. Available for Method: Param & length and Method: Radius & length .
Start radius	Editable field	The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in Spiral direction . Available for Method: Radius & length and Method: Radius & end chain when Use partial spiral is checked.
End radius	Editable field	The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in Spiral direction . Available for Method: Radius & length and Method: Radius & end chain when Use partial spiral is checked.
End chainage	Editable field	The end chainage of the clothoid can be typed in. Available for Method: Radius & end chain and Method: Param & end chain .
Use partial spiral	Check box	To create partial clothoids. Available for Method: Radius & length and Method: Radius & end chain .

For **Element type: Cubic parabola**

Field	Option	Description
Start azimuth	Editable field	The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited.
Spiral direction	Right or Left	The direction of the cubic parabola looking in the direction of increasing chainage.
Spiral in/out	Spiral in Spiral out	For a transition from tangent to curve. For a transition from curve to tangent.
Radius	Editable field	Radius of the cubic parabola.
Start radius	Editable field	The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in Spiral direction . Available when Use partial spiral is checked.
End radius	Editable field	The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in Spiral direction . Available when Use partial spiral is checked.
Length	Editable field	Length of the cubic parabola element. Available for Method: Radius & length .
End chainage	Editable field	The end chainage of the cubic parabola element can be typed in. Available for Method: Radius & end chain .

Field	Option	Description
Use partial spiral	Check box	To create partial cubic parabolas.

For **Element type: Bloss**

Field	Option	Description
Start azimuth	Editable field	The azimuth of the tangent in the start point. This azimuth is used from the previous element. The value can be edited.
Spiral direction	Right or Left	The direction of the blossom looking in the direction of increasing chainage.
Spiral in/out	Spiral in Spiral out	For a transition from tangent to curve. For a transition from curve to tangent.
Radius	Editable field	Radius of the blossom.
Start radius	Editable field	The entry radius of the spiral. The signs are set by the system depending on the spiral direction defined in Spiral direction . Available for Method: Rad,Length,end coord .
End radius	Editable field	The exit radius of the spiral. The signs are set by the system depending on the spiral direction defined in Spiral direction . Available for Method: Rad,Length,end coord .

Field	Option	Description
Length	Editable field	Length of the blossom curve element. Available for Method: Radius & length and Method: Rad, length, end coord.
End chainage	Editable field	The end chainage of the blossom curve element can be typed in. Available for Method: Radius & end chain.
End easting	Editable field	Easting for the end chainage. Available for Method: Rad, length, end coord.
End northing	Editable field	Northing for the end chainage. Available for Method: Rad, length, end coord.

Next step

Page changes to the **Details** page, where all entered and calculated elements are displayed.

36.5

36.5.1

Edit Vertical Alignments

Overview

Description

Allows creating, editing and deleting of the following elements:

- Start Point
- Straight (Tangent)
- 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**.

Vertical Alignment

The available keys are identical to the keys in **Horizontal Alignment**. Refer to the paragraph "Horizontal Alignment".

36.5.2

Editing the Start Point

Access

In **Vertical Alignment**, highlight the start point and press **Edit...**

Vertical Start Point



OK

To accept the screen entries and continue.

Get Pt

To apply heights from an existing point in the working job.

Surv..

To go to **Survey** and measure a point.

Fn Reset

To reset all screen entries.

Fn Quit

To exit the application.



Description of fields

Field	Option	Description
Start chainage	Editable field	Start chainage of the vertical alignment.
Elevation	Editable field	Elevation at the start chainage of the vertical alignment.

36.5.3

Inserting/Editing an Element in a Vertical Alignment

Access



In **Vertical Alignment**, 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 "23.1 Regional settings" 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 parabola to/in a vertical alignment.
	Curve	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
Method	Length & end elev	Using the length and the end elevation of the straight.
	End chain & elev	Using the end chainage and the elevation of the straight
	Length & grade	Using the length and the grade of the straight.

Field	Option	Description
	End chain & grade	Using the end chainage and the grade of the straight.

For **Element type: Parabola**

Field	Option	Description
Method	Length & grades	Using the length and the grades of the parabola.
	End chain & grades	Using the end chainage and the grades of the parabola.
	Param & end elev	Using the parameter and the end elevation of the parabola.
	3 elevations	Using three elevations at defined chainages of the parabola.

For **Element type: Curve**

Field	Option	Description
Method	Radius & length	Using the radius of the curve and its length.
	Radius & end chain	Using the radius and the end chainage of the curve.
	Radius & grades	Using the radius and the grades of the curve.
	Length & grades	Using the length and the grades of the curve.
	End chain & grades	Using start, intermediate and end elevation and chainage of the curve.

**Vertical Straight/Vertical
Parabola/Vertical Curve,
Input page**

Next step

OK to access the next screen.

Vertical Straight	
Input	Details Plot
Start chainage:	0.000m
Start elevation:	0.000m
Length:	5.000 m
End elevation:	3.000 m

3DCQ:0.011m	2DCQ:0.006m	1DCQ:0.009m	Fn abc	15:08
OK		Get Pt	Survy..	Page

OK

To accept the screen entries and continue.

Inv..

To calculate the distance and angle between two points from the working job.

Last..

To select values from the last inverse calculations.

Get Pt

To apply coordinates or heights from an existing point in the working job. Available when coordinates must be typed in.

Survy..

To go to **Survey** and measure a point. Available when elevation must be typed in.

Page

To change to another page on this screen.

Fn Config..

To access the Alignment Editor configuration.

Fn Reset

To reset all screen entries.

Fn %/V:H/H:V

To switch between **h:v**, **v:h** and **%** for the grade unit.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Start chainage	Display only	The end chainage of the previous element is automatically used and cannot be edited.
Start elevation	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
Length	Editable field	Length of the straight element as slope distance. Available for Method: Length & end elev and Method: Length & grade .
End chainage	Editable field	Chainage at the end of the element. Available for Method: End chain & elev and Method: End chain & grade .

Field	Option	Description
End elevation	Editable field	Height at the end of the element. Type in manually or, alternatively, press Get Pt when the focus is on this line to select the height from an existing point in the working job. Available for Method: Length & end elev and Method: End chain & elev .
Grade	Editable field	The grade of the straight element. Positive inclines have positive values, negative inclines have negative values. Available for Method: Length & grade and Method: End chain & grade .

For **Element type: Parabola**

Field	Option	Description
Curve type	Crest	The curve type is convex. Available for Method: Param & end elev .
	Sag	The curve type is concave. Available for Method: Param & end elev .
Parameter p or K factor	Editable field	Parameter of the parabola. Available for Method: Param & end elev . The field name depends on the value chosen for the Vertical parabola definition in the Configuration, Advanced page.
Length	Editable field	Length of the parabola as horizontal distance. Available for Method: Length & grades and Method: Param & end elev .

Field	Option	Description
Int chainage	Editable field	Chainage of the second elevation. Available for Method: 3 elevations .
Int elevation	Editable field	Second elevation. Type in manually or press Get Pt when the focus is on this line to select the height from an existing point in the working job. Available for Method: 3 elevations .
End chainage	Editable field	Chainage at the end of the element. Available for Method: End chain & grades and Method: 3 elevations .
End elevation	Editable field	Height at the end of the element. Type in manually or, alternatively, press Get Pt when the focus is on this line to select the height from an existing point in the working job. Available for Method: Param & end elev and Method: 3 elevations .
Grade in	Editable field	The grade at the beginning of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for parabolas with Method: Length & grades and Method: End chain & grades .
Grade out	Editable field	The grade at the end of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for Method: Length & grades and Method: End chain & grades .

For **Element type: Curve**

Field	Option	Description
Curve type	Crest	The curve type is convex.
	Sag	The curve type is concave.
Radius	Editable field	Radius of the curve. Available for Method: Radius & length , Method: Radius & end chain and Method: Radius & grades .
Length	Editable field	Length of the curve along the segment. Available for Method: Radius & length and Method: Length & grades .
End chainage	Editable field	Chainage at the end of the element. Available for Method: End chain & grades and Method: Radius & end chain .
End elevation	Editable field	Height at the end of the element. Type in manually or, alternatively, press Get Pt when the focus is on this line to select the height from an existing point in the working job. Available for Method: Radius & length and Method: Radius & end chain .
Grade in	Editable field	The grade at the beginning of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for Method: Radius & grades , Method: Length & grades and Method: End chain & grades .

Field	Option	Description
Grade out	Editable field	The grade at the end of the parabola. Positive inclines have positive values, negative inclines have negative values. Available for Method: Radius & grades , Method: Length & grades and Method: End chain & grades .

Next step

Page changes to the **Details** page, where all entered and calculated elements are displayed.

36.6

36.6.1

Edit Cross Section Templates

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	Templates Plot <table><thead><tr><th>Name</th><th>No. of layers</th></tr></thead><tbody><tr><td>123</td><td>1</td></tr></tbody></table> 3DCQ:0.011m2DCQ:0.006m1DCQ:0.009mFn abc15:09 OKNew..Edit..DeleteDuplctPage OK To accept the screen entries and continue. New.. To create a new cross section template. Edit.. To edit the highlighted cross section template. Delete To delete the highlighted cross section template. Duplct To duplicate the highlighted template. Page To change to another page on this screen. Fn Quit To exit the application.	Name	No. of layers	123	1
Name	No. of layers				
123	1				

36.6.2

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...**



New Template, General page

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: 55 | ↩

General | Layers | Plot

Template name: 55

☒ **Allow absolute heights for cross section definition**

Center height: 0.000 m

3DCQ:0.011m 2DCQ:0.006m 1DCQ:0.009m Fn abc 15:10

OK | | | | Page

OK

To accept the screen entries and continue.

Page

To change to another page on this screen.

Fn Config..

To access the Alignment Editor configuration.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Template name	Editable field	Name of the cross section template to be created/edited.

Field	Option	Description
Allow absolute heights for cross section definition	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.
Center height	Editable field	To be able to create segments using absolute heights, a centre height must be defined. Available if Allow absolute heights for cross section definition is checked.

Next step

Page changes to the **Layers** page where the layers of the template are listed.

36.6.3

Add/Edit a Layer

Access



New Layer,
Segments

In **New Template/Edit Template, Layers** page, 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

General

Segments

Plot

Name	Horiz distance	Slope ratio
CL:	0.000	1:0

3DCQ:0.011m2DCQ:0.006m1DCQ:0.009mFn abc15:10

OK

Add

Edit..

Delete

More

Page

- OK

To accept the screen entries and continue.
- Add

To create and add a new segment.
- Edit..

To edit the highlighted segment.
- Delete

To delete the highlighted segment.
- More

To switch between **CL horizontal offset**, **Slope distance**, **Horiz distance** in the second column and between **CL vertical offset**, **Slope ratio**, **Vertical distance** in the third column.
- Page

To change to another page on this screen.
- Fn Mirror

To mirror the entered segments to the other side of the cross section.

Fn Quit

To exit the application.

Description of columns

Column	Description
Name	List of segments of the selected layer.
CL horizontal offset	Horizontal offset to the centre line of the segment.
CL vertical offset	Vertical offset to the centre line of the segment.
Slope distance	Slope distance to the neighbouring vertex.
Slope ratio	Slope ratio of the segment.
Horiz distance	Horizontal distance to the neighbouring vertex.
Vertical distance	Vertical distance to the neighbouring vertex.

Next step

Add to add a segment.

Add Segment, Input page

Add Segment

Input

Details

Plot

Template name:

55

Layer name:

Method:

Horiz dist & slope

▼

Horiz distance:

m

Slope ratio:

1:0

hv

3DCQ:0.011m

2DCQ:0.006m

1DCQ:0.009m

Fn abc

15:10

OK

%

Page

OK

To accept the screen entries and continue.

Inv..

To calculate the distance and angle between two points from the working job.

Last..

To select values from the last inverse calculations.

%/V:H/H:V

To switch between **h:v**, **v:h** and **%** for the slope ratio.

Page

To change to another page on this screen.

Fn Config..

To access the Alignment Editor configuration.

Fn Reset

To reset all screen entries.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Template name	Display only	Name of the cross section template to be edited.
Layer name	Display only	Name of the cross section template to be edited.
Method		Method to be used for defining the segment.

Field	Option	Description
	Horiz dist & slope	Using a horizontal distance and slope ratio to define the segment.
	Horiz dist & vert dist	Using a horizontal distance and a vertical distance to define the segment.
	CL offsets	Using a horizontal and vertical offset in relation to the centre line.
	Slope dist & ratio	Using a slope distance and slope ratio to define the segment.
	Horiz dist & height	Using a horizontal and absolute height to define the segment. Only available for templates with Allow absolute heights for cross section definition enabled.
	CL offset & height	Using a horizontal offset in relation to the centre line and absolute height. Only available for templates with Allow absolute heights for cross section definition enabled.
Horiz distance	Editable field	Horizontal distance of the segment. Available for Method: Horiz dist & slope and Method: Horiz dist & vert dist .
Vertical distance	Editable field	Vertical distance of the segment. Available for Method: Horiz dist & vert dist .
CL horizontal offset	Editable field	Horizontal centre line offset of the segment. Only available for Method: CL offsets .

Field	Option	Description
CL vertical offset	Editable field	Vertical centre line offset of the segment. Only available for Method: CL offsets .
Slope distance	Editable field	Slope distance of the segment. Only available for Method: Slope dist & ratio .
Slope ratio	Editable field	Slope ratio of the segment. Available for Method: Horiz dist & slope and Method: Slope dist & ratio .

Next step

Page changes to the **Details** page, where all entered and calculated elements are displayed.

36.7

36.7.1

Edit Cross Section Assignments

Overview

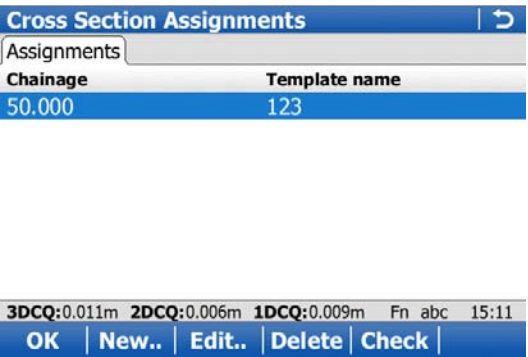
Description

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 assignment**. Press **OK**.

Cross Section Assign-
ments



- OK**
To accept the screen entries and continue.
- New..**
To create a new 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 Quit**
To exit the application.

36.7.2

Creating/Editing a Cross Section Assignment

Access



New Cross Section Assgnmnt

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 Assgnmnt

Chainage:

60.000

m

Template name:

123

3DCQ:0.011m

2DCQ:0.006m

1DCQ:0.009m

Fn abc

15:12

OK

- OK**
To accept the screen entries and continue.
- StartCh**
To take the start chainage of the vertical alignment for **Chainage**.
- End Ch**
To take the end chainage of the vertical alignment for **Chainage**.
- Fn Config..**
To access Alignment Editor configuration.
- Fn Quit**
To exit the application.

Description of fields

Field	Option	Description
Chainage	Editable field	The chainage to which the cross section template is assigned to.

Field	Option	Description
		Type in or edit the value for Chainage. Alternatively press StartCh or End Ch to apply the start or end chainage of the vertical alignment.
Template name	Selectable list	The cross section template to be assigned to. All existing cross section templates currently stored to the alignment can be selected. Select an existing template from the list or create a new one to be assigned to the Chainage.

36.8

36.8.1

Edit Chainage Equation

Overview

Description

Allows creating, editing and deleting of:

- Gaps
- Overlaps

Access

In **Alignment Editor Menu** highlight **Edit chainage equation**. Press **OK**.

Chainage Equation

Chainage Equation		
Chainage Back	Chainage Ahead	
40.000	50.000	

OK

To accept the screen entries and continue.

New..

To create a new chainage equation.

Edit..

To edit a chainage equation.

Delete

To delete a chainage equation.

Fn Quit

To exit the application.

3DCQ:0.011m	2DCQ:0.006m	1DCQ:0.009m	Fn abc	15:12
OK	New..	Edit..	Delete	

36.8.2

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
Chainage back	Editable field	Chainage back. Type in or edit the value.
Chainage ahead	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.

Description	Allows the onboard conversion of existing LandXML alignments including horizontal alignment, vertical alignment, cross sections and chainage equations to a RoadRunner job.
Access	In Alignment Editor Menu highlight Convert to RoadRunner job . Press OK .
Convert to Road Job/ Convert to Rail Job	Description of fields

Field	Option	Description
From alignment	Display only	Displays the modified or newly created alignment to be converted.
To road job	Selectable list	The Road job to which the alignment will be converted. Create a new job. Available if the Alignment type is set to Road in Select Alignment .  If a new job with the same name as an existing job must be created, then the existing job must be deleted first.
To rail job	Selectable list	The Rail job to which the alignment will be converted. Create a new job. Available if the Alignment type is set to Rail in Select Alignment .
		 If a new job with the same name as an existing job must be created, then the existing job must be deleted first.
Conversion mode		Defines the mode to be used for the conversion process.

Field	Option	Description
	Horiz & vert	Only horizontal and vertical alignment will be converted.
	Horizontal only	Only horizontal alignment will be converted.
	H_z,vert,cross section	Horizontal alignment, vertical alignment and cross sections will be 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 \Data\XML folder on the data storage device.

After the successful conversion, press **OK** to return to the **Main Menu** on the instrument.

37

37.1

Roads - Road

Creating a New Road Job

Description

There are two ways of creating road/rail jobs:

Typing them in manually by using the **Alignment Editor** application.

OR

Converting data created in a design package.

Manually entered data

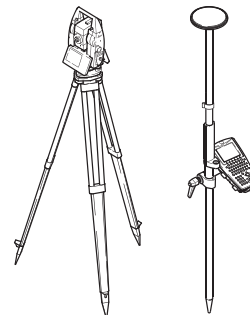
Data can be typed in and edited with **Alignment Editor**. Refer to "36 Roads - Alignment Editor" for information on how to enter data manually.

Converted data

The Design to Field component of LEICA Geo Office 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.



Road_065



LEICA Geo Office can be found on the LEICA Geo Office DVD.

The latest version of the Design to Field importers can be found in the downloads section of:

- myWorld@Leica Geosystems
<https://myworld.leica-geosystems.com>
 - of the Leica Geosystems website:
http://www.leica-geosystems.com/en/page_catalog.htm?cid=3291
-

37.2

37.2.1

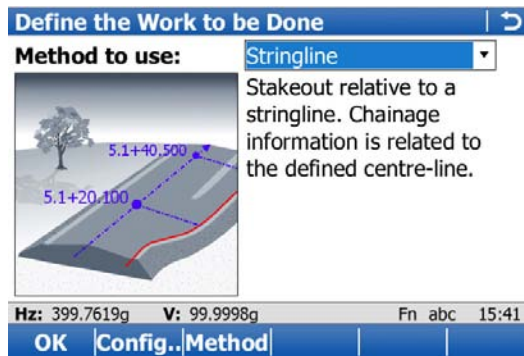
Defining the Work

Defining the Method and the Task

Access

- 1) Select **Main Menu: Go to Work!\Roads\Roads - Stakeout** or **Roads - As built check**.
- 2) In the screen **Job Selection**, select the required jobs. Refer to "35.4.1 Choosing a Job".
- 3) Press **OK**

Define the Work to be Done



OK

To continue to the next screen.

Fn Config..

To access the configuration settings. Refer to "35.3 Configuring Roads Applications".

Method

To define what is shown in the selectable list for **Method to use**.

Fn Quit

To exit the screen.

Description of the methods

Method	Description
Stringline	To stake/check any type of line, for example a centreline or kerb. Chainage information is related to the centreline.
Individual stringline	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.

Method	Description
Cross slope	To stake/check a cross slope defined by the road design. Two stringlines define the cross slope (a lane or running surface).
Manual slope	To stake/check a manually defined slope relative to an existing centreline. The slope is defined by one stringline (hinge point) and the slope direction with ratio.
Slope	To stake/check a slope defined by two stringlines of the 3D road design.
Crown	To stake/check a road crown defined by two cross slopes and one common stringline. The information for both cross slopes is displayed at the same time.
Layer	To stake/check a layer surface defined by the road design relative to the layer centreline.
DTM	To checks a DTM surface. Available for Roads - As built check only.

Next step

OK accesses the **Define Task** screen.

Define Task screen

Define Stringline Task

Layer: Test Strings

Working chainage: 100.0000 m

Line: Centreline

☒ **Toggle offsets left/right**

☒ **Refer to an additional line**

Line: Centreline

Hz: 399.7618g V: 99.9998g Fn abc 16:57

OK | Shifts.. | Load.. | Save..

OK

To continue to the next screen.

Slope

Available for **Method to use: Manual slope** and **Method to use: Slope**. To define the slope parameters. Refer to "37.2.3 Advanced Slope Settings".

Shifts..

To apply horizontal and vertical shifts to the selected element. Refer to "35.5 Working with Shifts".

Load..

To load a task. Refer to "35.6 Tasks".

Save..

To save the settings as a task. Refer to "35.6 Tasks".

Page

Available for **Method to use: Manual slope**. To change to **Hinge offset** page.

Fn Config..

To access the configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Quit

To exit the application.

The fields available depend on the selection for **Method to use** in **Define the Work to be Done**.

Description of fields

Common to all methods

Field	Option	Description
Layer	Display only or selectable list	The selected layer in the working job.

For **Method to use: Stringline**

Field	Option	Description
Working chainage	Editable field	The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage.
Line	Selectable list	To select a stringline. Refer to "37.2.2 Selecting a Line".
Toggle offsets left/right	Check box	When this box is checked, points can be staked/checked on the left/right side of the centreline in one process. Refer to "37.2.4 Toggle Offsets Right/Left".

Field	Option	Description
Refer to an additional line	Check box	When this box is checked, a second stringline can be selected. 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 cross slope where the height information comes from the cross slope, but the chainage information comes from a string which is not the centreline of the current layer. For the additional line, an offset and a height difference can be defined on the Offsets page.
Line	Selectable list	The stringlines available as second stringlines. Refer to "37.2.2 Selecting a Line".

For **Method to use: Individual stringline**

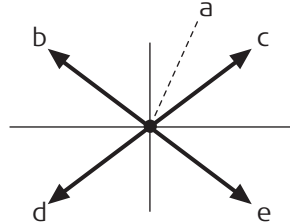
Field	Option	Description
Line	Selectable list	To select a stringline. Refer to "37.2.2 Selecting a Line".
Toggle offsets left/right	Check box	When this box is checked, points can be staked/checked on the left/right side of the centreline in one process. Refer to "37.2.4 Toggle Offsets Right/Left".
Refer to an additional line	Check box	When this box is checked, a second stringline can be selected. 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 cross slope where the height information comes from the cross slope but the chainage information comes from a string which is not the centreline of the current layer.
Line	Selectable list	The stringlines available as second stringlines. Refer to "37.2.2 Selecting a Line".

For **Method to use: Cross slope**

Field	Option	Description
Working chainage	Editable field	The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage.

Field	Option	Description
Left stringline	Selectable list	The name of the left stringline defining the cross slope. Refer to "37.2.2 Selecting a Line".
Right stringline	Display only	The name of the right stringline defining the cross slope.
Reference line	Left stringline or Right stringline	To select one of the stringlines to be used as the reference line.
Toggle offsets left/right	Check box	When this box is checked, points can be staked/checked on the left/right side of the centreline in one process. Refer to "37.2.4 Toggle Offsets Right/Left".
Refer to an additional line	Check box	When this box is checked, a second stringline can be selected. 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 cross slope where the height information comes from the cross slope but the chainage information comes from a string which is not the centreline of the current layer.
Line	Selectable list	The stringlines available as second stringlines. Refer to "37.2.2 Selecting a Line".

For **Method to use: Manual slope**

Field	Option	Description
On the Slope page:		
Working chainage	Editable field	The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage.
Hinge line	Selectable list	To select the hinge point of the slope. Refer to "37.2.2 Selecting a Line".
Slope type	Cut right, Cut left, Fill right or Fill left	Differentiates if the defined slope is a cut/fill and left/right.  Road_079 a) Hinge Point b) Cut left c) Cut right d) Fill left e) Fill right
Slope ratio	Editable field	Defines the ratio of the slope.  The slope ratio format is defined as system setting in Regional Settings, Slope page.

Field	Option	Description
On the Hinge offset page:		
Apply hinge offsets	Check box	When this box is check, a horizontal and vertical offset of the hinge point can be defined.
Offset type	Absolute Relative to line or Relative to DTM	The vertical offset type for the hinge point. The only option available for 2D lines. Available for 3D lines.
Offset	Editable field	The horizontal offset of the hinge point from the centreline/reference line.
Elevation	Editable field	The elevation of the hinge point (absolute height). Available for Offset type: Absolute .
Height difference	Editable field	For Offset type: Relative to line : A vertical offset for the hinge point using a height difference can be defined. For Offset type: Relative to DTM : A height difference to the DTM height can be applied.

For **Method to use: Slope**

Field	Option	Description
Working chainage	Editable field	The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage.
Left stringline	Selectable list	The name of the left stringline defining the slope.

Field	Option	Description
Right stringline	Display only	The name of the right stringline defining the slope.
Reference line	Left stringline or Right stringline	To select one of the stringlines to be used as the reference line (= hinge line).

For **Method to use: Crown**

Field	Option	Description
Working chainage	Editable field	The chainage for the stake/check survey. The chainage can range between the start chainage and the end chainage.
Crown line	Selectable list	Stringline defining the middle line of the crown. Refer to "37.2.2 Selecting a Line".
Left stringline	Display only	The name of the stringline defining left line of the crown.
Right stringline	Display only	The name of the stringline defining right line of the crown.
Reference line	Left stringline or Right stringline	To select one of the stringlines to be used as the reference line.
Toggle offsets left/right	Check box	When this box is checked, points can be staked/checked on the left/right side of the centreline in one process. Refer to "37.2.4 Toggle Offsets Right/Left".

Field	Option	Description
Refer to an additional line	Check box	When this box is checked, a second stringline can be selected. 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 cross slope where the height information comes from the cross slope but the chainage information comes from a string which is not the centreline of the current layer.
Line	Selectable list	The stringlines available as second stringlines.

For **Method to use: Layer**

Field	Option	Description
Layer	Selectable list	A list of all available layers of the selected Road job .
Centreline	Display only	Active centreline of the selected layer.
Extend end slopes	Check box	When this box is checked, the left most and right most end slopes of the design are extended.

For **Method to use: DTM**, available for **Roads - As built check**

Field	Option	Description
DTM layer	Display only	A list of all DTM surfaces available in the selected DTM job.

Field	Option	Description
Number of triangles	Display only	Number of triangles the selected DTM consists of.

Next step

OK to access the **Stake** or **Check** screen.

Access



In the Define screen, open a selectable list for a line, for example for **Line** or **Left stringline**.

The selection of stringlines 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

If no working chainage has been entered, the list shows all stringlines of the current layer.
If a working chainage is available, all stringlines existing at that chainage are listed only.

Select Stringline		
Lines	Plot	
Line name	CL offset	Height
LeftCatch	----	----
LeftHinge	----	----
LeftBox	----	----
LeftEdge	----	----
Centreline	----	----
CentrelineLines	----	----
RightEdge	----	----
RightBox	----	----
Hz: 399.7619g V: 99.9996g Fn abc 16:21		
OK		More Page

- OK**
To return to the previous screen.
- More**
To display information about the absolute height or the height difference. Unavailable for individual stringlines.
- Page**
To change to another page on this screen.
- Fn Quit**
To exit the application.

Description of columns

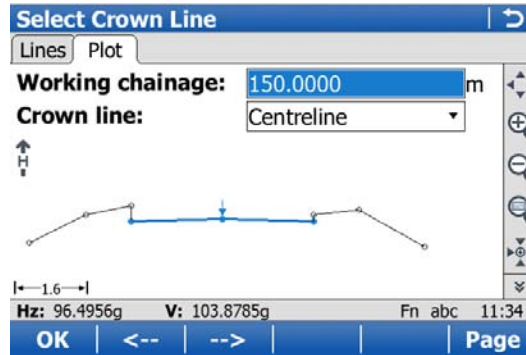
Column	Description
Line name	The name of the line.
CL offset	The offset from the centreline. The format is defined as system setting in Regional Settings .
Height	The absolute height of the line.
Ht diff	The height difference to the centreline.



In addition to the list selection the required lines and slopes can also be selected on **Plot** page.

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.
- planar view which is always available. The defined working chainage is displayed as a grey line. The size corresponds to the working corridor settings.



<--
To select the previous line.

-->
To select the next line.

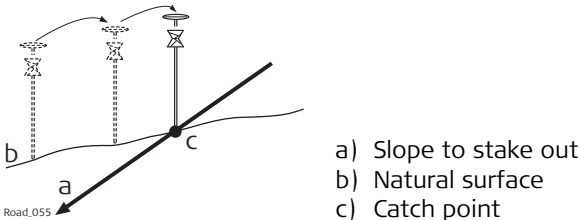
Access

Press **Slope** in the Define screen.

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 Δ **offset** indicates how far the catch point is away. If the natural surface is not horizontal, more iterations could be needed.

Slope Stakeout Settings

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.

Field	Option	Description
Type	Reference Point	Stakeout of a reference peg with a defined offset from the catch point. Refer to "Slope staking using Reference Point".
	Batter rail	Stakeout of batter rails with defined peg heights. Refer to "Slope staking using Batter rail".
	Reference batter	Stakeout of batter rails with a defined offset from the catch point. Refer to "Slope staking using Reference batter".
	Ref point surface	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 "Slope staking using Ref point surface".

For **Use advanced slope stakeout: Reference Point**

Field	Option	Description
Ref offset	Editable field	The defined offset of the reference point from the catch point.

For **Use advanced slope stakeout: Batter rail**

Field	Option	Description
Batter type	Cut or Fill	Defines the cut or fill rail.
Rail over batter	Editable field	The vertical height of the rail top above the batter.

Field	Option	Description
Rail over ground	Editable field	The vertical height of the rail over the ground.

For **Use advanced slope stakeout: Reference batter**

Field	Option	Description
Ref offset	Editable field	The defined offset of the inner peg from the catch point.
Traveler height	Editable field	The vertical height of the rail above the batter.

For **Use advanced slope stakeout: Ref point surface**

The only available fields are **Use advanced slope stakeout** and **Type**.

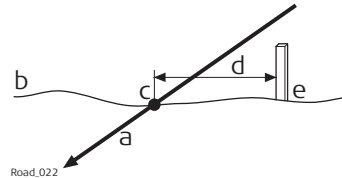
Next step

OK returns to the Define screen.

Slope staking using Reference Point

Description

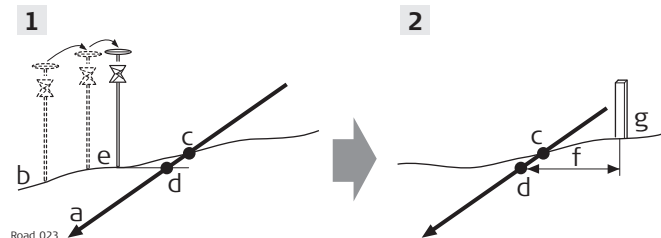
When staking out slopes using the reference point method, the catch point of the slope is marked with a reference peg using a defined offset. The grade of the slope is marked and controlled by "grade checkers".



- 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 offset
- g) Reference peg

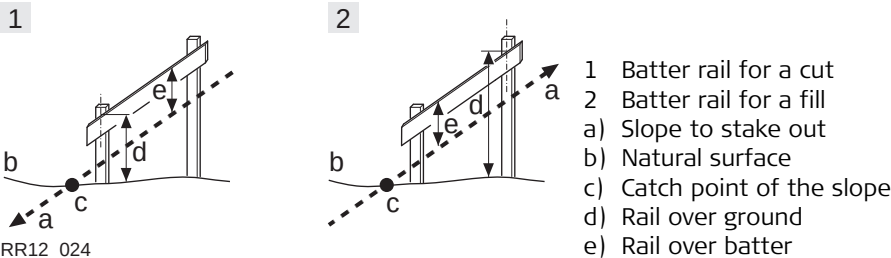
Step	Description
1.	The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, this process has to be done iteratively. As soon as the measured position (e) is close enough to the real catch point (c), it can be used as the approximate catch point. Based 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 Tools menu. Values in Stake Slope Reference Point, Stake page will guide 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 via the reference peg. Values to be marked on the reference peg can be found on Stake Slope Reference Point, 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

Description

When staking out slopes with the **Batter rail** 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.



The defined rail over ground should guarantee that the rails are positioned as high as possible, to make them easier to use.

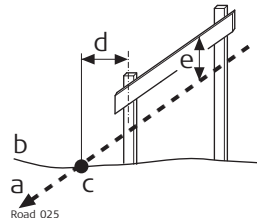
Step	Description
1.	The first peg to stake out is always the peg closest to the hinge point. Stake out the position of the first peg of the batter by using Δ offset on the Stake page of the Stake/Check screen. The height of the rail over ground Rail over ground is taken into account for Δ offset . This action means that when Δ 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 Δ 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 Δ chainage and place the peg.

Step	Description
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. Δ height should now read zero.  All values shown under the Info page are relative to the original slope.

Slope staking using Reference batter

Description

This method is used if batter rails with a constant distance from the inner peg to the catch point are required.



- a) Slope to stake out
- b) Natural surface
- c) Catch point of the slope
- d) Defined reference point offset
- e) Height of the "traveller"

Workflow

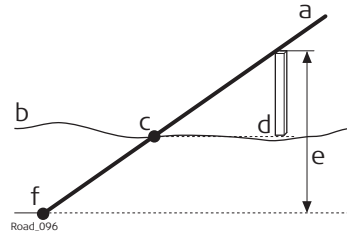
Step	Description
	The first step is to stake out the catch point of the slope. The reference point offset and traveller height are not taken in account in this step. Based on this approximate catch point the projected catch point on the slope is calculated. The projected catch point is used as a starting point for the stakeout of the reference peg.

Step	Description
1.	Stake out the position of the catch point by using Δ offset and/or Δ height on the Stake page of the Stake/Check screen. When Δ offset and Δ height are equal to zero, the catch point has been located.
2.	Fn Tools.. to access the Tools screen. 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 screen for the reference peg.
4.	Stake out the reference point using Δ offset . When Δ 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 Δ 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. Δ height should now read zero. All values shown under the Info page are relative to the original slope.
7.	 to return to Stake Slope . Stake out the next catch point from this screen.

Slope staking using Ref point surface

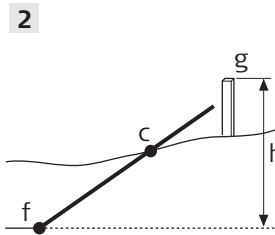
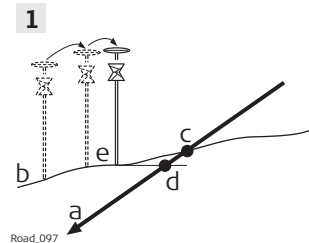
Description

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

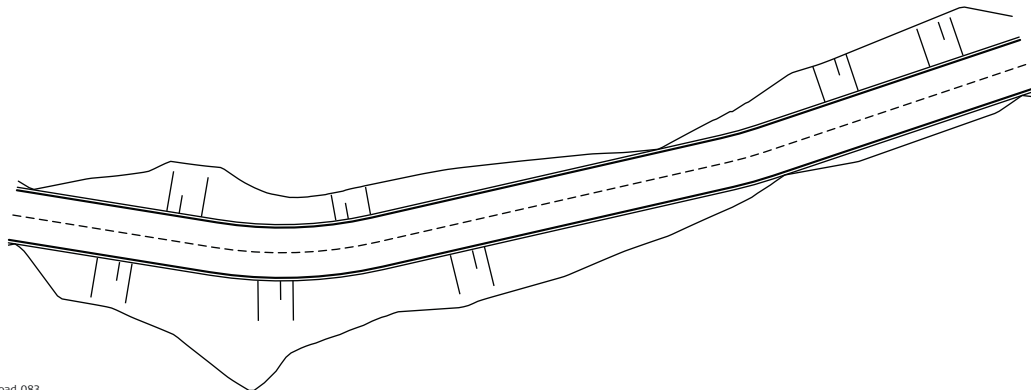
Step	Description
	The first step when staking out is to find the catch point of the slope. As the natural surface is unknown, this process has to be done iteratively. As soon as the measured position (e) is close enough to the real catch point (c), it can be used as the approximate catch point. Based 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 Δ offset and/or Δ height on the Stake page of the Stake/Check screen. When Δ offset and Δ height are equal to zero, the catch point has been located.
2.	Define the hinge height difference. Fn Tools.. to access the Tools screen.
3.	Select Place surface reference peg to access the define screen 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 difference field displays the Hinge ht diff value from the Stake page of the Stake/Check screen. 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 Point Surface, Stake page 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 Point Surface, Info page.
5.	 to return to Stake Slope . Stake out the next catch point from this screen.

Extending design slopes

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.

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 a cut is required where the design still shows a fill, or one of the lines defining the slope ends before intersecting with the natural surface.

The application can handle these different situations with various slope extras. A message appears prompting if the slope should be extended, as soon as a measurement is taken outside of the defined design slope. The extension of a line is always based on the end-tangent of the stringline. When moving back into the defined design a notification appears.



Road_083

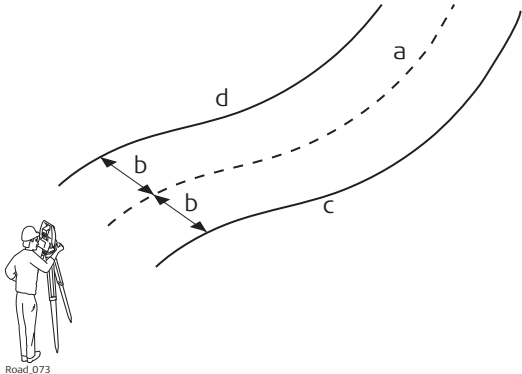
Slopes left and right of design changing from cut to fill.

37.2.4

Toggle Offsets Right/Left

Description

If staking out a street that is defined as a centreline with offsets of 2.5 m left and right, this functionality allows to toggle between the two lines to stake out.



- a) Centreline
- b) Defined **Stake offset**
- c) Parallel right stringline
- d) Parallel left stringline

This functionality is available for the following stake out/check methods:

Type	Description
Stringline	Toggle between parallel stringline left and right.
Cross slope	Toggle between left and right stringline of the cross slope.
Crown	Toggle between left and right cross slope

The application automatically detects which side of the centreline is being used and selects the appropriate stringline as a reference.

Auto position

When pressing auto position **Fn Positn** a message box comes up prompting if either the left or right side should be staked out/checked.

37.3

37.3.1

Stake/Check screen, General page

Staking/Checking the Road

The Stake/Check Screen

The **Stake Stringline** is shown as example.

The screenshot shows the 'Stake Stringline' screen with the 'General' tab selected. The fields are as follows:

Field	Value	Unit
Point ID:	TPS0002	
Target height:	1.5800	m
Stake chainage:	-----	m
Chainage increment:	0.0000	m

Below the fields is a checkbox labeled 'Use manual height instead of design heights' which is currently unchecked. At the bottom, there is a status bar showing 'Hz: 399.7619g V: 99.9998g Fn abc 11:34' and a navigation bar with buttons: Meas, Dist, Store, Ch-, Ch+, and Page.

Meas

GPS To start measuring the point being staked. The key changes to **Stop**.

TPS To measure a distance and store distance and angles.

Stop **GPS**

To end measuring the point being staked. When **Automatically stop point measurement** is checked in **Quality Control, General** page recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. After ending the measurements, the differences between the measured point and the point to be staked are displayed.

Store

GPS To store the measured point. When **Automatically store point** is checked in **Quality Control, General** page, the measured point is stored automatically. The key changes to **Meas**.

TPS To store angles and distance. Distance must be measured before.

Dist **TPS**

To measure a distance.

Ch-

Available for **Roads - Stakeout**. To decrease the chainage as defined by **Chainge increment**.

Ch+

Available for **Roads - Stakeout**. To increase the chainage as defined by **Chainge increment**.

Page

To change to another page on this screen.

Fn Config..

To access configuration settings.
Refer to "35.3 Configuring Roads Applications".

Fn Positn **TPS**

To position the total station to the defined stakeout point, including defined offsets.
This depends on the settings for **Turn to point** in **Configuration, TPS** page. Refer to "Configuration, TPS page".

Fn Tools..

To access the method-specific Tools Menu.
Refer to "37.4 The Tools Menu".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
 The following fields are always shown in all Stake and Check methods.		
Point ID	Editable field	Name of the next point to be stored. The ID is incremented/decremented whenever a point gets stored.
Antenna height 	Editable field	Height of the antenna.
Target height 	Editable field	Height of the prism.
 The following fields are always shown in all Stake methods, except for method Layer .		
Stake chainage	Editable field	Nominal chainage of the point to be staked out.
Chainage increment	Editable field	Chainage increment. Value by which the nominal chainage increases/decreases when pressing Ch-/Ch+ .
 The following field is shown in the Stake and Check methods except for Slope and Manual slope .		

Field	Option	Description
Use manual height instead of design heights	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.
Manual height	Editable field	The height to be used.

Next step

Page changes to the **Offsets** page.

Stake/Check screen, Offsets page

Refer to "Stake/Check screen, General page" for a description of keys.

Description of fields

Field	Option	Description
Apply offsets	Check box	When this box is checked, the defined stake/check offsets are applied.
Stake offset	Editable field	Available for Stake. Horizontal offset from the reference stringline (as defined by the chosen method) of the point to stake.
Stake height diff	Editable field	Available for Stake. Vertical offset from the reference stringline or surface (as defined by the chosen method) of the point to stake.
Check offset	Editable field	Available for Check. Horizontal offset from the reference stringline, as defined by the chosen method, of the point to stake.

Field	Option	Description
Check height diff	Editable field	Available for Check. Vertical offset from the reference stringline or surface, as defined by the chosen method, of the point to stake.
 The following field is shown for the Stake methods Stringline , Individual stringline and Manual slope .		
Work with non-perpendicular offset	Check box	When this box is not checked the measured point is projected in an right angle to the selected stringline. When this box is checked, any projection angle can be defined.
Offset angle	Editable field	Manually defined projection angle.
 The following fields are shown in the Stringline , Individual stringline , Cross slope and Crown methods when Refer to an additional line is checked in the Define screen.		
Apply offsets to additional line	Check box	When this box is checked, an offset to the additional line can be defined.
Offset	Editable field	Horizontal stake/check offset to the additional line.
Height difference	Editable field	Vertical stake/check height difference to the additional line.

Next step

Page changes to the **Stake** page.

Understanding priorities of various heights

Type of height	Overrules	Stake height diff
Manually entered OR Obtained from individual point	All other heights	Considered
Use DTM height for stakeout (Tools menu: Use heights from DTM)	Design height	Considered
From design	No other heights	Considered
Show DTM height difference on Info page (Tools menu: Use heights from DTM)	No influence on priorities For additional info only	-

Stake screen, Stake page

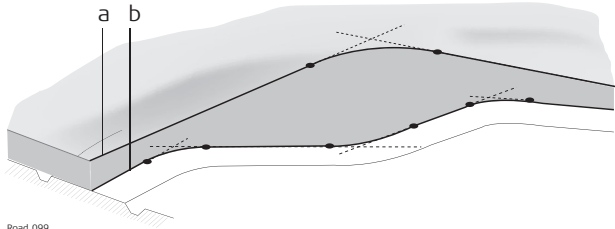


This page is available for Roads - Stakeout only.

This page displays the differences between the measured points and stakeout points (delta values). If these values are zero, the measured point coincides with the stakeout point. Refer to "Stake/Check screen, General page" for a description of keys. Refer to "42.4 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 O	Display only	Perpendicular horizontal offset to the centreline.

Field	Option	Description
Δ chainage	Display only	Difference between the defined Stake chainage and the current chainage Chainage of the measured position. If no defined chainage exists, for example if staking out random chainages or checking, this field shows - ----.
NrTP	Display only	The chainage difference between the measured point and the nearest tangent point (start/end point of a road segment) of the design is displayed.  a) Vertical alignment b) Horizontal alignment Only tangent points (start/end point of a road segment) are detected.
Δ O	Display only	Horizontal offset between the defined position and the current position. The Stake offset defined on the Offsets page is taken into account.

Field	Option	Description
Δ height	Display only	Vertical offset between the defined position and the current position. The Stake height diff defined on the Offsets page is taken into account.

Next step

Page changes to the **Info** page.

Stake/Check screen, Info page

A user definable **Info** page exists for each of the stake methods and check methods. Refer to the chapters from "35.3.2 Road Stringline - Info Page" to "35.3.8 Road DTM - Info Page". Refer to "Configuration, Info page" for information on all available items for the **Info** page and how to select them.

Stake/Check screen, Plot page

The **Plot** page for Stake shows information about the measured point relative to the design. The design is defined by the selected layer and stringline, and the values entered on the **General** page.

The **Plot** page for Check and Stake are similar. The only difference is that the current chainage is always shown instead of Δ **chainage**.

For Check and when only a DTM job is used, the **Plot** page shows the DTM and the lines of selected Road layer - always in plan view. At the top of the page, DTM height and delta height are shown.



Refer to "Stake/Check screen, General page" for a description of keys.

Fn Layrs..

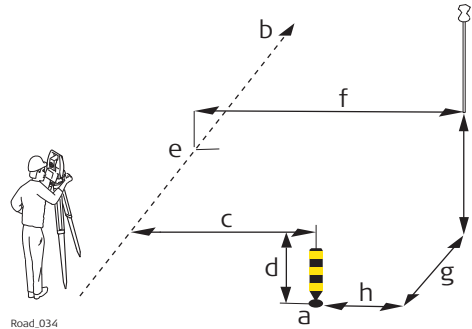
To turn layers of background maps (CAD files) on and off. Refer to "4.2 Creating a New Job" for information on CAD files and CAD background maps.

The following information is shown:

- 1) Chainage difference between the measured point and the defined chainage. When working with random chainages, for instance if no defined chainage has been entered on the **General** page, **ΔCh** changes to **Ch**. **Ch** is the current chainage as shown on the **Stake** page.
- 2) Horizontal offset (left/right arrow) to the design
- 3) Height difference (up/down arrow) to the design
- 4) The measured point
- 5) The element to stake is shown in bold and blue. The position to stake is marked with a yellow-black peg.
- 6) The plot can be shown as a cross plot or plan view by using the  eye icon on second level of MapView toolbar.

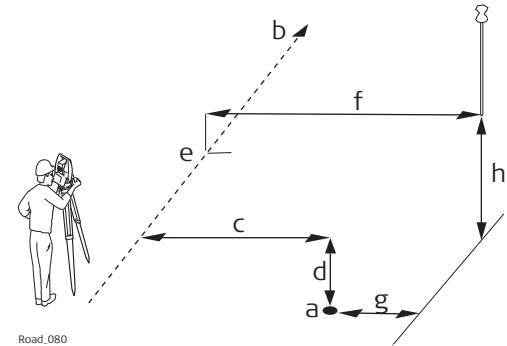
Graphical overview

Roads - Stakeout



- a) Position to stake out, defined by chainage, stake offset and, optionally, stake height difference
- b) Centreline/stringline the position is defined relative to
- c) **Stake offset**
- d) **Stake height diff**
- e) **Chainage**
- f) **CL offset/Ref offset**
- g) Δ **chainage**
- h) Δ **offset**
- i) Δ **height**

Roads - As built check



- a) Position to check, defined by check offset and, optionally, check height difference
- b) Centreline/stringline the position is defined relative to
- c) **Check offset**
- d) **Check height diff**
- e) **Chainage**
- f) **CL offset/Ref offset**
- g) Δ **offset**
- h) Δ **height**

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 stringline.
- 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 stringline.

Required elements

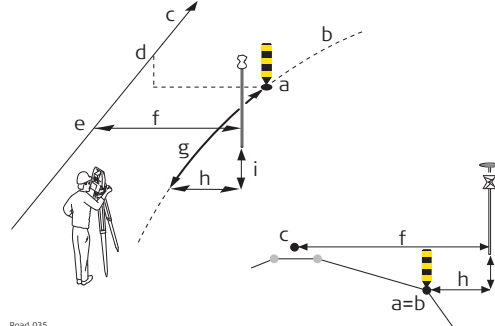
- For 2D, a horizontal centreline is required.
- For 3D, a 3D centreline is required.

37.3.3

Measuring Stringlines Relative to a Centreline

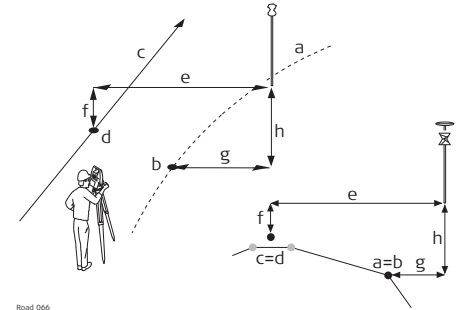
Graphical overview

Roads - Stakeout



- a) Position to stake out
- b) Stringline to stake out
- c) Centreline
- d) **Stake chainage**
- e) **Chainage**
- f) **CL offset**
- g) **Δ chainage**
- h) **Δ offset**
- i) **Δ height**

Roads - As built check



- a) Stringline to check
- b) Projected point on stringline
- c) Centreline
- d) **Chainage**
- e) **CL offset**
- f) **CL ht diff**
- g) **Δ offset**
- h) **Δ height**

Description

- Stringlines define various elements, including:
 - Centreline of the design
 - Change in slope ratio, for example, the edge of a carriage way

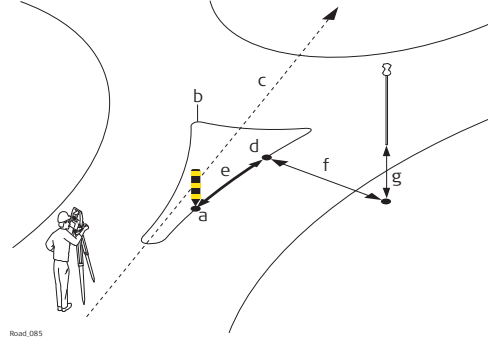
- Gutter, cable, pipeline or any other type of alignment element
- Refer to "35.7.3 Road - Basic Elements for Stake and Check Measurements" for information on the usage of stringlines.

Required elements

- For 2D, at least a 2D stringline and a 2D centreline are required.
 - For 3D, a 3D stringline and a 2D or 3D centreline are required.
-

Graphical overview

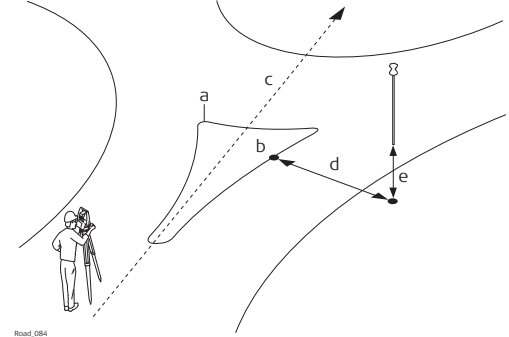
Roads - Stakeout



Stakeout of Roundabout

- a) Position to stake out
- b) Stringline to stake out
- c) Centreline of the layer- is not used for the individual stringline
- d) **Chainage**
- e) Δ **chainage**
- f) Δ **offset**
- g) Δ **height**

Roads - As built check



Checking a Roundabout

- a) Stringline to check
- b) **Chainage**
- c) Centreline of the layer- is not used for the individual stringline
- d) Δ **offset**
- e) Δ **height**

Description

This process is different to stringlines, where the stake/check is always relative to the centreline defined for the layer. Individual stringlines no longer have a relationship to an overall centreline. Individual stringlines are used to check roundabouts, parking bays, subdivision works and any other type of lines. The different stringlines 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.

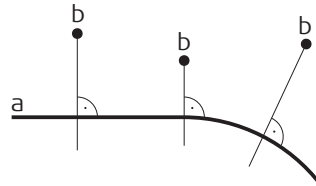
Indefinite triangle

Description

In almost all situations, a measured position is shown relative to the individual stringline by the stringline chainage and a square offset to the stringline. 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.

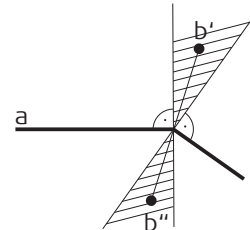
Graphic

A



Road_091

B



Road Design A

- a) Individual stringline
- b) Measured position (displayed relative to the stringline by chainage and square offset)

Road Design B

- a) Individual stringline 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 and is displayed by chainage and square offset

Screen

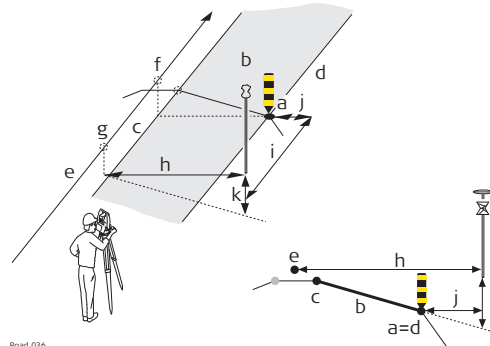
Points measured within an indefinite triangle are always shown relative to the tangent point.

37.3.5

Measuring Cross Slopes

Graphical overview

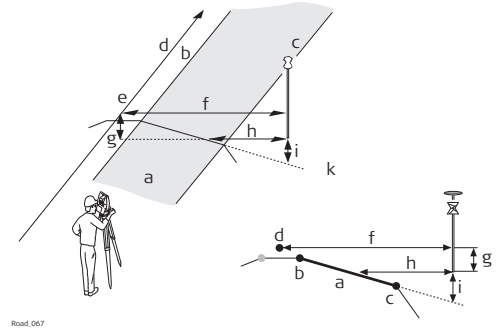
Roads - Stakeout



Road_036

- a) Position to stake out
- b) Cross slope to stake out
- c) Left stringline
- d) Right stringline
- e) Centreline
- f) **Working chainage**
- g) **Chainage**
- h) **CL offset**
- i) Δ **chainage**
- j) Δ **offset**
- k) Δ **height**

Roads - As built check



Road_067

- a) Cross slope to check
- b) Left stringline
- c) Right stringline
- d) Centreline
- e) **Chainage**
- f) Δ **offset**
- g) Δ **height**
- h) **Cross slope offset**
- i) **Cross slope ht diff**

Description

- Surfaces such as the final carriage way, are often staked/checked using cross slopes. A cross slope consists of a combination of two stringlines.
- Refer to "35.7.3 Road - Basic Elements for Stake and Check Measurements" for information on the usage of cross slopes.

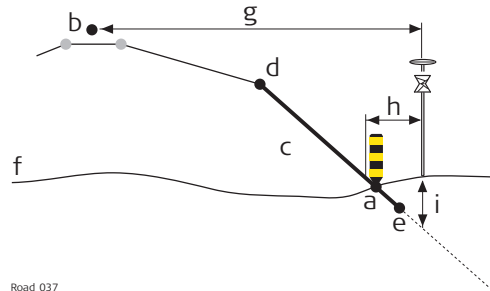
Required elements

A 3D design of the road is required.

Measuring Manual Slopes and Design Slopes

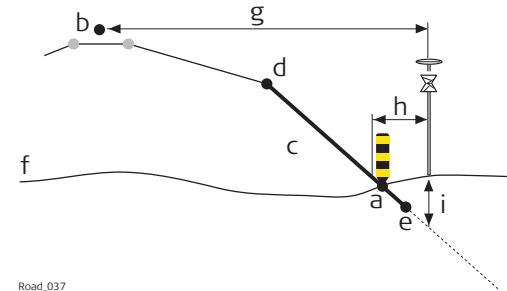
Graphical overview

Roads - Stakeout



- a) Catch point
- b) Centreline
- c) Slope to stake out
- d) Hinge point = left stringline
- e) Second / right stringline
- f) Natural surface
- g) **CL offset**
- h) Δ **offset**
- i) Δ **height**

Roads - As built check



- a) Catch point
- b) Centreline
- c) Slope to check
- d) Hinge point
- e) Second stringline of the slope
- f) Natural surface
- g) **CL offset**
- h) **Slope offset**
- i) **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 stringlines. Refer to "35.7.3 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 "37.2.3 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

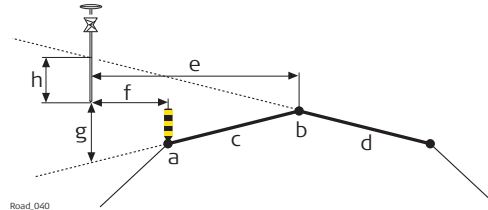
The slope is defined manually relative to a selected 3D stringline, slope direction and slope ratio or relative to a 2D stringline using a manual height, slope direction and slope ratio.

Description of design slopes

For this method, a 3D representation of the slope, defined by two stringlines, is required.

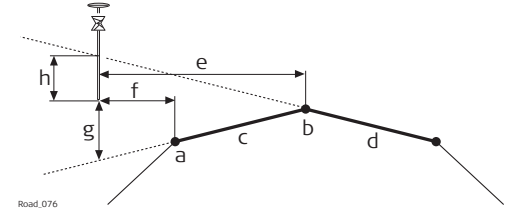
Graphical overview

Roads - Stakeout



- a) Position to stake out, in this case the left stringline of the crown
- b) Middle stringline of the crown, in this case also the centreline
- c) Left cross slope to stake out
- d) Right cross slope to stake out
- e) **CL offset**
- f) Δ **offset**
- g) Δ **ht left**
- h) Δ **ht right**

Roads - As built check



- a) Left stringline of the crown
- b) Middle stringline of the crown, common for both cross slopes
- c) Left cross slope to check
- d) Right cross slope to check
- e) **CL offset**
- f) Δ **offset**
- g) Δ **ht left**
- h) Δ **ht right**

Description

- Staking road crowns allows the stake out of two cross slopes at the same time. If **Toggle offsets left/right** is checked, the reference for Δ **offset** is automatically switched between the right and left cross slope depending on whether the measured position is to the right or left of the middle stringline.
- When checking road crowns, it allows the check of two cross slopes at the same time. The information for both cross slopes is shown at the same time.

Required elements

A 3D design of the road, defining a crown consisting of three stringlines, is required.

Specific fields

The following fields vary from the description used in "37.3.1 The Stake/Check Screen":

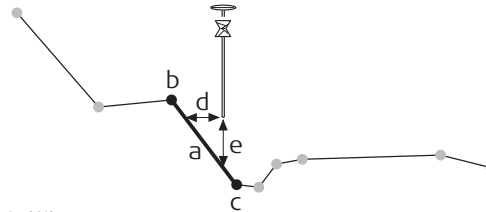
Field	Option	Description
$\Delta \text{ ht left} / \Delta \text{ ht right}$ or $\Delta \text{HtL} / \Delta \text{HtR}$	Display only	Vertical offset to the left/right cross slope defining the road crown.

37.3.8

Measuring Road Layers

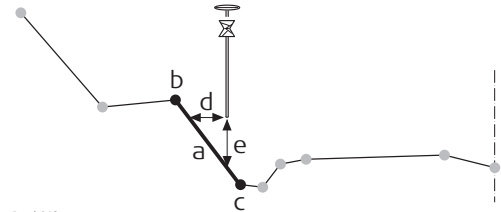
Graphical overview

Roads - Stakeout



- a) Relevant part of the layer for the current position
- b) Left stringline **Left name**
- c) Right stringline **Right name**
- d) Δ **offset**
- e) Δ **height**

Roads - As built check



- a) Relevant part of the layer for the current position
- b) Left stringline **Left name**
- c) Right stringline **Right name**
- d) **Slope offset**
- e) **Layer ht diff**

Description

All stringlines are grouped in layers. Such a layer describes a surface of the road. When staking/checking out a layer, it is automatically detected the stringline left and right of the measured position.

Required elements

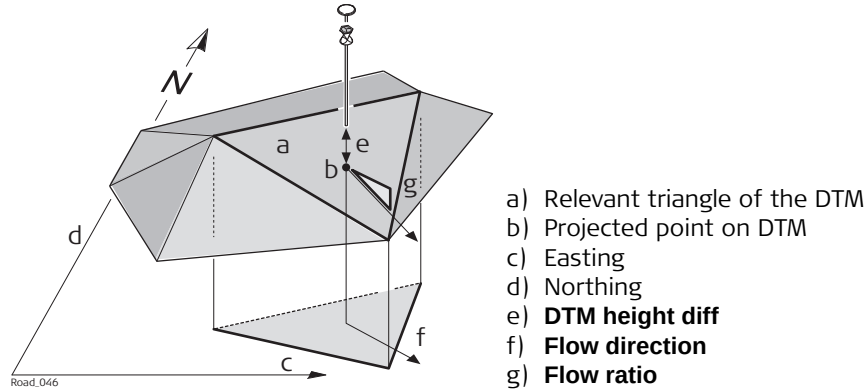
A 3D design of the road is required.

37.3.9

Measuring Digital Terrain Models (DTM)

Graphical overview

Roads - As built check



Description

A DTM check returns the height difference between the current height and the height the DTM at the measured position.

Required elements

A DTM job is required.

37.4

37.4.1

The Tools Menu

Overview

Access

Press **Fn Tools..** on any page of the Stake/Check screen.

Description

The Tools menu 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:

- "37.4.2 Use heights from DTM"
- "37.4.3 Apply current chainage"
- "37.4.4 Get current angle to alignment"
- "37.4.5 Individual point"
- "37.4.6 Additional layer information"
- "37.4.7 Box / base definition"
- "37.4.8 Get current slope"
- "37.4.9 Reset slope to design"
- "37.4.10 Shift reference line"
- "37.4.11 Re-initialise search"

37.4.2

Use heights from DTM

Availability

This menu function is available for the following stake/check methods: Stringline, individual stringline, cross slope, crown, layer.

Description

The application 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 **Info** page: **DTM 2 Ht Diff**, **DTM 2 Height** and **DTM 2 Name**.
- show the DTM triangles in the planar view and in the cross section view on the **Plot** page.

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

☒ Use DTM height for stake out

DTM layer:

Existing

☒ Show DTM height difference on Info page

DTM layer:

Existing

☒ Show DTM on map

DTM layer:

Existing

Hz: 390.1879g

V: 99.9999g

Fn abc

14:24

OK

- OK
- To confirm the settings and return to the Stake/Check screen.
- Quit
- To exit the application.

Description of fields

Field	Option	Description
DTM	Display only	DTM from the selected DTM job.
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.
DTM layer	Selectable list	Available when Use DTM height for stake out is checked. When selecting a DTM layer the relevant triangle of the DTM is shown on the Plot page.
Show DTM height difference on Info page	Check box	When this box is checked, a layer of the DTM to be used as a height reference on the Info page. When this box is not checked, no additional height information relative to the DTM is shown on the Info page.
DTM layer	Selectable list	Available when Show DTM height difference on Info page 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 on the Plot page.
Show DTM on map	Check box	When this box is checked, the DTM triangles are displayed in planar view on the Plot page.
DTM layer	Selectable list	All available layers are selectable.

37.4.3

Apply current chainage

Availability

This menu function is available for all stake/check methods except layer.

Description

To set **Stake chainage** on the **General** page of the stakeout to the current chainage.

37.4.4

Get current angle to alignment

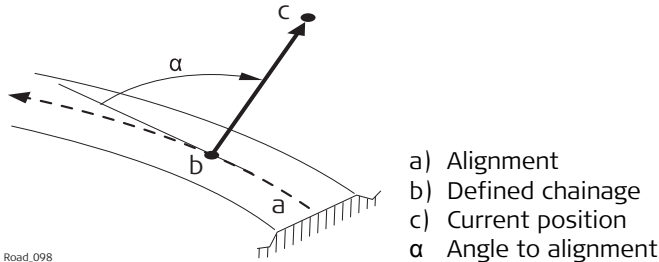
Availability

This menu function is available for the stake/check of stringlines and individual stringlines.

Description

To project a measured point to the alignment considering the entered **Stake chainage**. This functionality is only available when **Work with non-perpendicular offset** is checked in the Stake screen on the **Offsets** page.

Graphic



Workflow

Step	Description
1.	Measure a point: TPS Dist GPS Meas and Stop
2.	Press Fn Tools.. to access the Tools menu.
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 angel is set as Offset angle for Work with non-perpendicular offset on the Offsets page.

Step	Description
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 .

37.4.5

Individual point

Availability

This menu function is available for the stake/check of stringlines and individual stringlines.

Description

To select the point to stake from the selected **Working job**.

If a control job has been selected on the **Job Selection** screen, a point from the control 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.

To access **Data: Points** page, which allows staking out points with known Easting, Northing and Height. Points can either be selected from the **Working job** or manually typed in.

The **Stake chainage** and **Stake offset** of the Stake screen are calculated based on the coordinates of the selected point.

The height for the stakeout can be set as **Manual height**.



If the chosen point has no height the design height will be used. If the point has a height it is possible to use that one or continue working with the design height.

37.4.6

Additional layer information

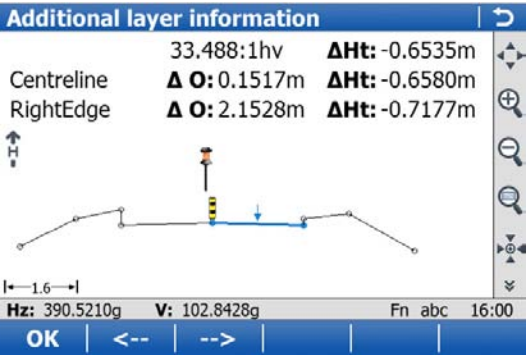
Availability

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 information



OK
To store the selected element, which is then automatically recalled.

<-- or -->
To select the relevant element in the plot.
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.

Reset
To move back to the originally selected element.

Fn Quit
To exit the application.

37.4.7

Box / base definition

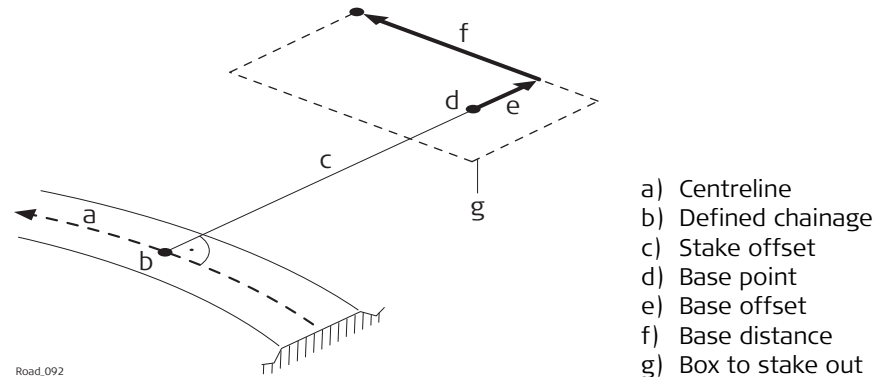
Availability

This menu function is available for the stake/check of stringlines and individual stringlines.

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 stringline 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: 150.0000m

Base offset: 0.0000m

Distance box: 0.0000 m

Offset box: 0.0000 m

Base easting: -19863.9901 m

Base northing: 5301092.7000 m

Base height: 418.2750 m

Base direction: 300.1080 m

Hz: 221.9996g V: 100.0002g Fn abc 16:39

OK Define Base

OK

To store the selected element, which is then automatically recalled.

Define

To overwrite the values before pressing **Base** If a different base had been defined before.

Base or Clear

To freeze or unfreeze the values of the base point.

Fn Quit

To exit the application.

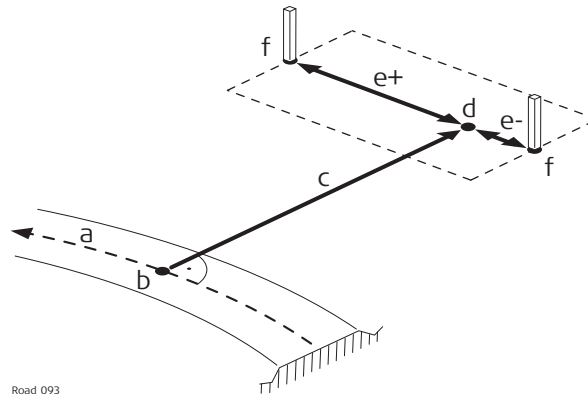
Description of fields

Field	Option	Description
Base chainage	Display only	The position defined by Stake chainage .
Base offset	Display only	The position defined by Stake offset .
Distance box	Editable field	The distance in the direction of increasing chainage of base point is positive.
Offset box	Editable field	The offset to the right of base point is positive.
Base easting, Base northing and Base height	Editable field	The coordinates of the base point, either from the Working job or from a surveyed point.

Field	Option	Description
Base direction	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.



Road_093

- a) Centreline
- b) Defined chainage
- c) Stake offset
- d) Base point
- e) Base distance, positive (e+), negative (e-)
- f) Peg to stake out

Step	Description
1.	Define the base point for the box/base stakeout using Stake offset and Stake height diff from the Offsets page.
2.	Press Fn Tools.. to access the Tools menu.
3.	Select Box / base definition . Press OK to continue to the next screen.

Step	Description
4.	The position defined by Stake chainage and Stake 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 Tools menu. The Box/Base functionality calculates the new point to stake out and changes the according values of Stake chainage and Stake offset . The Box/Base functionality also activates the Manual height functionality.
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 screen. Pressing this key freezes the values of the base point. 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. That is; offset to the right = positive; distance in direction of increasing chainage = positive.
8.	Press OK to continue to the next screen.
9.	The values of Stake chainage , Stake offset and the Manual height are adjusted accordingly.
10.	The fields Δ chainage , Δ offset and Δ height on the Stake page guide you to the new position to stake out. Press Fn Tools.. to access Tools menu.
11.	Select Box / base definition . Press OK to continue to the next screen.

Step	Description
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.

37.4.8

Get current slope

Availability

This menu function is available for the stake/check of slopes and manual slopes.

Description

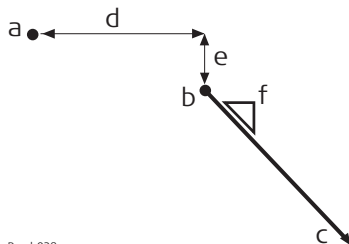
To access **Slope Definition**. The slope ratio **Current ratio** of the last measured position is used as the defined **Slope ratio**. All others values in **Slope Definition** are filled in with the last measured position. The defined manual slope is used for all points to stake out or check.



The manual slope is active until it is turned of with **Reset slope to design** from the Tools menu.

Graphic

Slopes are defined relative to the centreline.



Road_038

- a) Centreline
- b) Hinge point
- c) New slope
- d) Defined hinge offset **Offset**
- e) Defined hinge height difference **Height difference**
- f) **Slope ratio**

Slope Definition

Slope Definition

Hinge line:

Centreline

Hinge offset:

Absolute

Offset:

0.0000

m

Height difference:

416.7632

m

Slope type:

Fill right

Slope ratio:

1:0

hv

Hz: 221.9996g

V: 100.0002g

Fn abc

08:26

OK

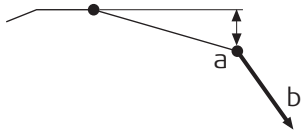
Config..

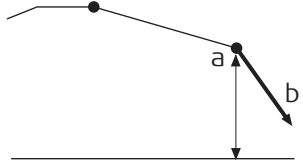
OK
To accept changes and move to the next screen depending on the settings for slope staking.

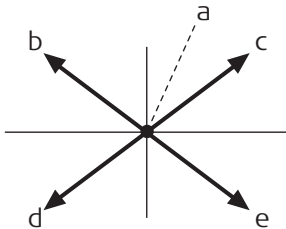
Config..
To access the configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Quit
To exit the application.

Description of fields

Field	Option	Description
Hinge line	Display only	The stringline the slope is defined relative to.
Hinge offset	Relative to line	The vertical offset type for the hinge point. Define the hinge point by the height difference relative to the selected Reference line.  a)Hinge point b)Slope

Field	Option	Description
	Absolute	Define the hinge point using its absolute height.  a)Hinge point b)Slope Road_039b
	Hold hinge	The hinge point of the slope stays fixed at the defined stringline.
Offset	Editable field	The horizontal offset of the hinge point from the centreline/reference line.
Height difference	Editable field	The height difference of the hinge point from the centreline/reference line. Available for Hinge offset: Relative to line.
Elevation	Editable field	The absolute height of the hinge point. Available for Hinge offset: Absolute.

Field	Option	Description
Slope type	Selectable list	Differentiates if the defined slope is a cut/fill and left/right.  Road_079 a) Hinge point b) Left cut c) Right cut d) Left fill e) Right fill
Slope ratio	Editable field	Defines the ratio of the slope. The measured slope ratio is the default value. This value can be edited manually.  The display format is defined as system setting in Regional Settings, Slope page.

37.4.9

Reset slope to design

Availability

This menu function is available for the following stake/check methods: Stringline, individual stringline, cross slope, crown, layer.

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.

37.4.10

Shift reference line

Availability

This menu function is available for the stake/check of slopes and cross slopes. The **Shift reference line** item of the Tools menu 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

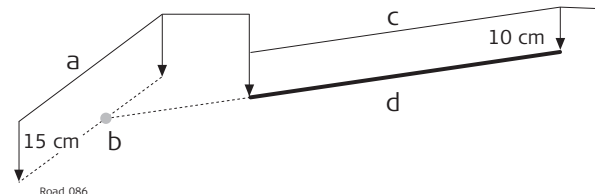
When staking out or checking different layers of the road strata, such as the subgrade, gravel or asphalt, it is often found that not all these layers are available in the design. For such cases, the application offers the possibility to apply either a negative or positive height shift to the design values.

Example

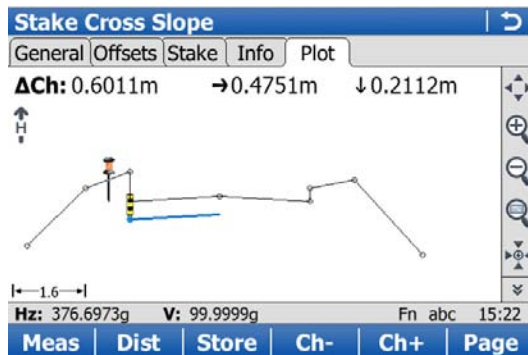
A gravel layer with a thickness of 10 cm is to be staked out. A negative vertical shift to the final design surface is applied. This shift is applied:

- by pressing **Shifts..** in the **Define** screen and
- by applying a vertical shift of -10 cm.

As shown, the selected cross slope is shifted by 10 cm.



- a) Reference surface
- b) Shifted reference point
- c) Original cross slope
- d) Shifted cross slope



When staking out the newly shifted cross slope, the original left edge of the shifted cross slope is of little interest. It is the intersection with the left end slope that is of greater interest.

Reference Shift

Reference Shift

☒ Shift slope reference line

Left line: LeftCatch

Right line: LeftHinge

Shift mode: Plumbline

Shift value: -0.1500m

Hz: 376.6973g V: 99.9998g Fn abc 15:26

OK

OK

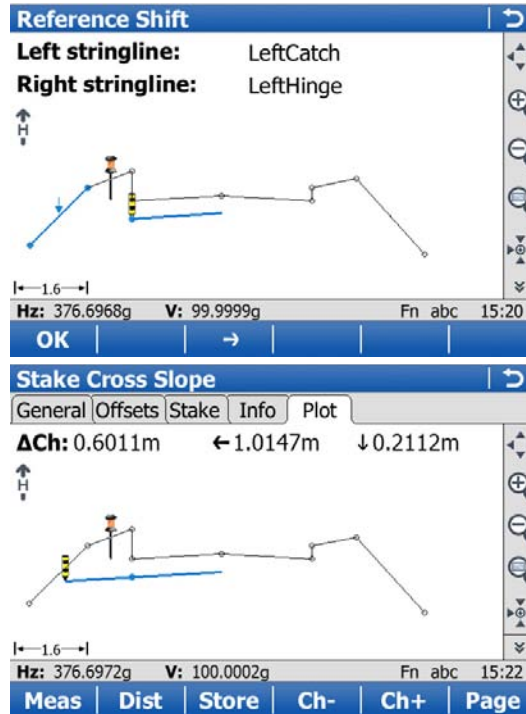
To confirm the settings and return to the **Stake/Check** screen.

Quit

To exit the application.

Description of fields

Field	Option	Description
Shift slope reference line	Check box	When this box is checked, the settings for the shift can be set.
Left line	Display only	Shows the name of the left stringline from the surface.
Right line	Display only	Shows the name of the right stringline from the surface.
Shift mode	Plumbline	The vertical shift applied to the surface selected. The shift defined under Shift value gets applied following the plumb line.
	Perpendicular	The shift defined under Shift value gets applied perpendicular to the selected surface.
Shift value	Editable field	Value the selected surface gets shifted following the chosen Shift mode .



The graphical selection.

The expanded element and the shifted reference line, marked with a cross, are shown in the **Plot** page in the Stake/Check screen.

On the **Stake** page, the Δ offset and Δ height guide you to the new shifted position.

37.4.11

Re-initialise search

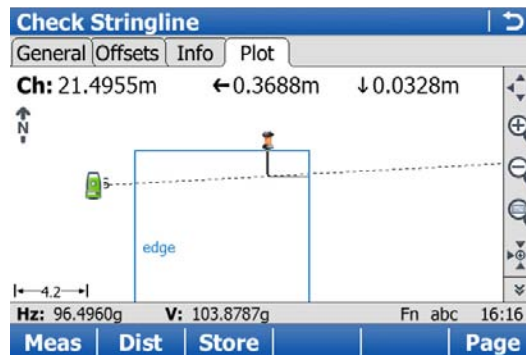
Availability

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 **Re-initialise search** forces a re-projection of the current position.

Example



Before initialisation

This screen shows the projection of the current position to the left segment, although the distance to the right segment is shorter.



After initialisation

This screen shows the projection after the reinitialisation.

38

38.1

38.1.1

Roads - Rail

Creating a New Rail Job

Overview

Description

There are two ways of creating road/rail jobs:

Typing them in manually by using the **Alignment Editor** application.

OR

Converting data created in a design package.

Manually entered data

Data can be typed in and edited with **Alignment Editor**. Refer to "36 Roads - Alignment Editor" for information on how to enter data manually.

Converted data

The Design to Field component of LEICA Geo Office 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.



LEICA Geo Office can be found on the LEICA Geo Office DVD.

The latest version of the Design to Field importers can be found in the downloads section of:

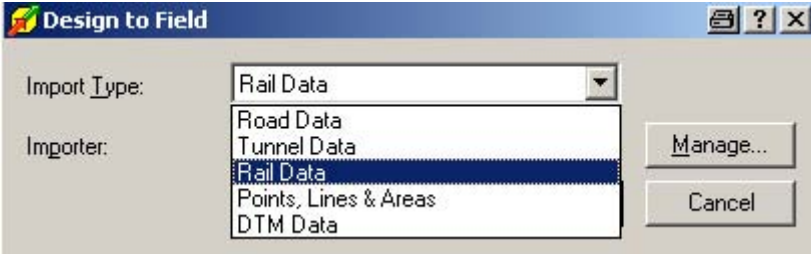
- myWorld@Leica Geosystems
<https://myworld.leica-geosystems.com>
 - of the Leica Geosystems website:
http://www.leica-geosystems.com/en/page_catalog.htm?cid=3291
-

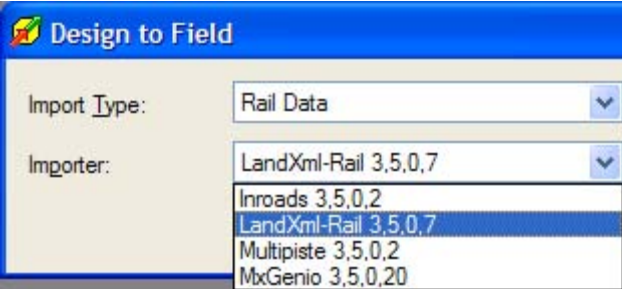
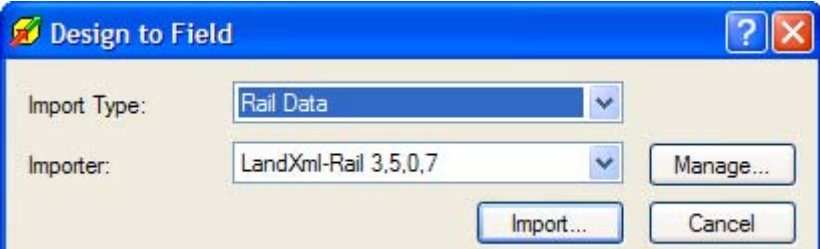
38.1.2

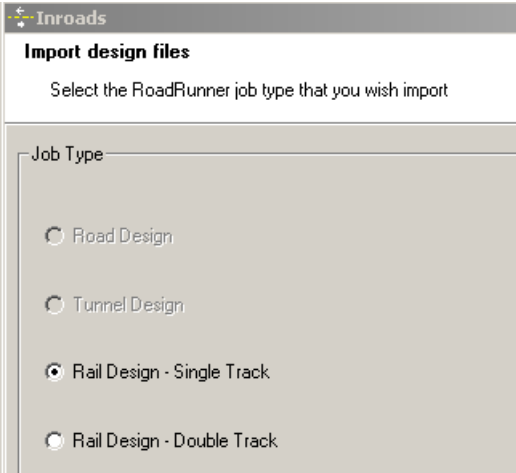
Installing all necessary Software

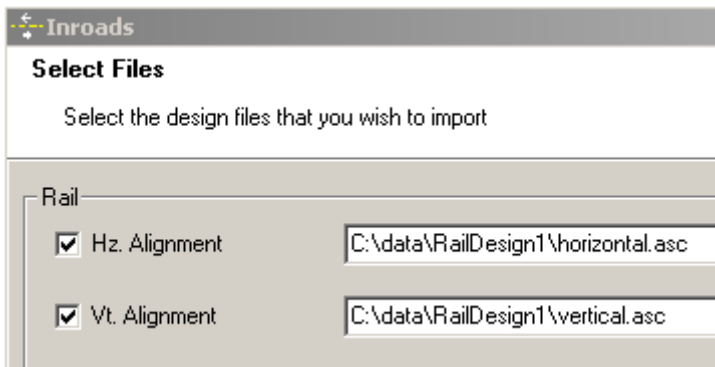
Install LEICA Geo Office	LGO runs under WindowsXP or Windows Vista and can only be installed successfully if the user is logged in as the Administrator. To install LGO, run the setup file from the DVD and follow the instructions on the screen.
Install Design To Field	To prepare the track design for use 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 LGO which is automatically installed with LGO.
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: • myWorld@Leica Geosystems: https://myworld.leica-geosystems.com • of the Leica Geosystems website: http://www.leica-geosystems.com/en/page_catalog.htm?cid=3291
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 LGO 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.
Install Roads and Rail	Roads and Rail are the onboard programs which are loaded onto the instrument: • via a data storage device (under the System folder), which is inserted into the instrument, • via a serial cable and LGO.

Importing the design

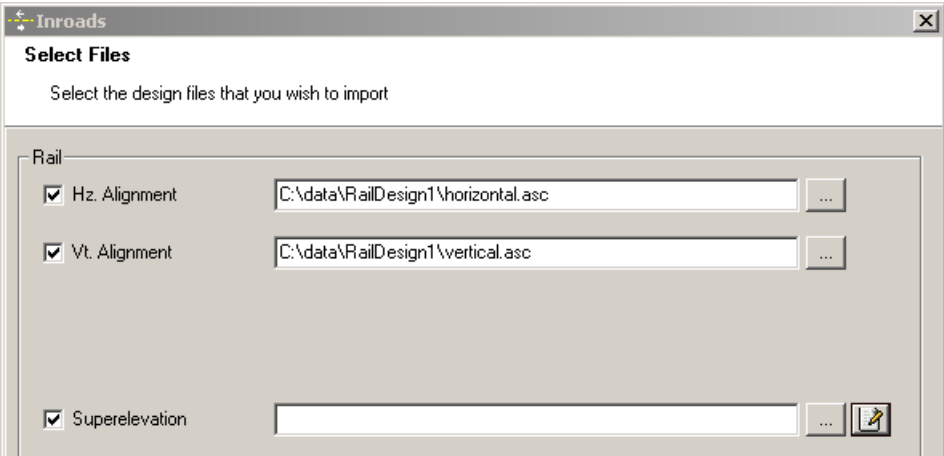
Step	Description
1.	Starting the Design to Field program To import a track centreline select Design to Field from the Tools menu in LGO.  Design to Field
2.	Selecting an Import Type To prepare track design for onboard use successfully, it has to be converted from its original data format to an onboard job which will run on the instrument. Select Importer Type: Rail Data 

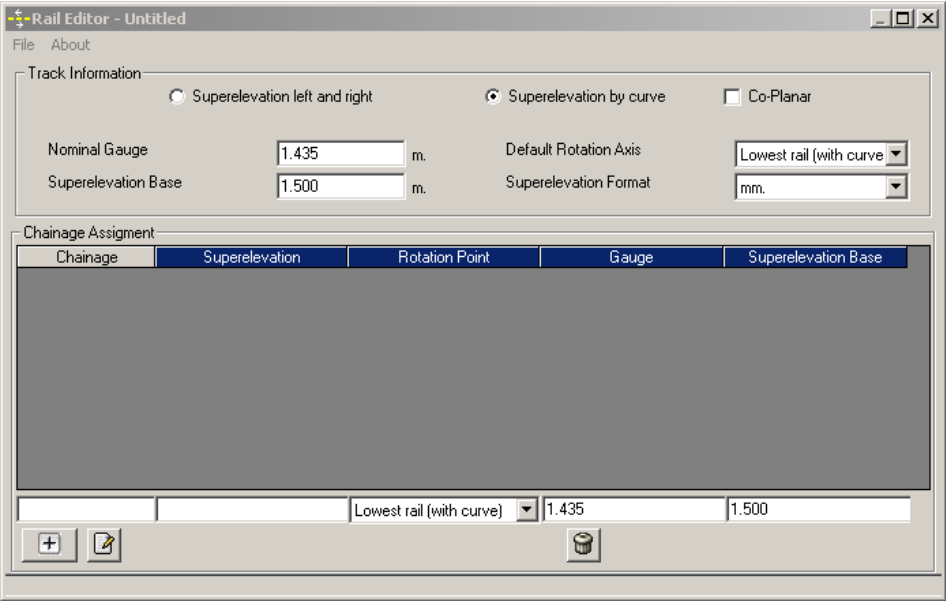
Step	Description
3.	Selecting a Field Importer Importers are used to convert the data. Additional importer formats can be added to the selectable list by clicking Manage. Select the importer related to the track design from the selectable list of available importers. 
4.	Importing Click Import to start the file selection wizard. 

Step	Description
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.

Step	Description
6.	Selecting the horizontal and vertical alignment files  Inroads Select Files Select the design files that you wish to import Rail ☒ Hz. Alignment C:\data\RailDesign1\horizontal.asc ☒ Vt. Alignment C:\data\RailDesign1\vertical.asc

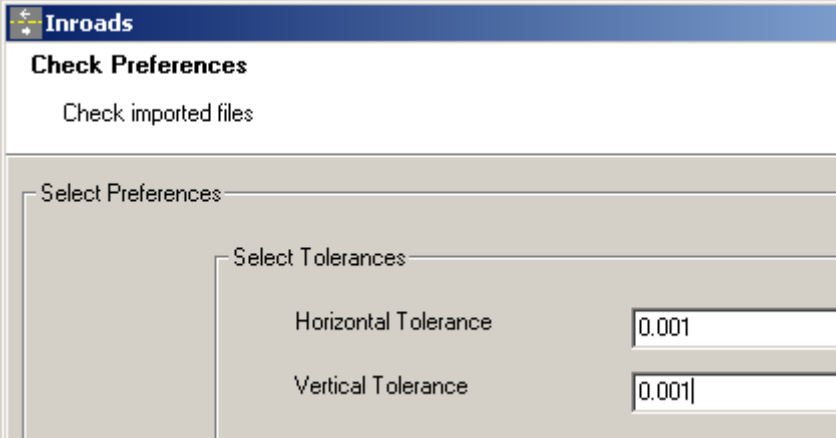
Step	Description
	- For a single track, select the horizontal and vertical alignments using the browse button. - For a double track, three screens are used to define the design data. The arrows at the bottom of the screens can be used to move between the different screens. First screen - Centreline: The first screen 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 screen can be left blank. Second screen - Left track: The second screen defines the horizontal and vertical alignments and the rail definition (superelevation) of the left track. Third screen - Right track: The third screen 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.

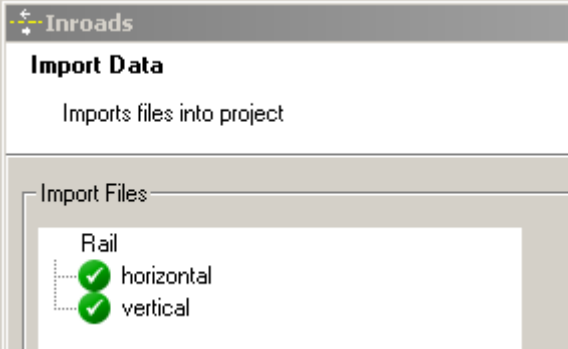
Step	Description
	A superelevation file can be obtained in the following ways: • by selecting an existing superelevation file. • by selecting an existing superelevation file and modifying it with Rail Editor. • by creating a new superelevation file with Rail Editor. Creating a superelevation (rail definition)  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. 

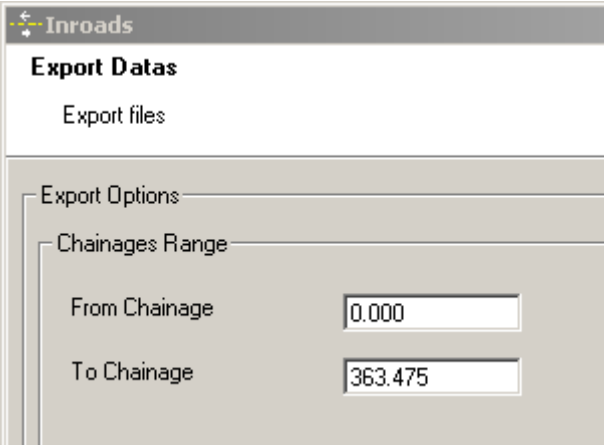
Step	Description
	The Rail Editor program is used to define the height of the rails at a given chainage. The height of the rails can be defined by a rotation point and a cant or by a left and right cant.  The screenshot shows the 'Rail Editor - Untitled' window. The 'Track Information' section has three radio buttons: 'Superelevation left and right' (unselected), 'Superelevation by curve' (selected), and 'Co-Planar' (unselected). Below these are input fields for 'Nominal Gauge' (1.435 m) and 'Superelevation Base' (1.500 m). To the right, there are dropdown menus for 'Default Rotation Axis' (set to 'Lowest rail (with curve)') and 'Superelevation Format' (set to 'mm.'). The 'Chainage Assignment' section features a table with five columns: 'Chainage', 'Superelevation', 'Rotation Point', 'Gauge', and 'Superelevation Base'. The table body is currently empty. At the bottom of the window, there are buttons for adding (+) and deleting (-) entries, and a preview icon. A status bar at the very bottom shows the current settings: 'Lowest rail (with curve)', '1.435', and '1.500'. Describing the screen elements - Entering Track Information

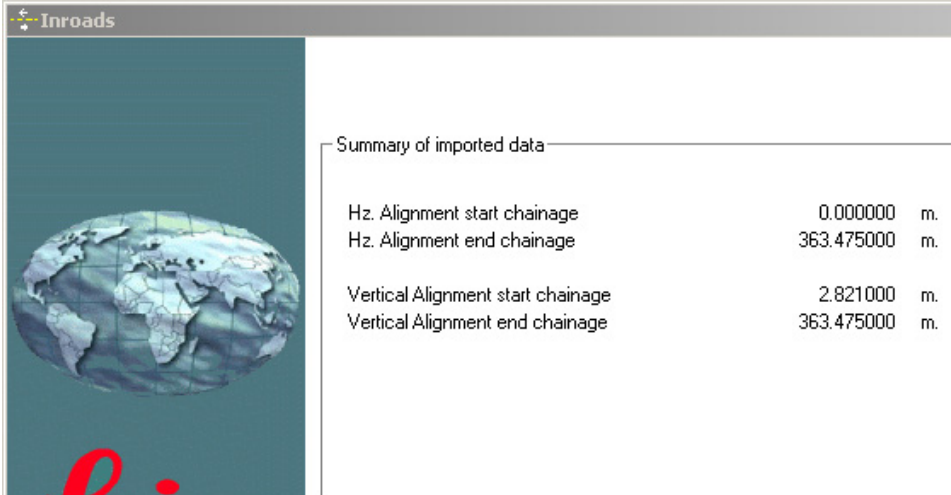
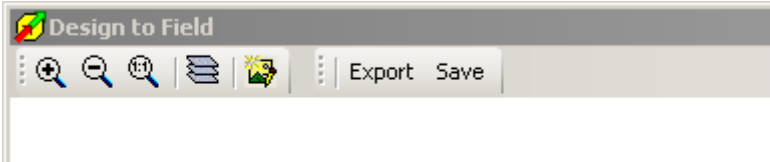
Step	Description
	Superelevation left and right To define the height of the rails using one super-elevation value for the left rail and another super-elevation value for the right rail. Superelevation by curve To define the rails using a rotation point and a super-elevation value.  Once the method by which the super-elevation 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 part any rail definition (super-elevation). Superelevation Base The distance over which the super-elevation 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 (super-elevation). Default Rotation Axis If a rotation point is used, this selection will be used as the default for all new rail definitions. This value can be changed if necessary for any rail definition (super-elevation).

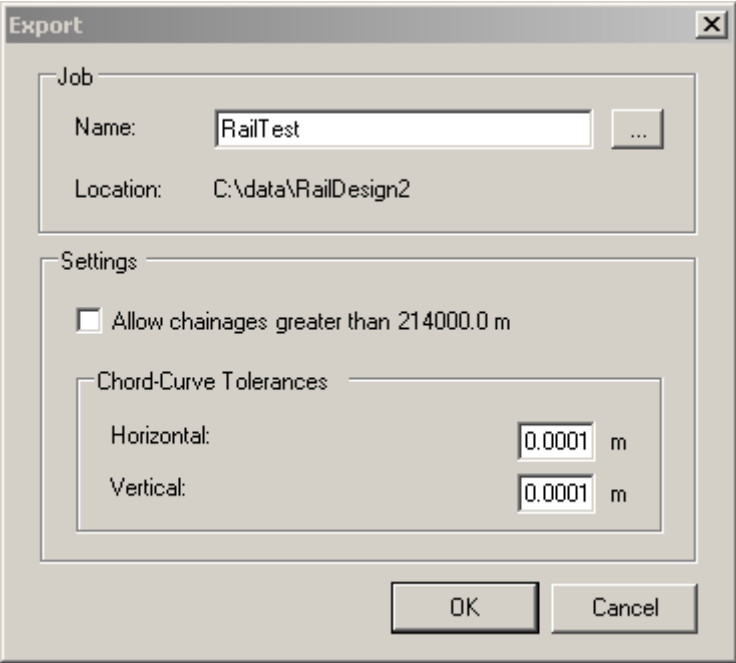
Step	Description
	Superelevation Format The format in which the superelevation values are entered.  Once all superelevation data has been entered, press the button to add the data to the chainage assignment screen.  To delete an element, select the element and press the button.  To modify an existing 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.

Step	Description
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.

Step	Description
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.

Step	Description
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.

Step	Description												
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.  The screenshot shows a software window titled "Inroads". On the left is a 3D globe with a red line indicating a track alignment. On the right, under the heading "Summary of imported data", is a table with the following information: <table><tr><td>Hz. Alignment start chainage</td><td>0.000000</td><td>m.</td></tr><tr><td>Hz. Alignment end chainage</td><td>363.475000</td><td>m.</td></tr><tr><td>Vertical Alignment start chainage</td><td>2.821000</td><td>m.</td></tr><tr><td>Vertical Alignment end chainage</td><td>363.475000</td><td>m.</td></tr></table>	Hz. Alignment start chainage	0.000000	m.	Hz. Alignment end chainage	363.475000	m.	Vertical Alignment start chainage	2.821000	m.	Vertical Alignment end chainage	363.475000	m.
Hz. Alignment start chainage	0.000000	m.											
Hz. Alignment end chainage	363.475000	m.											
Vertical Alignment start chainage	2.821000	m.											
Vertical Alignment end chainage	363.475000	m.											
12.	Viewing the track design The track design can be viewed graphically.  The screenshot shows a software window titled "Design to Field". It features a toolbar with icons for zooming in (+), zooming out (-), zooming to fit (1:1), a list view icon, a design tool icon, and buttons for "Export" and "Save".												

Step	Description
	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.

38.1.4

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 "Appendix C Directory Structure of the Memory Device".

38.2

Defining the Work

Access

- 1) Select **Main Menu: Go to Work!\Roads\Rail - Stakeout** or **Rail - As built check**.
- 2) In the screen **Job Selection**, select the required jobs. Refer to "35.4.1 Choosing a Job".
- 3) Press **OK**.

Define

Define | ➔

Layer: Rechtes Gleis

Chainage stringline: Centerline

Working chainage: 150.0000 m

Line: Centre line ▼

Hz: 221.9996g V: 100.0001g Fn abc 15:22

OK | Shifts.. | Save.. |

OK

To continue to the next screen.

Shifts..

To apply horizontal and vertical shifts to the selected element. Refer to "35.5 Working with Shifts".

Load..

To load a task. Refer to "35.6 Tasks".

Save..

To save the settings as a task. Refer to "35.6 Tasks".

Fn Config..

To access the Rail configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Layer	Display only or selectable list	Layers contained in the active rail job can be selected, for example layer of left or right track design.
Chainage stringline	Display only	Shows the name of the chainage stringline, at the selected layer.
Working chainage	Editable field	To enter a chainage (ranging between the start chainage and end chainage) of the chainage centreline. Only those elements which appear at this chainage can then be selected from Line .
Line		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 stringline with which measured values are then compared.
	Centre line	The track centreline.

Field	Option	Description
	Left rail or Right rail	- For design data including the rails: When working with design data including the rails, the horizontal and vertical alignment of the design is used. Depending on the rail design configuration setting, the superelevation of the design or the manually defined superelevation can be used. - For design data without rails (only track centreline): 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 program configuration is used for the calculation. - When working with horizontal alignments only: The height of the rails is calculated by using the values for Manual cant definition defined on Stake Track/Check Track, General page.

38.3

38.3.1

Staking/Checking the Track

The Stake/Check Screen

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.

Stake Track/Check Track, General page

Information regarding the measured point can be entered. This screen allows any point of the track to be checked against design values.

Stake Track	
General	Offsets
Point ID:	TPS0002
Target height:	1.5600 m
Stake chainage:	150.0000 m
Change increment:	0.0000 m
☐ Use manual height instead of design heights	

Hz: 221.9996g	V: 99.9998g	Fn abc	16:35		
Meas	Dist	Store	Ch-	Ch+	Page

Meas

GPS To start measuring the point being staked. The key changes to **Stop**.

TPS To measure a distance and store distance and angles.

Stop **GPS**

To end measuring the point being staked. When **Automatically stop point measurement** is checked in **GPS Settings Quality Control, General** page recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. After ending the measurements, the differences between the measured point and the point to be staked are displayed.

Store

GPS To store the measured point. When **Automatically store point** is checked in **GPS Settings Quality Control, General** page, the measured point is stored automatically. The key changes to **Meas**.

TPS To store angles and distance. Distance must be measured before.

Dist **TPS**

To measure a distance.

Ch-

Available for **Rail - Stakeout**. To decrease the chainage as defined by **Chainge increment**.

Ch+

Available for **Rail - Stakeout**. To increase the chainage as defined by **Chainge increment**.

Page

To change to another page on this screen.

Fn Config..

To access Rail configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Positn **TPS**

To position the total station to the defined stakeout point, including defined offsets. This depends on the settings for **Turn to point** in **Configuration, TPS** page. Refer to "Configuration, TPS page".

Fn Tools..

To access the Tools Menu.
Refer to "38.4 The Tools Menu".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	Name of the next point to be stored. The ID is incremented/decremented whenever a point gets stored.
Antenna height GPS	Editable field	Height of the antenna.
Target height TPS	Editable field	Height of the prism.
Stake chainage	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.
Chainage increment	Editable field	Value by which the nominal chainage increases/decreases when pressing Ch-/Ch+ . If a point is to be staked at more than one chainage, a chainage increment can be defined.

Field	Option	Description
Use manual height instead of design heights	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.
Manual height	Editable field	Available when Use manual height instead of design heights is checked. The height to be used.
Manual cant definition	Display only	This field and the following fields are available for Superelevation: Manual in Configuration, Rail design page.
Ht lower rail	Editable field	Defines the absolute height of the lowest rail at the defined chainage.
Cant left	Editable field	Defines the superelevation at the left rail. • When working with horizontal alignments only: If the superelevation is rotated around the left rail, the superelevation would be zero. • 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.

Field	Option	Description
Cant right	Editable field	Defines the superelevation at the right rail. - 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 configuration. - 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 configuration.

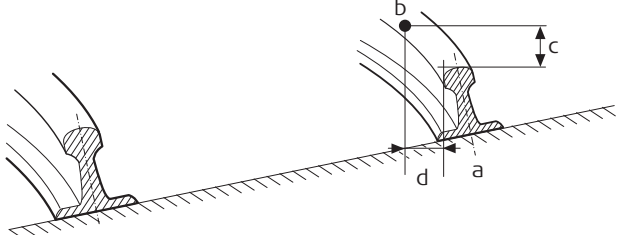
Next step

Page changes to the **Offsets** page.

**Stake Track/Check
Track,
Offsets page**

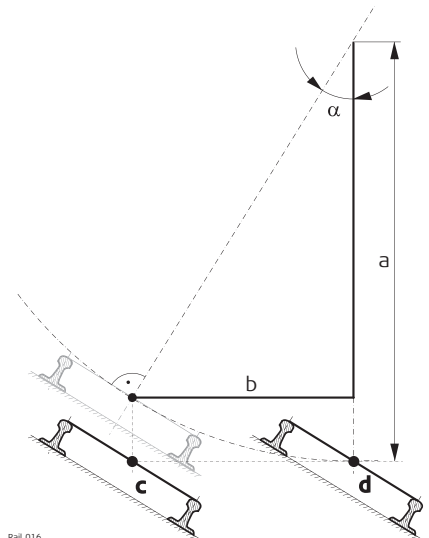
Refer to "Stake Track/Check Track, General page" for a description of keys.

Description of fields

Field	Option	Description
Apply offsets	Check box	When this box is checked, offsets can be typed in. Often it is necessary to set out points with a fixed plan offset and fixed height offset from a known reference line (track centreline or rail). 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 "35.7 Understanding Terms and Expressions".  Rail_013 a) Reference line (right rail) b) Point to stake c) Stake height diff d) Stake offset

Field	Option	Description
Offsets	Manual	Offsets can be entered in Stake offset/Check offset or Stake height diff/Check height diff .
	From library	The offset is stored as part of the rail job and recalled whenever required.
Offsets	Selectable list	Available for Offsets: From library . The point ID of the stored stake offsets. To select a different stored offset or to create a new point, highlight this field and open the selectable list. Refer to "38.3.2 Offset Library".
Stake offset	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.
Stake height diff	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.
Check offset	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.
Check height diff	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.

Field	Option	Description
Work with pendular displacement	Check box	This functionality is used in railway tunnels. The functionality is available for Rail - Stakeout and Rail - As built check. Some rail projects require additional pendular displacement calculation for the design axis. 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.  The pendular displacement calculation only influences the horizontal position of the design axis. It does not change the height of the track. 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 Info page.

Field	Option	Description
		 Rail_016 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 α Pendulum angle

Field	Option	Description
Pendular length	Editable field	Available when Work with pendular displacement is checked. The pendulum length as distance value. Positive values (0 - 9999.9999) point upwards. Negative values are not allowed.

Next step

IF you work with	THEN Page changes to the
Rail - Stakeout	Stake page.
Rail - As built check	Info page.

Stake Stringline, Stake page

 This page is available for Rail - Stakeout only.

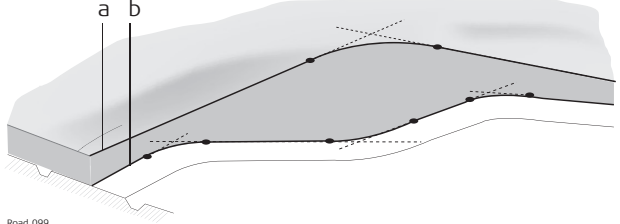
This page displays the differences between the measured point and the defined point. The position of the point to stake is reached when all difference values are close to zero. The chainage can be de-/incremented by pressing left/right arrow key. The defined value for chainage increment is applied.

Refer to "Stake Track/Check Track, General page" for a description of keys.

Refer to "42.4 Staking Out" for a description of the elements of the graphical display.

Description of fields

Field	Option	Description
Chainage	Display only	The current track chainage.
CL O	Display only	Perpendicular horizontal offset from the centreline.

Field	Option	Description
Δ chainage	Display only	Difference between the defined Stake chainage and the current chainage Chainage of the measured position. If no defined chainage exists, for example if staking out random chainages or checking, this field shows - ----.
NrTP	Display only	The chainage difference between the measured point and the nearest tangent point (start/end point of a road segment) of the design is displayed.  a) Vertical alignment b) Horizontal alignment Only tangent points (start/end point of a road segment) are detected.
Δ O	Display only	Horizontal offset between the defined position and the current position. The Stake offset defined on the Offsets page is taken into account.

Field	Option	Description
Δ height	Display only	Vertical offset between the defined position and the current position. The Stake height diff defined on the Offsets page is taken into account.

Next step

Page changes to the **Info** page.

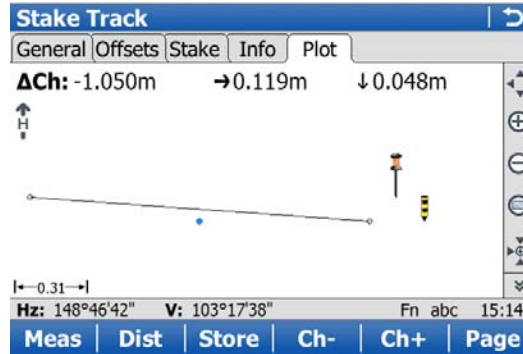
Stake Track/Check Track, Info page

The **Info** page displays the differences between the measured and design data. The fields viewed on this page can be configured in **Rail Configuration, Info** page. Refer to "Configuration, Info page" for information on all available items for the **Info** page and how to select them.

Stake Track/Check Track, Plot page

The **Plot** page displays a plot of the measured point with respect to the track design. The design is defined by the selected rail or track centreline, and the values entered on the **General** page.

The **Plot** page for Check and Stake are similar. The only difference is that the current chainage is always shown, as shown on the **Info** page.



Refer to "Stake Track/Check Track, General page" for a description of keys.

Fn Layers..

To turn layers of background maps (CAD files) on and off. Refer to "4.2 Creating a New Job" for information on CAD files and CAD background maps.

The following information is shown:

- 1) Chainage difference between the measured point and the defined chainage. When working with random chainages, for instance if no defined chainage has been entered on the **General** page, **ΔCh** changes to **Ch**. **Ch** is the current chainage as shown on the **Stake** page.
- 2) Horizontal offset (left/right arrow) to the design
- 3) Height difference (up/down arrow) to the design
- 4) The measured point
- 5) The element to stake is shown in bold and blue. The position to stake is marked with a yellow-black peg.
- 6) The plot can be shown as a cross plot or plan view by using the  eye icon on second level of MapView toolbar.

38.3.2

Offset Library

Description

To select a different stored offset or to create a new point.

Access

- 1) In **Stake Track/Check track**, **Offsets** page, select **Offsets: From library**.
- 2) Highlight **Offsets** and open the selectable list.

Rail job: Job name

This screen allows offsets relative to a reference line to be defined and stored in the rail job. These points can be recalled at any time.

Rail job: eingleisig+CL_D2F			
Point ID	Offset	Height difference	
<None>	-----	-----	
Aux0002	2.0000m	5.0000m	

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.

More

To display information about the reference rail or the Offset and the height difference.

Fn Quit

To exit the application.

Hz: 222.0003g	V: 100.0001g	Fn abc	09:20
OK	Add	Edit..	Delete
More			

Next step

Press **Add** or **Edit...**

Rail job: Job name, Offsets

This screen 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**.

38.3.3

Working with Pendular Displacements

Requirements

In **Stake Track/Check Track, Offsets** page, check **Work with pendular displacement** and type in a value for **Pendular length**.

Specific values on the Info page

Value	Description
Pendular length	The defined pendulum length as entered on Offsets page.
Def pendulum displacement	Resulting horizontal displacement at defined chainage.
Actl pendulum displacement	Resulting horizontal displacement at current chainage.
Def pendulum angle	Resulting pendulum angle at defined chainage.
Actl pendulum angle	Resulting pendulum angle at current chainage.

38.4

38.4.1

The Tools Menu

Overview

Access

Press **Fn Tools..** on any page of the Stake/Check screen.

Description

Additional functions for staking/checking the track can be accessed through the Tools menu. 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:

- "38.4.2 Use heights from DTM"
 - "38.4.3 Apply current chainage"
 - "38.4.4 Individual point"
 - "38.4.5 Second point of cant"
-

38.4.2

Use heights from DTM

Availability

This menu function is available for stake and check.

Description

The application 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 **Info** page: **DTM 2 Ht Diff**, **DTM 2 Height** and **DTM 2 Name**.
- show the DTM triangles in the planar view and in the cross section view on the **Plot** page.

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

☒ Use DTM height for stake out

DTM layer: Existing

☒ Show DTM height difference on Info page

DTM layer: Existing

☒ Show DTM on map

DTM layer: Existing

Hz: 390.1879g V: 99.9999g Fn abc 14:24

OK

OK

To confirm the settings and return to the Stake/Check screen.

Quit

To exit the application.

Description of fields

Field	Option	Description
DTM	Display only	DTM from the selected DTM job.
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.
DTM layer	Selectable list	Available when Use DTM height for stake out is checked. When selecting a DTM layer the relevant triangle of the DTM is shown on the Plot page.
Show DTM height difference on Info page	Check box	When this box is checked, a layer of the DTM to be used as a height reference on the Info page. When this box is not checked, no additional height information relative to the DTM is shown on the Info page.
DTM layer	Selectable list	Available when Show DTM height difference on Info page 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 on the Plot page.
Show DTM on map	Check box	When this box is checked, the DTM triangles are displayed in planar view on the Plot page.
DTM layer	Selectable list	All available layers are selectable.

38.4.3

Apply current chainage

Availability

This menu function is available for stake.

Description

To set **Stake chainage** on the **General** page of the stakeout to the current chainage.

38.4.4

Individual point

Availability

This menu function is available for stake.

Description

To select the point to stake from the selected **Working job**.

If a control job has been selected on the **Job Selection** screen, a point from the control 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.

To access **Data: Points** page, which allows staking out points with known Easting, Northing and Height. Points can either be selected from the **Working job** or manually typed in.

The **Stake chainage** and **Stake offset** of the Stake screen are calculated based on the coordinates of the selected point.

The height for the stakeout can be set as **Manual height**.



If the chosen point has no height the design height will be used. If the point has a height it is possible to use that one or continue working with the design height.

38.4.5

Second point of cant

Availability

This menu function is only available for check.

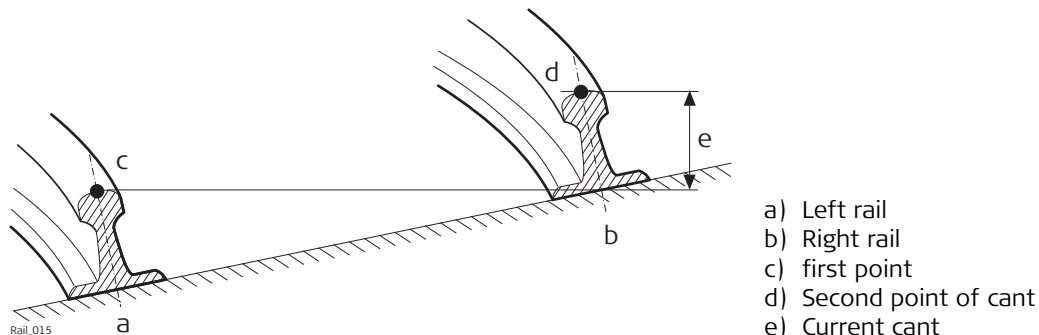
Description

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 superelevation base. The calculation is dependent upon the superelevation base.

Diagram



Procedure

Measuring the first point

The first point can be measured directly from the **Check Track** screen.

Measuring the second point

The second point is measured after accessing the **Second point of cant** in the Tools menu. Once the second point has been measured, the value **Current cant** is displayed on the **Info** page.

39

39.1

39.1.1

Downloads section



Roads - Tunnel TPS

Creating a New Tunnel Job

Preparing Design Data

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 LEICA Geo Office computer application.

Converters are available for more than 15 different design packages.

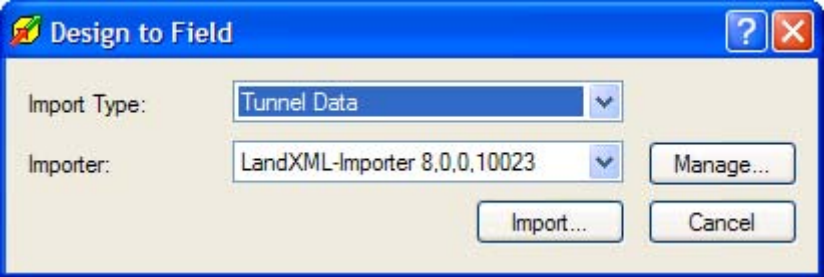
The latest version of the Design to Field importers can be found in the downloads section of:

- myWorld@Leica Geosystems
<https://myworld.leica-geosystems.com>
 - the Leica Geosystems website:
http://www.leica-geosystems.com/en/page_catalog.htm?cid=3291
-

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

Step	Description
1.	To import a centreline using the Design to Field component select the Tools/Design to Field option of the LEICA Geo Office computer application. 
2.	



For general information about Design to Field, please refer to the LEICA Geo Office manual or Online Help.

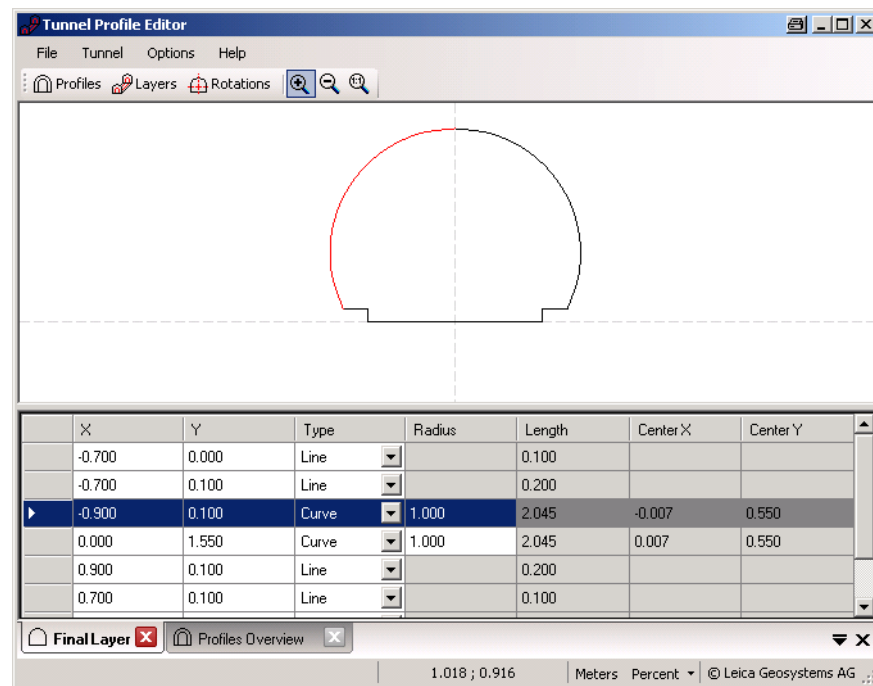
39.1.3

Design Profiles

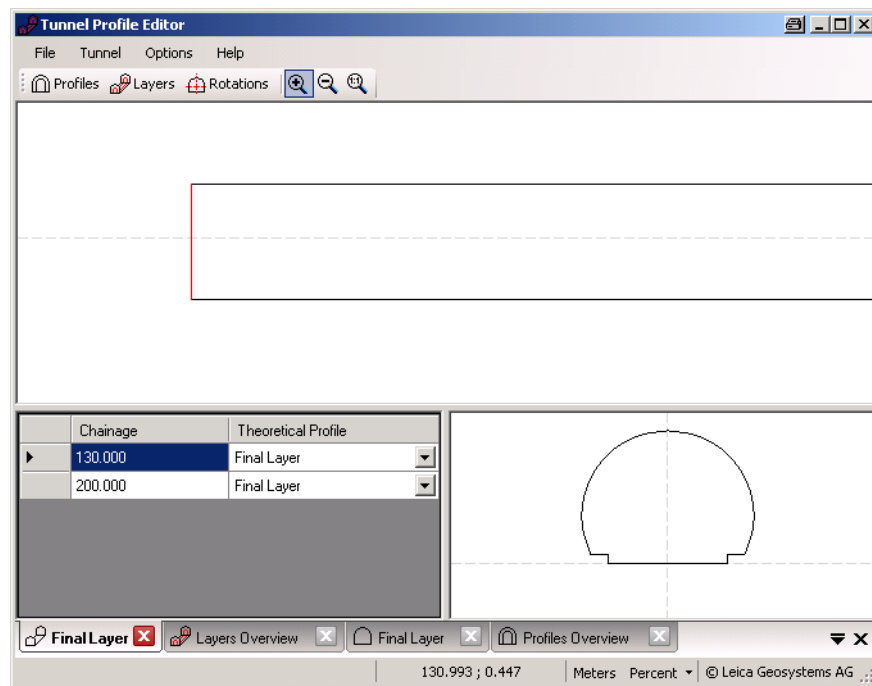
Tunnel design profiles

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

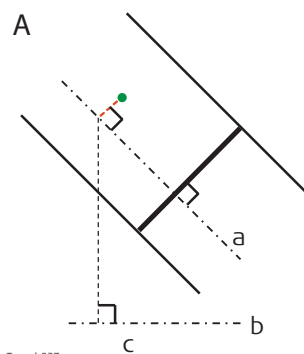


Tunnel Profile Editor, Layer details view

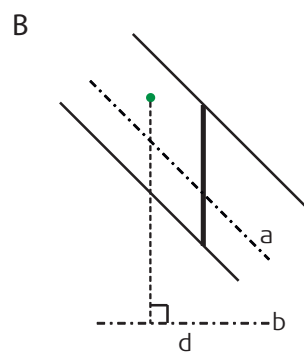


Vertical or perpendicular profiles

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

39.1.4

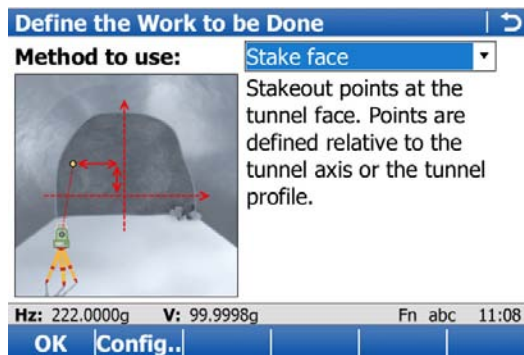
Data Transfer to Instrument

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**.

Access

- 1) Select **Main Menu: Go to Work!\Roads\Tunnel - Stakeout** or **Tunnel - As built check**.
- 2) In the screen **Job Selection**, select the required jobs. Refer to "35.4.1 Choosing a Job".
- 3) Press **OK**.

Define the Work to be Done**OK**

To continue to the next screen.

Config..

To access the configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Quit

To exit the screen.

Description of the methods

Method	Description
Stake face	Stakeout points at the tunnel face. Points are defined relative to the tunnel axis or the tunnel profile.
Stake profile	Stakeout points at defined chainages. Points are defined relative to the tunnel axis or the tunnel profile.
Check profile	Measure deviations of the built tunnel to the original design.

Method	Description
Scan profile	Automatically scan profiles in a defined section of the tunnel

Next step

OK accesses the **Define** screen.

Define

The screen is an example valid for **Method to use: Stake face**.

OK

To continue to the next screen.

Shifts..

To apply horizontal, vertical and profile shifts to the selected element. Refer to "35.5 Working with Shifts".

Load..

To load a task. Refer to "35.6 Tasks".

Save..

To save the settings as task. Refer to "35.6 Tasks".

Fn Config..

To access the configuration settings. Refer to "35.3 Configuring Roads Applications".

Fn Quit

To exit the application.

Description of fields

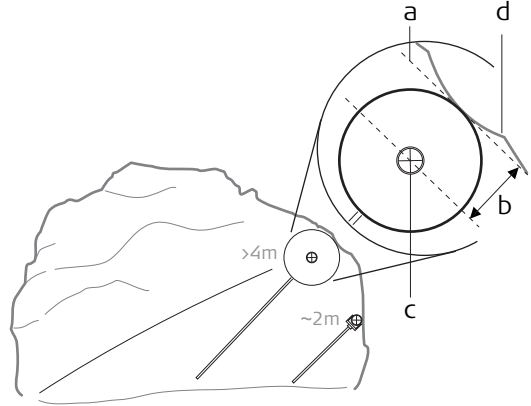
Common to all methods

Field	Option	Description
Layer	Display only or selectable list	Layers contained in the active tunnel job can be selected.
Centreline	Display only	The name of the layer centreline.

For **Method to use: Stake face**

Field	Option	Description
Drilling rig orientation	Check box	Available for Method to use: Stake face . 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.
Drilling distance	Editable field	The bore hole length. Available when Drilling rig orientation is checked.
Boom length	Editable field	The length of the drilling rig. Available when Drilling rig orientation is checked.
Tolerance	Editable field	Defines how accurate the drilling rig must be positioned to calculate the delta angles (max 10% of boom length). Available when Drilling rig orientation is checked.

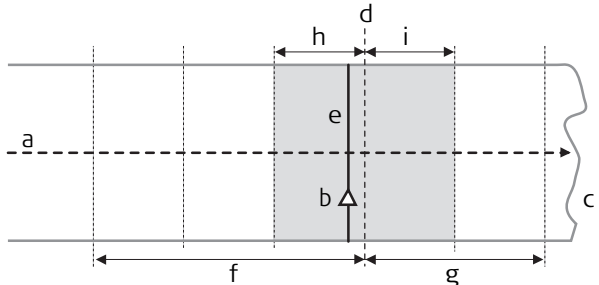
For **Method to use: Check profile**

Field	Option	Description
Apply target radius	Check box	Available for Method to use: Check profile. When using a prism to check a design profile, it is important to take the prism radius into account. 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. 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

Field	Option	Description
		a) Tangent to design profile b) Prism radius c) Prism d) Design profile If reflectorless measurements are used or no design profile has been defined, the prism radius parameter will not be used in the calculation. In Check Profile, Plot page a plot of the measured point regarding the design profile is displayed.
Target radius	Editable field	Available for Method to use: Check profile and when Apply target radius is checked. The radius of the prism.

For **Method to use: Scan profile**

Field	Option	Description
Scan area defined by	Chainage or Distance	Available for Method to use: Scan profile . When measuring tunnel profiles, it is possible to scan various profiles from one instrument position. Profiles are scanned at a given forward and back interval within a given forward and back distance or chainage from the defined profile.

Field	Option	Description
		Plan view  Tunnel_009 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

39.3

39.3.1

Stake face/Stake
profile/Check profile,
General page

Staking/Checking the Tunnel

Overview

This screen is an example valid for **Method to use: Stake profile.**

The screenshot shows the 'Stake Profile' screen with the following elements:

- Title Bar:** 'Stake Profile' with a back arrow on the left and a right arrow on the right.
- Tabs:** 'General', 'Offsets', 'Stake', 'Info', 'Plot'. The 'Stake' tab is currently selected.
- Input Fields:**
 - Point ID:** A text field containing 'TPS0003'.
 - Stake chainage:** A text field containing '-----' with a unit 'm' to its right.
 - Change increment:** A text field containing '0.0000' with a unit 'm' to its right.
- Bottom Bar:** A navigation bar with buttons: 'Meas', 'Dist', 'Store', 'Ch-', 'Ch+', and 'Page'.
- Status Bar:** At the very bottom, it displays 'Hz: 199.7619g', 'V: 159.9972g', 'Fn abc', and '09:04'.

Meas

To measure a distance and store distance and angles.

Dist

To measure a distance.

Store

To store angles and distance. Distance must be measured before.

Ch-

Available for **Tunnel - Stakeout**. To decrease the chainage as defined by **Change increment**.

Dist+

To increase the distance along the profile. Available for **Input method: Profile, dist & offset** and **Input method: Dist from top&offset**.

Ch+

Available for **Tunnel - Stakeout**. To increase the chainage as defined by **Change increment**.

Page

To change to another page on this screen.

Fn Config..

To access configuration settings.

Refer to "35.3 Configuring Roads Applications".

Fn Positn

Available for **Tunnel - Stakeout**. 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:

- the number of iterations set as the configuration parameter **Max iterations** is reached, or
- the difference between the measured point and the design point is less than the value set as the configuration parameter

Position limit.

Fn Tools..

Available for **Tunnel - Stakeout**. To access the tools menu.

Refer to "37.4 The Tools Menu".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	The point identifier of the point to be staked.
Stake chainage	Editable field	Available for Tunnel - Stakeout . The defined or approximate chainage of the point to be staked out.
Chainage increment	Editable field	Available for Method to use: Stake profile . Chainage increment. Value by which the nominal chainage increases/decreases when pressing Ch+/Ch- . If a point is to be staked at more than one chainage, a chainage increment can be defined.
Target height	Editable field	Available for Method to use: Check profile . 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, General page

Scan Profile	
General	Offsets
Point ID:	TPS0003
Stake chainage:	221.0953 m
Back distance:	----- m
Back interval:	----- m
Forward distance:	----- m
Forward interval:	----- m

Hz: 199.7624g	V: 159.9971g	Fn abc	09:19
Start	GetBck	GetFwd	Manual
			Page

Start

Available for automatic scanning. To start the scanning process. Refer to "Making a scan".

Stop

Available for automatic scanning. To stop the scanning process.

Pause

To pause the scan. Refer to "Making a scan".

GetBck

Available for automatic scanning. To measure a distance from the instrument position and to calculate the difference in chainage between the measured point and the chainage of the instrument position. The calculated difference is then set as

Back distance.

The measured point for a back distance must always be at a chainage less than the chainage of the instrument position. If this condition is not met, an error message is displayed and it is necessary to redefine the distance.

GetFwd

Available for automatic scanning. To measure a distance from the instrument position and to calculate the difference in chainage between the measured point and the chainage of the instrument position. The calculated difference is then set as

Forward distance.

The measured point for a forward distance must always be at a chainage greater than the chainage of the instrument position. If this condition is not met, an error message is displayed and it is necessary to redefine the distance.

Meas

Available for manual scanning. To measure a distance and store distance and angles.

Dist

Available for manual scanning. To measure a distance.

Store

Available for manual scanning. To store angles and distance. Distance must be measured before.

Manual or Auto

To switch between manual and automatic scanning. Refer to "Defining discrete points to measure".

Page

To change to another page on this screen.

Fn Config..

To access configuration settings.
Refer to "35.3 Configuring Roads Applications".

Fn Limit

To define the scan limits. Refer to "Making a scan".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	The point identifier of the point to be staked.
Stake chainage	Editable field	The defined or approximate chainage of the point to be staked out.
Back interval and Forward interval	Editable field	Profiles are scanned at a given forward/back interval within a given forward/back distance/chainage from the defined profile.
 The scan area can be defined by distances from the instrument setup point or as chainage range.		
Back distance and Forward distance	Editable field	The limit for the profile measurements is entered manually or is measured using the GetBck/GetFwd . Available for Scan area defnd by: Distance .
Back chainage and Forward chainage	Editable field	Available for Scan area defnd by: Chainage .

**Stake face/Stake
profile/Check
profile/Scan profile,
Offsets page**

Next step

Page changes to the **Offsets** page.

Refer to "Stake face/Stake profile/Check profile, General page" for a description of keys.

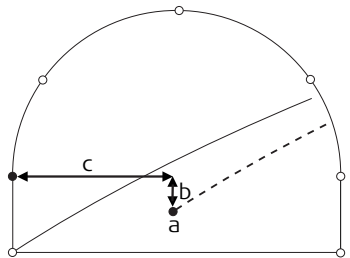
Description of fields

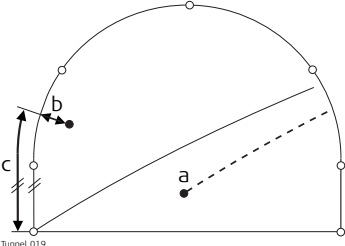
Common for all methods

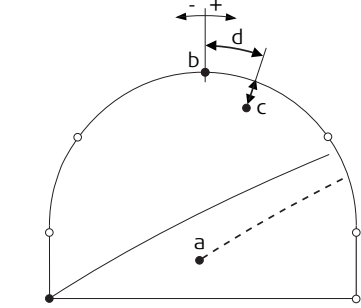
Field	Option	Description
Apply offsets	Check box	When this box is checked, horizontal and vertical offsets can be applied.

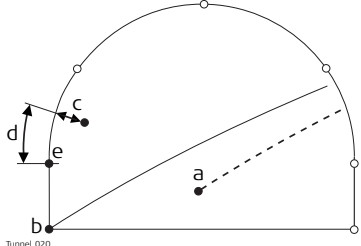
For **Tunnel - Stakeout**

Field	Option	Description
Input method	Offset & height	To define the position of the point to be staked out. The point is staked out with a known perpendicular and vertical offset from the horizontal and vertical alignments respectively.

Field	Option	Description
	From job Profile, dist & offset	 Tunnel_018 a) Centreline b) Centreline height difference c) Centreline offset The offsets of the point are stored as coordinates in the Working job. The Stake offset is stored as the X coordinate and the Stake height diff is stored as the Y coordinate. The point is defined by the distance from the start of the profile and an offset perpendicular to the design profile.

Field	Option	Description
	Dist from top&offset	 a) Centreline b) Profile offset c) Distance from start of design profile The point is defined by the distance from the top of the tunnel and an offset perpendicular to the design profile.

Field	Option	Description
	Element & offset	 Tunnel_028 a) Centreline b) Top of profile c) Offset perpendicular to the profile segment d) Distance from the top of the profile 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
		 Tunnel 020 a) Centreline b) Point defining start of design profile c) Offset perpendicular to profile segment d) Distance from start of start point of segment in % e) Start point of segment
Stake offset	Editable field	Applies a horizontal offset perpendicular to the centreline. Available for Input method: Offset & height.
Stake height diff	Editable field	Applies a vertical offset to the centreline. Available for Input method: Offset & height.
Point ID	Selectable list	Available for Input method: From job.
Profile distance	Editable field	The distance from start of design profile. Available for Input method: Profile, dist & offset.
Top distance	Editable field	The distance from the top of the tunnel. Available for Input method: Dist from top&offset.

Field	Option	Description
Profile offset	Editable field	The offset from the design profile. Available for Input method: Profile, dist & offset , Input method: Dist from top&offset and Input method: Element & offset .
Increment	Editable field	To increment the distance for offset definitions as distance and offset. Available for Input method: Profile, dist & offset and Input method: Dist from top&offset .
Element no.	Editable field	Element number 1 is the first element of the design profile.
% Element	Editable field	Distance in percentage terms of the measured point along the design profile element.
Check offset	Editable field	Available for Method to use: Check profile . Applies a horizontal offset perpendicular to the centreline used for comparing to the measured point.
Check height diff	Editable field	Available for Method to use: Check profile . Applies a vertical offset to the centreline used for comparing to the measured point.

For **Tunnel - As built check**

Field	Option	Description
Check offset	Editable field	Applies a horizontal offset perpendicular to the centreline used for comparing to the measured point.
Check height diff	Editable field	Applies a vertical offset to the centreline used for comparing to the measured point.

Next step

IF you work with	THEN Page changes to the
Tunnel - Stakeout	Stake page.
Tunnel - As built check	Info page.

Stake face/Stake profile, Stake page



This page is available for Tunnel - Stakeout 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/Check profile, General page" for a description of keys. Refer to "42.4 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 O	Display only	Perpendicular horizontal offset from the centreline.
Δ chainage	Display only	Difference between the Stake chainage and the current chainage. If no defined chainage exists, for example if staking out random chainages or checking, this field shows - ----.

Field	Option	Description
Δ O	Display only	Horizontal offset between the defined position and the current position. The offset defined on the Offsets page is taken into account.
Δ height	Display only	Vertical offset between the defined position and the current position. The height difference defined on the Offsets page is taken into account.

Next step

Page changes to the **Info** page.

Stake face/Stake profile/Check profile/Scan profile, Info page

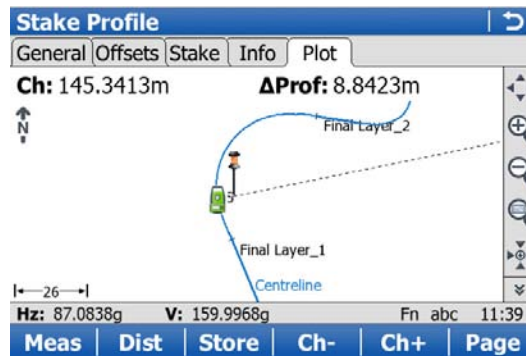
The **Info** page displays the differences between the measured and design data.

The fields viewed on this page are be configurable.

Refer to " Configuration, Info page" for information on all available items for the **Info** page and how to select them.

**Stake face/Stake
profile/Check
profile/Scan profile,
Plot page**

The **Plot** page displays a plot of the measured point regarding the tunnel design.
This screen is an example valid for **Method to use: Stake profile**.



Ch-

Available for **Tunnel - Stakeout**. To decrease the chainage as defined by **Change increment**.

Ch+

Available for **Tunnel - Stakeout**. To increase the chainage as defined by **Change increment**.

39.3.2

Stake face

Stake face

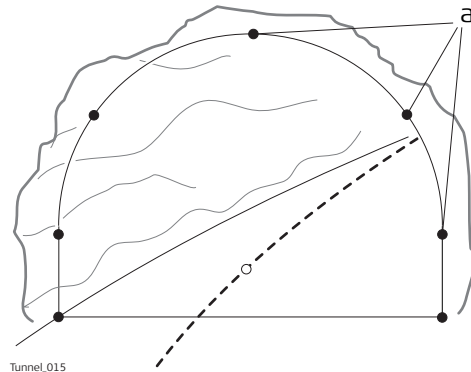
Overview

When excavating a tunnel, it is required to stake out the tunnel portal before excavation can begin. In addition, for excavation methods other than those involving tunnel boring machines (TBMs), it is then 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 application using **Stake face**.

This function allows the setting 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

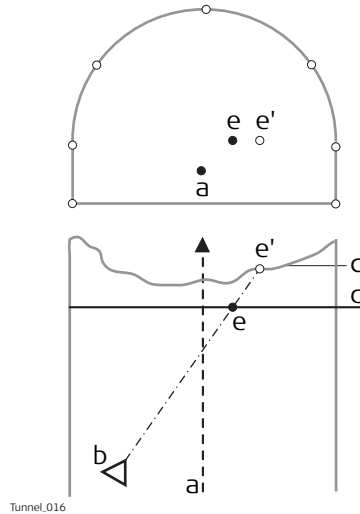
Given that it is likely that a degree of rock debris is present at the tunnel face or that inexact excavation techniques such as blasting are used, it cannot be assumed that the tunnel face at any stage of the excavation is perpendicular to the horizontal alignment.

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 stake 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

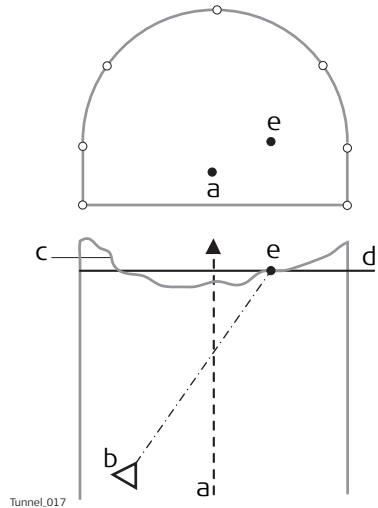


- a) Centreline
- b) Instrument position
- c) Tunnel face
- d) Approximate chainage to stake out
- e) Point to stake out at approximate chainage
- e') Point to stake out on tunnel face

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 tolerance set by the user.



- a) Centreline
- b) Instrument position
- c) Tunnel face
- d) Calculated chainage from first iteration
- e) Point to stake out at calculated chainage

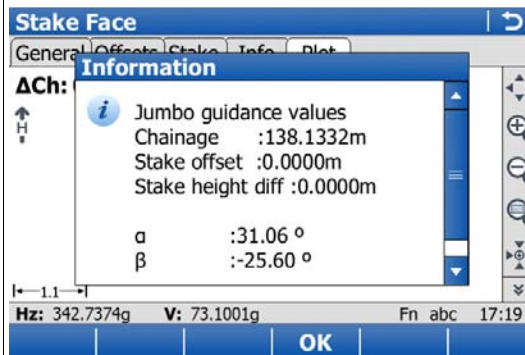
Drilling rig orientation

Description

This functionality helps to orientate the drilling rig when drilling holes parallel to the tunnel axis direction. The entry point at the tunnel face will be marked and delta angles to align the drilling rig are provided.

Drilling rig orientation step-by-step

Step	Description
1.	Make sure that Tunnel - Stakeout and Method to use: Stake face is selected.
2.	In the Define screen check Drilling rig orientation and type in the values.
3.	In Stake Face, General page, define the entry position relative to the axis or to the profile.  Fn Positn to stake out that point.
4.	Roughly position the drilling bit and target to its end.
5.	Fn Tools... Select Check Jumbo position to get the delta angles for the final rig orientation.

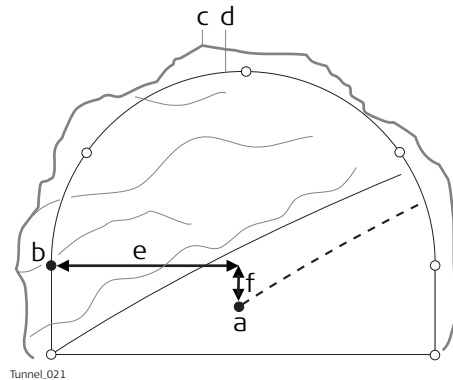


α Horizontal angle
 β Vertical angle

39.3.3

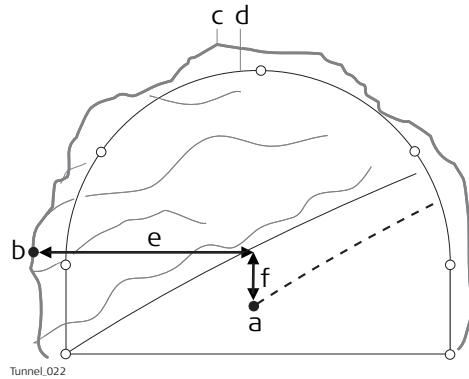
Stake profile and Check profile

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



Scan limits

The instrument measure always the profile in the chainage where the instrument is stationed before measuring additional profiles.

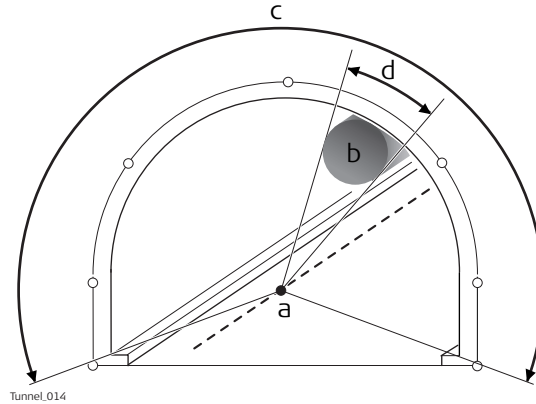
Inclusive and exclusive sections

Once the chainages of the profiles to scan have been defined, and before starting the measurement, it is necessary to define the limits of the scan.

The scan limits are used to define the angular limits to be scanned in a plane perpendicular to the centreline. These limits normally define the starting point and end point of the profile to scan as well as any zone that is excluded from measuring.

Limits are defined regarding the instrument axis. In the following example, a limit is defined. This limit includes the entire area to be scanned and an overlapping area that is not scanned because a ventilation shaft is obstructing a clear view of the tunnel surface.

Any number of limits is definable. In addition each limit must be defined as an include limit, that is measure within the defined zone, or an exclude limit, that is do not measure within the defined zone. If overlapping zones are defined, an exclude limit has priority over an include limit.



- a) Instrument axis
- b) Ventilation shaft
- c) Include limit
- d) Exclude limit

Access

Press **Fn Limit** in **Scan Profile**.

Angular Limits

Angular Limits			↩
Limit	Measure	Increment	
1	Yes	0.5000m	
2	No	0.5000m	

OK

To return to **Scan Profile** after defining the angular limits,

New..

To create a new angular limit.

Edit..

To edit a defined limit.

Delete

To delete a defined limit.

Fn Default

To use the angular limits by default.

Fn Quit

To exit the application.

Hz: 199.7621g	V: 159.9972g	Fn abc	09:37
OK	New..	Edit..	Delete

Description of columns

Column	Description
Limit	The name of the limit.
Measure	Yes indicates an include limit within which points are measured. No indicates an exclude limit which is not measured.
Increment	The approximate distance between the points to be measured.

Next step

New.. to access **New Angular Limits**.

New Angular Limits

New Angular Limits

Hz: 199.7619g
V: 159.9969g
Slope distance: -----m
Limit name: 3
☒ Measured status
Increment: 0.5000 m
Full scan: No
Angle start: -----

Hz: 199.7619g V: 159.9969g Fn abc 13:11

OK Dist Positn

OK

To store the defined limit and return to **Angular Limits**,

Dist

To measure the distance to points at the starting angle and the end angle of a limit. Available when **Angle start** or **Angle end** is highlighted.

Positn

To review the position of the limit once it has been defined. The instrument turns to the corresponding angle. Available when **Angle start** or **Angle end** is highlighted.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Hz	Display only	Current horizontal angle of the instrument.

Field	Option	Description
V	Display only	Current vertical angle of the instrument.
Slope distance	Display only	The slope distance measured by pressing Dist .
Limit name	Editable field	The name of the limit.
Measured status	Check box	When this box is checked, it can be defined whether points are measured within the limit.
Increment	Editable field	The approximate distance between points to be measured.
Full scan	Yes	The whole measurement area is scanned. The area around the tripod cannot be scanned.
	No	The limit is defined manually.
Angle start	Display only	The angle measured to the point at the beginning of the limit.
Angle end	Display only	The angle measured to the point at the end of the limit.

Defining a limit step-by-step

Step	Description
1.	Type in the Limit name .
2.	Highlight Angle start .
3.	Turn the instrument to point at the starting angle of the limit.
4.	Press the Dist to measure the distance.

Step	Description
5.	Highlight Angle end .
6.	Turn the instrument to point at the end angle of the limit.
7.	Press the Dist to measure the distance.
8.	Enter the approximate distance between points to be measured on the line Increment .

Defining discrete points to measure

Measure additional points

In addition to defining the chainage and the angular limits of the profiles to scan, it is also possible to define discrete points in the profile. Discrete points are to be measured at each chainage.

These points could represent a breakpoint in the section, for example, or a point that is required for positioning services such as electricity cables.

Defining a manual point step-by-step

Step	Description
1.	In Scan Profile press Manual .
2.	Aim at the point to measure.
3.	Use Meas , Dist and Store to measure the point in the usual manner.
4.	Repeat the process for all the manual points that are required to be added to the profile.

Making a scan

Starting the scan

Once all manual points have been defined, the scanning of the profiles is started by pressing **Auto**. If no manual points are required, scanning of the profiles is started by pressing **Start**.

Once scanning has started, the values of the measured point are viewed in **Scan Profile, Info** page. The values shown on this screen can be configured in the configuration. Refer to "35.3 Configuring Roads Applications" for more information.

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**.

Pause and options before continuing

Once the scan has been paused, several options are available before continuing:

- **Stop**: To end the scan.
- **Resum**: To continue the scan at the next position. Turn the instrument to skip a section of the profile if needed.
- **Prof+**: To skip the remaining points in the profile being measured and to move on to the next profile.
- **Manual**: To add a point measured manually to the measured profile. If this key has been pressed, the automatic scan is resumed by pressing **Auto**.

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 back distance or forward distance defined in **Scan Profile, General** page were too large.
-

Description

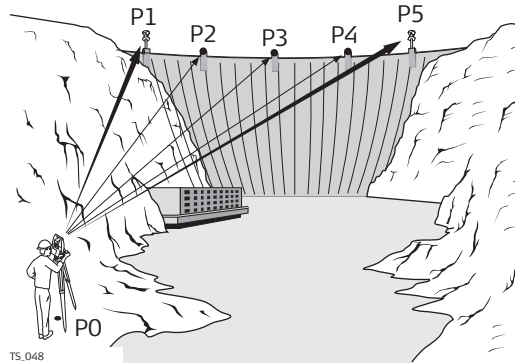
Sets of Angles:

- This application is used to measure multiple sets of directions and distances (optional) to pre-defined target points in one or two faces. The application can include Monitoring as an option.
- 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.

Monitoring:

- This module can be 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.
-

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) Residual for each direction and distance (optional), within a set
- c) Reduced average direction and average distance (optional) to each target point, for all active sets

Measure at least:

- a) Two target points
- b) Two 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.
Station setup and station orientation	If oriented grid coordinates are to be recorded, a station set up and station orientation is required before starting the Sets of Angles application.
Point properties	The properties stored with Sets of Angles points are: • Class: Meas or None • Sub class: TPS • Source: Sets of Angles • Instrument source: TPS
Point averaging	An average is never calculated for Sets of Angles points, even if a measured point of class Meas already exists with the same point ID.

40.2

40.2.1

Sets of Angles

Accessing Sets of Angles

Access

Select **Main Menu: Go to Work!\Survey+\Sets of Angles.**

Choose Control Job



OK

To accept changes and access the next screen. The chosen settings become active.

Fn Config..

To configure the Sets of Angles application. Refer to "40.2.2 Configuring Sets of Angles".

Fn Quit

To exit the application.



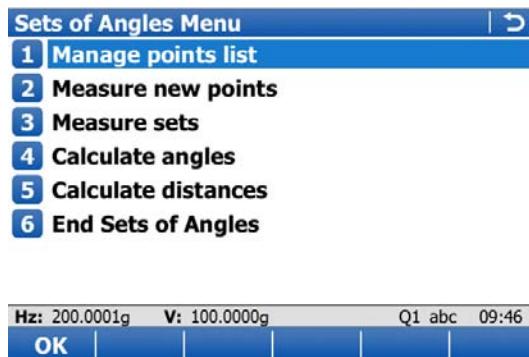
Description of fields

Field	Option	Description
Control job	Selectable list	The job where the target points to be observed can be selected and a points list created.

Next step

OK accepts the changes and accesses **Sets of Angles Menu.**

Sets of Angles Menu



OK

To select the highlighted option and to continue with the next screen.

Fn Config..

To configure the Sets of Angles application. Refer to "40.2.2 Configuring Sets of Angles".

Fn Quit

To exit the application.

Description of Sets of Angles Menu options

Options	Description
Manage points list	To create, edit and manage a points list of the target points for the survey. Refer to "40.2.3 Managing the Points List".
Measure new points	To define the target points and to measure the first set. Refer to "40.2.4 Measuring the New Points".
Measure sets	To measure the second set and any further sets. Refer to "Measure Sets".
Calculate angles	To calculate horizontal/vertical angles and their residuals. Refer to "40.2.6 Calculations - Calculating Angles and Distances in Two Faces".

Options	Description
Calculate distances	To calculate distances and their residuals. Refer to "40.2.7 Calculations - Viewing Angle and Distance Results in Two Faces".
End Sets of Angles	To end the Sets of Angles program.

40.2.2

Configuring Sets of Angles

Access

Select **Main Menu: Go to Work!\Survey+\Sets of Angles**. Press **Fn Config...**

Configuration, Tolerances page

Description of fields

Field	Option	Description
Use tolerances	Check box	If checked, the entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements.
Hz tolerance	Editable field	Tolerance for horizontal directions.
V tolerance	Editable field	Tolerance for vertical directions
Distance tolerance	Editable field	Tolerance for distances.

Next step

Page changes to the **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.

Field	Option	Description
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

Page changes to the first page on this screen.

40.2.3

Managing the Points List

Description

A points list of the target points for the survey can be created, edited and managed. New points are always added from the fixpoint job, as defined in the Sets of Angles Begin screen.

Access

Highlight **Manage points list** in **Sets of Angles Menu** and **OK**.

Point list name

Points List	
Point	No. points
List3	9
List1	2
List2	3

Hz: 200.0000g		V: 99.9999g		Q1 abc		09:53	
OK	New	Edit	Delete	More			

- OK**
To return to the Sets of Angles Menu.
- New**
To create a new points list.
- Edit**
To edit an existing points list.
- Delete**
To delete an existing points list.
- More**
To display additional information.
- Fn Quit**
To exit the application.

Next step
New to access **New Points List**.

New Points List, General page

New Points List | ↻

General | Points

Point list name:

☐ **Automatically survey this point**

☒ **Auto sort points**

Hz: 200.0003g V: 99.9998g Q1 abc 09:56

Store | | | | **Page**

Store

To store the new points list.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point list name	Editable field	The name of the points list.
Automatically survey this point	Check box	Check this box to survey the target points automatically. The instrument will automatically turn and measure the target point. For instruments with automatic aiming.
Auto sort points	Check box	Check this box to sort the target points automatically. The instrument will work in a clockwise direction and find the shortest path to move between the target points.

New Points List, Points page

Select Points	
General	Points
Point	Point code
TPS0001	SV
TPS0002	TSB
TPS0003	ELP

Hz: 395.4943g	V: 100.8935g	Q1 abc	11:06
Store	+ All	+ 1	Remov
More	Page		

Store

To store the points to the list.

+ All

To add points from the fixpoint job to the list.

+ 1

To add one point from the fixpoint job to the list.

Remov

To remove the highlighted point from the list. The point itself is not deleted.

More

To display additional information.

Page

To change to another page on this screen.

Fn Rmv all

To remove all points from the list.

Fn Quit

To exit the application.

40.2.4

Measuring the New Points

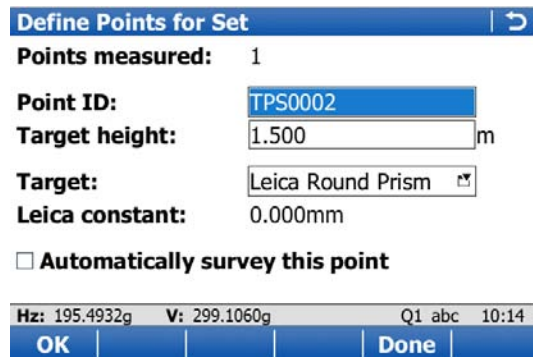
Description

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 **Measure new points** in **Sets of Angles Menu** and **OK**.

Define Points for Set



Define Points for Set | ➔

Points measured: 1

Point ID: TPS0002

Target height: 1.500 m

Target: Leica Round Prism

Leica constant: 0.000mm

☐ **Automatically survey this point**

Hz: 195.4932g V: 299.1060g Q1 abc 10:14

OK Done

OK

To measure the entered point and to access **Select Points - Survey**.

Done

To finish selection of points and access **Sets of Angles Menu** for further steps.

Fn Get Pt

To select points stored in the database.

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Automatically survey this point	Check box	Available for instruments with automatic aiming and Target aiming: Automatic . If checked, search and measurements are done to specified targets in additional sets.

Next step

IF	THEN
new or selected points are to be measured	OK to access Select Points - Survey .
existing points are to be selected	Fn Get Pt to select a point from Data, Points page.
all desired points have been selected and measured	Done to return to the Sets of Angles Menu .

Select Points - Survey, Sets page

Select Points - Survey

Sets Appl Map

Point ID: TPS0002

Target height: 1.500 m

Hz: 195.4936g

V: 299.1061g

Slope distance: 106.831m

Δ Hz: ----g

Δ V: ----g

Hz: 195.4936g V: 299.1060g Q1 abc 10:16

Meas Dist Store Positn Page

Meas

To measure and store the angles and distance, and to return to **Define Points for Set**.

Dist

To measure a distance.

Store

To store data and to return to **Define Points for Set**.

Positn

To position the instrument to the selected target point. Available if the target point has been selected using **Fn Get Pt** in the **Define Points for Set** screen.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Δ Hz	Display only	Difference between the current horizontal angle and the horizontal angle to this target when selected.
Δ V	Display only	Difference between the current vertical angle and the vertical angle to this target when selected.
Δ slope	Display only	Difference between the current slope distance to the target and the slope distance to this target when selected.

Next step

Meas to measure and store the angles and distance, and to return to **Define Points for Set**.

40.2.5

Measuring the Sets

Description

The selected points from **Measure new points** are used for measuring further sets. The settings of measurements are taken from the first measurement to each target.

Access

Highlight **Measure Sets** in **Sets of Angles Menu** and **OK**.

Measure Sets

Measure Sets | ↩

Enter no. of sets to be measured

No. of sets: 2

No. of points: 3

OK

Opens a screen to measure the points.
When auto survey is activated, measurements are done automatically.

Hz: 395.4932g V: 100.8939g Q1 abc 10:17
OK | | | | |

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
No. of sets	Editable field	The number of sets to measure with the target points. There is a maximum of 99 sets allowed.
No. of points	Display only	The number of target points.

Next step

OK to measure further sets of the defined points.

Set n of n, Pt n of n,
Sets page

Set 2 of 3, Pt 1 of 3

Sets Appl Map

Point ID: TPS0001

Target height: 1.500 m

Hz: 395.4934g

V: 100.8934g

Slope distance: 106.831m

Δ Hz: 0.0001g

Δ V: 0.0003g

Hz: 395.4934g V: 100.8937g Q1 abc 10:20

Meas Dist Store Skip Done Page

Meas

To measure and store the angles and distances, and to increment to the next point.

Dist

To measure a distance.

Store

To store data and to increment to the next point.

Skip

To skip measuring the displayed point and continue with the next point.

Done

To end the sets of angles measurements and to return to **Sets of Angles Menu**.

Page

To change to another page on this screen.

Fn Positn

To position the instrument to the selected target point.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Δ Hz	Display only	Difference between the current horizontal angle and the horizontal angle to this target when selected.
Δ V	Display only	Difference between the current vertical angle and the vertical angle to this target when selected.
Δ slope	Display only	Difference between the current slope distance to the target and the slope distance to this target when selected.

Next step

Meas 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.

For the calculation, two entire sets must be measured. Horizontal and vertical angles and distances can be calculated individually.



40.2.6

Calculations - Calculating Angles and Distances in Two Faces

Description

For two or more sets, measured with angles and distances in two faces calculations can be done for angles and distances. For sets measured in one face, the results can be viewed but no calculations are done. Refer to "40.2.8 Calculations - Viewing Results in One Face" for more information.

Access

Highlight **Calculate Angles** or **Calculate Distances** in **Sets of Angles Menu** and **OK**.

Calculate Angles/Calculate Distances, Hz Set/V Set/Distance set page

The softkeys are the same for vertical angles, horizontal angles and distances.

Calculate Angles | ➔

Hz Set | V Set | Plot

Points active: 3

Sets active: 3

SD single direction: 0.0002g

SD avg direction: 0.0001g

Hz: 395.4932g V: 100.8936g Q1 abc 10:21

OK | | | More | Page

OK

To access **Sets of Angles Menu**.

More

To view results of calculation. Refer to "40.2.7 Calculations - Viewing Angle and Distance Results in Two Faces".

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Points active	Display only	Number of active points which are set to Yes in the Use column and used for calculation.

Field	Option	Description
Sets active	Display only	Number of active sets which are set to Yes in the Use column and used for calculation.
SD single direction	Display only	Standard deviation of a single horizontal or vertical direction.
SD single distance	Display only	Standard deviation of a single distance.
SD avg direction	Display only	Standard deviation of the average horizontal or vertical direction.
SD avg distance	Display only	Standard deviation of the average distance.

Next step

Page accesses the **Plot** page. The functionality and softkeys available are described in the MapView chapter. Refer to "28.4.1 Screen Area" for information functionality.

40.2.7

Calculations - Viewing Angle and Distance Results in Two Faces

Access

Press **More** in **Calculate Angles** or **Calculate Distances**.

Angle Results/Distance Results

Angle Results			
Set	Use	Hz Σr	V Σv
1	Yes	0.0004g	-0.0000g
2	Yes	-0.0004g	0.0000g
3	No	-----	-----

OK

To return to the previous screen.

Edit..

To access **View Residuals in Set n**.

Use

To set **Yes** or **No** in the **Use** column for the highlighted set.

Hz: 395.4933g	V: 100.8935g	Q1 abc	10:23
OK	Edit..	Use	

Fn Quit

To exit the application.

Description of columns

Column	Description
Set	Displays the numbers of all sets measured.
Use	For Yes : The selected set is used for calculations. For No : The selected set is not used for calculations.
Hz Σr	Shows the calculated 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.

Column	Description
V Σv	Shows the calculated 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.

Next step

Edit.. to access **View Residuals in Set n.**

View Residuals in Set n

Residuals in Set 1				↩
Point ID	Use	sd	Resdl V	
TPS0001	Yes	0.0000g	0.0000g	
TPS0002	Yes	0.0003g	0.0000g	
TPS0003	Yes	0.0001g	-0.0001g	

OK

To return to the previous screen.

Use

To set **Yes** or **No** in the **Use** column for the highlighted point.

More

To view additional information.

Fn Quit

To exit the application.

Hz: 395.4938g	V: 100.8935g	Q1 abc	10:25
OK		Use	More

Description of columns when calculating angles

Column	Description
Point ID	This column is always visible. Point ID of the measured points in the order they were defined and measured in Measure new points .
Use	For Yes : The selected point is used for calculations in all sets. For No : The selected point is not used for calculations in any set.
sd	Residual in the angle of the selected point within the single set.
sd	Residual in the Hz value of the selected point within the single set.
Resdl V	Residual in the V value of the selected point within the single set.
Avg Hz	Reduced Average Hz value of the point in all active sets.
Avg V	Average V value of the point in all active sets.
Mean Hz	Mean Hz value of the point within the single set.
Mean V	Mean V value of the point within the single set.

Description of columns when calculating distances

Column	Description
Point ID	This column is always visible. Point ID of the measured points in the order they were defined and measured in Measure new points .
Use	For Yes : The selected point is used for calculations in all sets. For No : The selected point is not used for calculations in all sets.
Resdl SD	Residual in the distance value of the point within the single set.

Column	Description
Avg SD	Average distance value of the point in all active sets.
Mean SD	Mean distance value of the point within the single set.

40.2.8

Calculations - Viewing Results in One Face

Access

Highlight **Calculate Angles** or **Calculate Distances** in **Sets of Angles Menu** and press **OK**.

Single Face Results

Single Face Results			↩
Point ID	SD Hz	Avg Hz	
TPS0001	0.0003g	395.4945g	
TPS0002	0.0001g	395.4946g	
TPS0003	0.0001g	395.4948g	

OK

To return to the previous screen.

More

To view additional columns.

Hz: 395.4947g	V: 100.8938g	Q1 abc	10:28
OK			More

Fn Quit

To exit the application.

Description of columns

Column	Description
Point ID	Point ID of the measured points in the order they were defined and measured in Measure new points .
SD Hz	Standard deviation of all Hz readings to the point.
Avg Hz	Average value of all Hz readings to the current point.
SD V	Standard deviation of all V readings to the current point.
Avg V	Average value of all V readings to the current point.

Column	Description
SD distance	Standard deviation of all distance measurements to the current point.
Avg SD	Average value of all distance measurements to the current point.

Description

Monitoring is a module integrated within the Sets of Angles application. 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 screens during measurement sets is also enabled.

Important aspects

For monitoring, instruments must be motorised.

Monitoring is licence protected and is only activated through a licence key. The licence key can be entered manually or loaded from the data storage device.

Monitoring preparation

This step-by-step description is an example on preparing a set for monitoring.

Step	Description
1.	Set station coordinates and station orientation.
2.	Select Main Menu: Go to Work!\Survey+\Sets of Angles .
3.	In Choose Control Job , select the control job and press OK .
4.	In Sets of Angles Menu press Fn Config.. to configure Sets of Angles for monitoring. For the Parameters page set: • Measure method: A'B'A"B" (for example purposes only). • Page to show: None (for example purposes only). • Stop measuring for: All messages (for example purposes only). • Time out: 10 secs (for example purposes only).

Step	Description
	• Define time when sets should be measured (timer monitoring) (this option must be selected for monitoring). This setting will enable access to the Define Monitoring Timer screen.
5.	Press OK to access the Sets of Angles Menu screen.
6.	Select Measure new points .
7.	Press OK to access the Define Points for Set screen.
8.	Enter details of the target point as required. For each target point, ensure that auto survey is activated. This setting will enable 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 - Survey screen.
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 Sets of Angles Menu screen will be accessed.
13.	Select Measure Sets .
14.	Press OK to access the Define Monitoring Timer screen.

Define Monitoring Timer Description of fields

Field	Option	Description
Begin date	Editable field	Start date for monitoring.
Begin time	Editable field	Start time for monitoring.
End date	Editable field	End date for monitoring.
End time	Editable field	End time for monitoring.
Interval	Editable field	The time between the start of each scheduled measurement set.
Stop measuring for	Selectable list	To define what action is taken when a message screen appears during a measurement set. The setting for this editable field has already been defined in the configuration. It can be changed in this screen if desired, before starting the monitoring process.
Time out	Selectable list	To define the time delay for the automatic closing of message screens during a measurement set. This selectable list is not available for Stop measuring for: Never stop . The setting for this editable field has already been defined in the configuration. Here, it can be changed if desired, before starting the monitoring process.

Next step

When all required information is entered press **OK** to begin the monitoring process.

A screen displays a notice that monitoring is in progress. If necessary, press **Abort** to stop the monitoring process and return to **Sets of Angles Menu**.
Refer to "40.2 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 application is only available for use with TPS instruments. Setup determines the station coordinates and the instrument orientation using TPS measurements and/or GPS measurements.

Setup with GPS using SmartPole	Setup with GPS using SmartStation
SmartPole allows target points to be determined using GPS measurements. The new points are then used as control points for the TPS setup.	SmartStation allows TPS station coordinates (position and height) to be determined from GPS measurements.

Setup methods

Setup Method	"Standard" setup type	"On-the-Fly" setup type	Methods for TPS	Methods for SmartPole	Methods for SmartStation
Set orientation	✓	-	✓	-	✓
Known backsight	✓	-	✓	✓	✓
Multiple backsights	✓	✓	✓	✓	✓
Transfer height	✓	-	✓	✓	-
Resection	✓	✓	✓	✓	-
Orientate to line	✓	-	✓	-	✓

- Each setup method requires different input data and a different number of target points.
- All setup methods are described in "41.7 Setup Methods".

Setup types

"Standard" setup	"On-the-Fly" setup
This type of setup is the traditional type. The user must always measure all setup points consecutively to complete the setup. The TPS station coordinates and TPS orientation must be set before measuring survey points.	This setup type allows the user to move between setup and survey before completing the setup (working "on the fly"). When leaving setup the TPS station coordinates and orientation do not have to be final, they can be set at anytime during the survey. This setup can only be used when measuring survey points. When staking out points, the TPS station coordinates and TPS 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 **Station 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 Survey application, Setup can be accessed by selecting the **Setup** softkey.
2. When entering any panel where it is possible to do a measurement, a message is displayed to notify that the setup is incomplete. It is then possible to:
 - a) continue with the existing application, or

OK

- b) start Setup and create a new station setup, or
c) start Setup and continue to measure additional fixpoints.
3. Assigning the function **TPS - Continue open setup** to the favourites or a hot key.

**New..
Setup**

Properties of setup points

TPS points

The properties stored with a TPS point are:

Type	Station	Target
Class	Ref	Meas or None
Sub class	TPS	TPS
Source	Setup(setup method)	Setup(setup method)
Instrument source	TPS	TPS

GPS points (only applicable when using SmartPole or SmartStation)

The properties stored with a GPS point are:

Type	Station	Station
Class	Meas	Nav
Sub class	GNSS Fixed	GNSS Code Only
Source	Setup(setup method)	Setup(setup method)
Instrument source	GPS	GPS

41.2

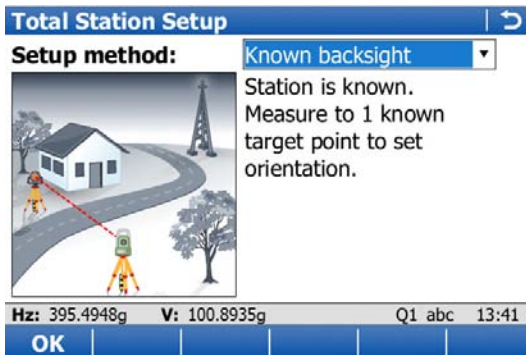
Accessing Setup

Access

Select **Main Menu: Go to Work!\Setup**.

Total Station Setup

An illustration and a description is shown for each Setup method.



OK

To accept changes and access the subsequent screen. The chosen settings become active. Refer to "41.4 Set Station Point" or "41.5 Enter Station Information".

Fn Config..

To configure the Setup application. Refer to "41.3 Configuring Setup".

Fn Quit

To exit the wizard.

Access

Configuration,
General page

Press **Fn Config..** in **Total Station Setup.**

Configuration | ↩

General | Known backsight | Advanced | Report sheet

☐ Remind me of last setup before measuring

☐ Use two face measurements in setup

☒ Use graphics to help choose setup method

☐ Show message when setup is complete

Hz: 395.4943g V: 100.8938g Q1 abc 13:31

OK | | | | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Fn About

To display information about the application name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Remind me of last setup before measuring	Check box	Current instrument setup details can be displayed to remind the user to either keep the current instrument setup, check the backsight, or create a new setup. Refer to "41.6 Setup Reminder" for details.
Use two face measurements in setup	Check box	Defines if the instrument measures the second face automatically after storing the first.

Field	Option	Description
		When this box is checked, after storing a measurement with All or Store motorised instruments change face automatically, non-motorised instruments access Telescope Positioning. The measurements of face I and face II are averaged. The averaged value is stored. When this box is not checked, no automatic measurement in two faces.
Use graphics to help choose setup method	Check box	When this box is checked, the setup methods are displayed in a screen accompanied by a graphic and text describing each setup method. When this box is not checked, the setup methods are selected from the drop-down menu in Go to Work!.
Show message when setup is complete	Check box	When this box is checked, a message informs when the setup is finished.

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
Check backsight position	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 Position limit is exceeded, the setup can be repeated, skipped or stored.
Position limit	Editable field	Available when Check backsight position is checked. Sets the maximum horizontal coordinate difference accepted in the position check.
Check backsight height	Check box	Allows a check to be made on the vertical difference between the existing and the measured known backsight point. If the Height limit is exceeded, the stake out can be repeated, skipped or stored.
Height limit	Editable field	Available when Check backsight height is checked. Sets the maximum vertical difference accepted in the height check.

Next step

Page changes to the **Advanced** page.

For **Setup method: Resection** and **Setup method: Multiple backsights**, the settings on this page apply.

Description of fields

Field	Option	Description
Auto position to setup targets	Check box	When this box is checked, the instrument positions horizontally and vertically to the point.
Calculate scale from target observations	Check box	Only if available if the job properties do not have Compute scale using set to Stn & coord system . If checked, a station scale will be calculated from the target observations. The user will have the option to 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 will not be displayed and therefore not applied to any survey observations.
Use Helmert method for resection	Check box	Helmert calculation is used.
Height weighting	1/distance or 1/distance²	Available when Use Helmert method for resection is checked. To change the distance weighting that is used in the calculation of the station height in the resection.
Edit default station quality checks	Check box	Check to type in values for standard deviation, position and height accuracy. If the limits are exceeded, a message will be shown when Calc is selected.

Field	Option	Description
Orientation limit	Editable field	Available when Edit default station quality checks is checked. Define a limit for the standard deviation of the orientation.
Position limit	Editable field	Available when Edit default station quality checks is checked. Define a position accuracy of the target point.
Height limit	Editable field	Available when Edit default station quality checks is checked. Define a height accuracy of the target point.

Next step

Page changes to the **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.

Field	Option	Description
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

Page changes to the first page on this screen.

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**. **Set Station Point** is then accessed automatically from **Setup**.

Set Station Point
OK

To accept changes and return to the screen from where this screen was accessed.

Scale..

To type in values for the scale corrections. Refer to "New Job, Scale page".

Atmos..

To type in values for the atmospheric corrections. Refer to "Atmospheric Corrections, Atmospheric ppm page".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Instrument height	Editable field	The height of the instrument.
Station point from		The selection made here determines the availability of the other fields on this screen.

Field	Option	Description
	Job	A station point can be selected from a job on a data storage device.
	Enter new point	Pressing OK opens a screen where a new point can be typed in. After pressing Store there, the Setup application continues.
	GPS - Smart-Station	Available when TPS and GPS are used. Pressing OK opens the GPS Survey application. After measuring a point with Meas, Stop, Store there, the Setup application continues. Refer to "44.4 Initialisation for Real-Time Rover Operations".  In order to use GPS, a coordinate system for the setup is required and must be attached to the working job. If not, then a coordinate system must be selected, or local coordinates for the station must be typed in, during the setup process.  To obtain the correct elevation of the setup point, measure the instrument height as usual and ensure the antenna type is set to the relevant SmartStation antenna.  If SmartPole is used in the setup or later in Survey, remember to update the antenna type after finishing the SmartStation measurement.
	Last used station	The station used last in the Setup application is displayed.

Field	Option	Description
Job	Selectable list	The job from which the station is to be selected. Refer to "4.4 Choosing a Job".
Point ID	Display only	The point ID of the station point.
Easting, Northing and Elevation	Display only	The coordinates of the station point.
Current scale	Display only	The scale according to the scale settings for the selected station.



Refer to "12 Antenna Heights" for further information regarding height values used in a SmartStation.

Access Station information must be typed in for **Setup method: Resection** and **Setup method: Orientate to line**. **Enter Station Information** is accessed after selecting **OK** in **Total Station Setup** with one of these setup methods selected.

Enter Station Information For a description of keys refer to "41.4 Set Station Point".

Description of fields

Field	Option	Description
Station ID	Editable field	Type in an ID for the station point.
Point code	Selectable list	Select a point code for the station point if desired.
Instrument height	Editable field	The height of the instrument.
Use control job for the target points	Check box	Target points can be selected from the control job.
Job	Selectable list	The control job from which the target points can be selected. Refer to "4.4 Choosing a Job".
Current scale	Display only	The scale according to the scale settings for the selected station.



Refer to "12 Antenna Heights" for further information regarding height values used in a SmartStation.

Description

When activated, the setup reminder appears whenever the user enters a measurement screen. The reminder allows the user to check the current station setup details before proceeding with the survey. When this reminder appears, three options are available to the user:

- 1) To keep the current station setup and proceed with the survey.
- 2) To check the backsight point.
- 3) To create a new station setup.

Current Setup Details

Current Setup Details | ↩

☒ **Continue with current setup**

Station ID: S101

Instrument height: 1.580m

☐ **Check the backsight**

Backsight ID: TPS0001

Target height: 1.941m

☐ **Make a new setup**

Hz: 299.9997g V: 100.0002g Q1 abc 10:09

OK | | | | |

OK

To accept the selection.

Fn Quit

To exit the screen.

Description of fields

Field	Description
Continue with current setup	The last setup is used and recorded in the working job.

Field	Description
Check the backsight	To open the Check Point screen. The point suggested is the point which Setup uses as the reference orientation. For the setup methods Set orientation and Known backsight , the orientation target point is suggested. For the setup methods Multiple backsights , Transfer height , Resection and Orientate to line , the first target is suggested.
Make a new setup	To start the Setup application and create a new station setup.

41.7

41.7.1

Setup Methods

Set orientation and Known backsight

Requirements

The position coordinates of the station 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 station are unknown and are determined with GPS. 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 station 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 station, and found to have different coordinates, then a message will appear. The user can then select whether to update the original setup or not. The update will use the backsight point coordinates to recalculate the orientation and subsequently update all measured points connected to the setup.

Access

In **Total Station Setup**, select **Setup method: Set orientation** or **Known backsight**. Press **OK**. In **Set Station Point**, select a station. Press **OK**.

Set Station Orientation, Orientation page

Set Station Orientation		↩
Orientation	Backsight	Station
Backsight ID:		TPS0001
Target height:		1.941 m
Computed direction:		262.5131g
Computed hz dist:		721.769m
Δ hz dist:		0.001m
Δ height:		0.001m
Hz: 299.9996g		V: 99.9999g
Q1 abc		10:15
Set	Dist	GPS
More		Page

Set

To set the station and orientation and exit the Setup application.

Dist

To measure a distance to the point being used to set the azimuth. For **Set orientation**: A distance measurement is **NOT** required when setting the Station and the Orientation with **Set**.

GPS

For **Known backsight** applicable when using SmartPole. To enter the GPS Survey screen and measure a point with GPS. The antenna height is automatically converted from the target height.

Store

To store the measurement with or without a distance. Only available when **Use two face measurements in setup** is selected in the **Setup** configuration.

More

To change between the slope and the horizontal distance.

Page

To change to another page on this screen.

Fn Run / IndivID

Available for **Setup method: Set orientation** only. **Run** automatically chooses the next available point ID from the list of points already stored. **IndivID** allows the user to type in any value for **Backsight ID**.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Backsight ID	Editable field Selectable list	Point ID of the backsight point. For Set orientation . For Known backsight . Select a point from the points stored in the control job.
Target height	Editable field	Height of the target above or below the backsight point. The last setup target height is always remembered.
Direction	Editable field	Available for Set orientation . The direction is set to 0 by default. This value can be edited. The value is not set to the system until Set is pressed.
Slope distance	Display only	Available for Set orientation . The slope distance measured between the station point and the backsight point.
Horiz distance	Display only	Available for Set orientation . Press Dist to measure a distance to the target point being used to set the azimuth.

Field	Option	Description
Height difference	Display only	Available for Set orientation . The vertical distance between the station point and the backsight point.
Computed direction	Display only	Available for Known backsight . Displays the calculated azimuth from the selected station to the backsight point.
Computed hz dist	Display only	Available for Known backsight . Displays the calculated horizontal distance between the selected station and backsight point.
Computed slp dist	Display only	Available for Known backsight . Displayed after More was pressed. The calculated slope distance to the backsight point.
Δ hz dist	Display only	Available for Known backsight . The difference between the calculated horizontal distance from station to backsight point and the measured horizontal distance.
?slope dist	Display only	Available for Known backsight . Displayed after More was pressed. The difference between the calculated slope distance from station to backsight point and the measured slope distance.
?height	Display only	Available for Known backsight . The difference between the control 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

Page changes to the **Backsight** page.

Set Station Orientation, Backsight page

Set Station Orientation | ↶

Orientation Backsight Station Plot

Backsight ID: TPS0001

Point code: SV

Description: *****

Hz: 300.0000g V: 99.9998g Q1 abc 10:16

Set +Attrib Last Default Page

Set

To set the station and orientation and exit the Setup application.

+Attrib

To create additional attributes for this point code.

Name or Value

Available for attributes for which an attribute name can be typed in. To highlight 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.

Last

To recall the last used attribute values for the selected code.

Default

To recall the default attribute values for the selected code.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Backsight ID	Editable field or display only	Point ID of the backsight point.
Point code	Selectable list	The code for the backsight point.
Description	Display only	A short description of the code.

Next step

Page changes to the **Station** page.

Set Station Orientation, Station page

Set Station Orientation | ↩

Orientation Backsight Station Plot

Station ID: S101

Instrument height: 1.580 m

Point code: S

Current scale: 1.000000000000

Hz: 299.9996g V: 99.9997g Q1 abc 10:16

Set Dist ppm Page

Set

To set the station and orientation and exit the Setup application.

Dist

To measure a distance to the point being used to set the azimuth. A distance measurement is **NOT** required when setting the Station and the Orientation with **Set**.

SF / Ppm

To switch between displaying the current scale as a scale factor or ppm value.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Station ID	Display only	Station ID as selected in Set Station Point .
Instrument height	Editable field	The instrument height.
Point code	Selectable list	The code for the backsight point.
Current PPM / Current scale	Display only	The current job scale. Refer to " New Job, Scale page" for more information on scale corrections.

Next step

Page changes to the **Plot** page.

Requirements

The position coordinates of the station point are required. The instrument is set up and oriented to one or more known backsight targets.

For SmartStation, the position coordinates of the station are unknown and are determined with GPS. The instrument is set up and oriented to one or more known backsight targets. For TPS and SmartStation, the orientation is determined by sighting to one or more known target points (maximum of ten target points). Only angles or both angles and distances can be measured. The height of the station point can also be derived from the target points.

Access

In **Total Station Setup**, select **Setup method: Multiple backsights**. Press **OK**.

In **Set Station Point**, select a station. Press **OK**.

Measure Target

Unless otherwise stated the following screen and description applies to the setup methods: **Multiple backsights**, **Transfer height**, **Resection**, and **Orientate to line**.

Measure Target 1	
Point ID:	TPS0001
Target height:	1.941 m
Hz angle:	300.0001g
V angle:	99.9999g
Slope distance:	10.000m
Δ azimuth:	----g
Δ hz dist:	----m
Δ height:	----m
Hz: 300.0001g V: 100.0001g Q1 abc 10:19	
Meas	Dist
Store	GPS

Meas

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.

Dist

To measure and display distances.

Store

Records displayed values temporarily. The target measurements will not be stored to the current job until the station is set. A distance measurement is not necessary before pressing **Store**. 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.

GPS

Applicable when using SmartPole. To enter the GPS Survey screen and measure a point with GPS. The antenna height is automatically converted from the target height.

Done

For **Resection** only. To temporarily exit the Setup application. The station setup will be incomplete but can be continued and completed at a later time. This softkey is replaced by **Calc** when sufficient data is available.

Calc

For **Multiple backsights**: Available after the first measurement. Allows the user to see the calculated station orientation and other results.

For **Resection**: Available after measuring two target points or as soon as a preliminary station and orientation can be calculated. The calculated station coordinates and overall "quality" of the results are displayed.

Fn Find

Stakeout values are provided to guide the prism holder to the selected target point.

For **Resection**: Available once sufficient data is available for calculation.

Refer to "41.9 Finding a Target Point".

Fn Positn

To position the instrument to the selected target point.

For **Resection**: Available once sufficient data is available for calculation.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Selectable list	The point ID of the target point to be measured.

Field	Option	Description
Target height	Editable field	The height of the target above or below the back-sight point. The last setup target height is always remembered.
Hz angle	Display only	The current horizontal angle.
V angle	Display only	The current vertical angle.
Slope distance	Display only	The measured slope distance after Dist was pressed.
Δ azimuth	Display only	Displays the difference between the calculated azimuth and the current horizontal angle. If Setup method: Resection , displays ---- until sufficient data for calculation is available.
Δ hz dist	Display only	The difference between the calculated and the measured horizontal distance.
Δ height	Display only	The difference between the given and the measured height of the target point.



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 **Station Results, Targets** page.

41.7.3

Transfer height

Requirements

This method is used to compute a station height to apply to the selected station. Only the height is updated, the orientation is not updated.
The position coordinates of the station point are required.

Access

In **Total Station Setup**, select **Setup method: Transfer height**. Press **OK**.
In **Set Station Point**, select a station. Press **OK**.



For a description of the **Measure Target** screen, refer to "41.7.2 Multiple backsights".

41.7.4

Resection

Requirements

The coordinates of the station point are unknown. The coordinates and orientation are determined by sighting to at least two or more known target points (maximum of ten target points). 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 **Enter Station Information**, type in the required information. Press **OK**.



For a description of the **Measure Target** screen, refer to "41.7.2 Multiple backsights".

41.7.5

Orientate to line

Description

This method can be used to calculate the 2D or 3D local coordinates for the instrument station 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 always defines the origin of the local coordinate system. The second target point, in conjunction with the first target point, always defines the local direction of North or East (depending on the working style).

Requirements

Important features:

- All coordinates calculated are local coordinates.
- The first target point always defines the origin of the local coordinate system (North=0, East=0, Height=0 (optional))
- The second target point, in conjunction with the first target point, always defines the local direction of North or East.

Access

In **Total Station Setup**, select **Setup method: Orientate to line**. Press **OK**.
In **Enter Station Information** type in the required information. Press **OK**.

Define Station Ht & Axis

Define Station Ht & Axis

Use station height : User entered
 Station height: 1.580 m

Axis defined between target 1 & 2:

North axis

OK

To accept all settings and continue. The chosen settings are activated and the next screen, **Measure Target**, is displayed.

Hz: 300.0003g V: 100.0000g Q1 abc 10:20
OK

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Use station height	User entered	The height value of the station will be entered by the user and used to calculate the height of the measured points.
	Transfer from trgt 1	The height of the station will be calculated relative to the first measured point.
Station height	Editable field	Available for Use station height: User entered . The elevation of the instrument station.
Target 1 height	Editable field	Available for Use station height: User entered . The height of the first measured point.
Axis defined between target 1 & 2		To define the positive North or positive East axis.

Field	Option	Description
	North axis	The second point measured defines the direction of the positive North axis.
	East axis	The second point measured defines the direction of the positive East axis.



For a description of the **Measure Target** screen, refer to "41.7.2 Multiple backsights".

Description

The results screen is displayed after pressing **Calc** in the **Measure Target** screen. The results screen is part of the **Multiple backsights**, **Transfer height**, **Resection** and **Orientate to line** setup methods.

Excluding **Orientate to line**, 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. After the station is set, all following measurements will be related to this new station and orientation.

Station Results,
Results page

Station Results	
Results	Station Quality Targets Plot
Easting:	-99.000m
Northing:	90.050m
Elevation:	10.361m
New orientation:	193.6234g
☒ Apply the computed elevation for this station	
Hz: 100.0000g V: 100.0000g Q1 abc 10:25	
Set	LSqrs Trgt+ Page

Set

To set the orientation, to store all setup data and exit the application.

For **Transfer height**: To store all setup data and exit the application.

Done

To exit the setup without setting it, the setup is incomplete.

Robust or LSqrs

To display the results for the robust or the least squares calculation method.

Trgt+

To access **Measure Target** and to measure more target points.

Page

To change to another page on this screen.

Fn 3 par or Fn 4 par

Switches between a 3 parameter and 4 parameter calculation. For 3 parameter, the current scale is not applied to setup observations for a new station calculation. For 4 parameter, the current scale is applied. The station coordinates will be automatically updated according to the setting used. Defaults to 4 parameter.

SF or ppm

To display the scale results by scale factor or as a ppm value.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
New orientation	Display only	New oriented azimuth with running angle as telescope moves. Not available for setup method Transfer height .
?height	Display only	The difference between the new calculated height and the old height. Available for setup methods Multiple backsights and Transfer height .

Field	Option	Description
Use the new height	Check box	For setup method Multiple backsights : When this box is checked, both orientation and height are updated. If not checked, only the orientation is updated. For setup method Transfer height : When this box is checked, the station height is updated. If not checked, the station height does not change. Not available for any other setup methods.
New height	Display only	The calculated height is displayed. Available for setup methods Multiple backsights and Transfer height .
Old height	Display only	The original height is displayed. Available for setup methods Multiple backsights and Transfer height .
σ height	Display only	Standard deviation of the calculated station height. Available for setup methods Transfer height .
Easting	Display only	The calculated Easting is displayed. Available for setup methods Resection and Orientate to line .
Northing	Display only	The calculated Northing is displayed. Available for setup methods Resection and Orientate to line .
Elevation	Display only	The calculated Height is displayed. Available for setup methods Resection and Orientate to line .

Field	Option	Description
Apply the computed elevation for this station	Check box	When this box is checked, then the height from the solution is set as the station height. When this box is not checked, then the scale is not updated. Available for setup method Resection .

Next step

Page changes to the **Station** page.

Station Results, Station page

Station Results | ↩

Results | Station | Quality | Targets | Plot

Station ID: S102

Instrument height: 1.580 m

Point code: S

Current scale: 1.000000000000

Hz: 99.9996g V: 99.9999g Q1 abc 10:25

Set | Scale.. | ppm | Page

Set

To set the orientation, to store all setup data and exit the application.

For **Transfer height**: To store all setup data and exit the application.

Done

To exit the setup without setting it, the setup is incomplete.

Scale..

To type in values for the scale corrections. Refer to "New Job, Scale page".

Page

To change to another page on this screen.

Fn 3 par or Fn 4 par

Switches between a 3 parameter and 4 parameter calculation. For 3 parameter, the current scale is not applied to setup observations for a new station calculation. For 4 parameter, the current scale is applied. The station coordinates will be automatically updated according to the setting used. Defaults to 4 parameter.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Station ID	Display only	Station ID of the current station set up.
Instrument height	Editable field	The current instrument height.
Point code	Selectable list	Select a point code for the station point if desired.
Current PPM / Current scale	Display only	The current job scale. Refer to " New Job, Scale page" for more information on scale corrections.

Next step

Page changes to the **Quality** page.

**Station Results,
Quality page**

For a description of the softkeys refer to "Station Results, Station page".
This page is not available for setup methods **Transfer height** or **Orientate to line**.

Description of fields

Field	Option	Description
New orientation	Display only	New oriented azimuth with running angle as telescope moves. Available for setup method Multiple backsights .
σ new orientation	Display only	Standard deviation of the calculated orientation.
?height	Display only	Delta height, the difference between original and calculated height. Available for setup method Multiple backsights .
σ height	Display only	Standard deviation of the calculated station height.
σ easting	Display only	Standard deviation of the calculated station Easting. Available for setup method Resection .
σ northing	Display only	Standard deviation of the calculated station Northing. Available for setup method Resection .

Next step

Page changes to the **Targets** page.

Station Results, Targets page

This screen displays information about the accuracy of the measured target points and allows exclusion of measurements that are not to be used in the calculation. Additional measurements can be made and measurements can be deleted. This page is not available for setup method **Orientate to line**.

Station Results				
Results	Station	Quality	Targets	Plot
!	Point ID	Use	Δ Hz g	
	TPS0003	3D	-0.0000	
	TPS0002	3D	0.0002	
	TPS0001	3D	0.0000	

Hz: 100.0000g		V: 99.9999g		Q1 abc		10:29
Set		Use	Remov	More	Page	

Set

To recalculate the station data and update all values after target points have been deleted or excluded from the calculation.

Use

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.

Remov

To delete a point from the list of measured target points and exclude it from the Setup calculation.

More

To change the value displayed in the fourth column.

For **Resection**: To change between **?Hz**, **Δ hz dist**, **Δ height**, **Δ easting** and **Δ northing**.

For **Multiple backsights**: To change between **?Hz** and **Δ height**.

For **Transfer height**: Only **Δ height** available.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of columns

Column	Description
!	The ! indicates that the delta value of either measured horizontal angle, distance or height exceeds the calculation limit.
Point ID	The point ID of the measured target points.
Use	Indicates if and how a target point is used in the station calculation. Choices are 3D , 2D , 1D and No .
?Hz	Can be displayed by pressing More . 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 a !.
Δ hz dist	Can be displayed by pressing More . Difference between calculated and measured distance from the station to the target points. If a target point does not have coordinates, ----- are displayed. Differences exceeding the defined limit are indicated by a !.
Δ height	Can be displayed by pressing More . 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 a !.

Column	Description
Δ easting	Can be displayed by pressing More . Difference between control point and measured point, calculated from new station coordinates.
Δ northing	Can be displayed by pressing More . Difference between control point and measured point, calculated from new station coordinates.

Next step

Page changes to the **Plot** page.

Description

The **Find Target** screen can be accessed, to guide the prism to the selected target point. The screen is only available if the Stakeout application is available on the instrument. The functionality of this screen is similar to a stake out 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

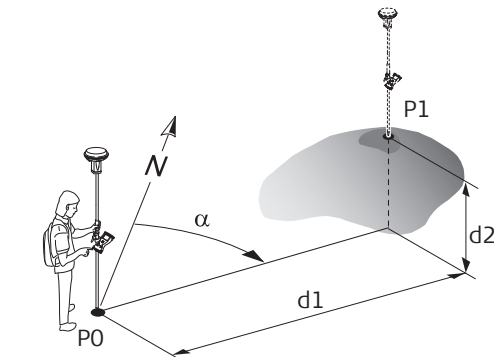
This screen is similar to the **Stakeout, Stake** page and is configured through the **Stakeout** configuration settings. Refer to "Stakeout, Stake page" for a detailed description of this screen.

Description

The Stakeout application 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 LGO.
- already exist in a job on the instrument.
- be uploaded from an ASCII file to a job on the instrument using **Main Menu: Jobs & Data\Import data\Import ASCII data.**

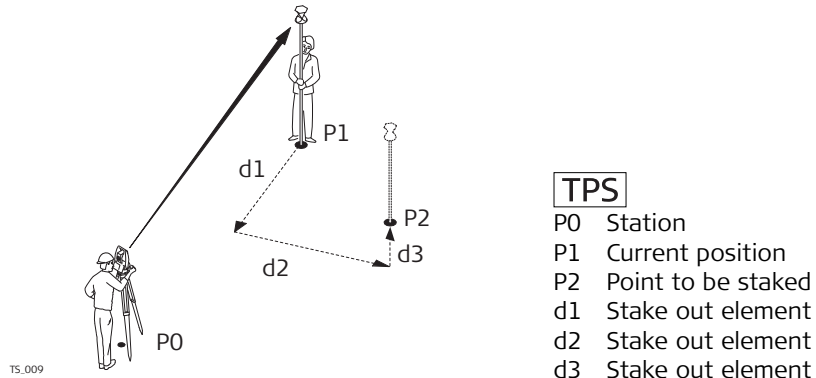
Diagram



GS_057

GPS

- P0 Current position
 P1 Point to be staked
 d1 Stake out distance
 d2 Height difference between current position and point to be staked
 α Stake out direction



Stakeout modes

Points can be staked using different modes:

- Polar mode.
- Orthogonal mode.



Staking out is possible for RTK rover and TPS.



The points to be staked must exist in a job on the active memory device or can be typed in.

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: Height type computed for current position:	Orthometric OR ellipsoidal 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 Digital Terrain Model. The DTM licence key must be loaded. Refer to "24.3 Load licence keys" 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, lines and areas. The behaviour of the coding functionality depends on the definition of a survey screen page with editable fields for coding and attributes.	
Properties of staked points	The properties stored with staked points are: • Class: Meas or for GPS also Nav depending on the position status when the staked point was measured. • Sub class:	

- **GPS** Code only, GPS code only, GPS fixed, GNSS Code Only or GNSS Fixed.
- **TPS** Stakeout
- Source: **Stakeout**
- Instrument source: **GPS** or **TPS**

Averaging of staked points

The principles for averaging are identical to the averaging principles of the Survey application.

Access

Select **Main Menu: Go to Work!\Stakeout.**

Choose Control Job



OK

To accept changes and access the subsequent screen. The chosen settings become active.

Fn Config..

To configure Stakeout application. Refer to "42.3 Configuring Stakeout".

Fn Quit

To exit the screen.



Description of fields

Field	Option	Description
Control job	Selectable list	The job containing the points to be staked.  Points which are measured during staking out are stored in the working job.

Next step

IF the Stakeout application	THEN
is to be accessed	OK accepts the changes and accesses Stakeout application. Refer to "42.4 Staking Out".
is to be configured	Config... Refer to "42.3 Configuring Stakeout".

Access

Select **Main Menu: Go to Work!\Stakeout**. Press **Fn Config...**

**Configuration,
General page**

This screen consists of five pages. The explanations for the softkeys given here are valid for all pages, unless otherwise stated.

Configuration | ➔

General | Quality control | Heights | Graphics | Report sheet

☒ **Automatically select next closest point**

☐ **Show additional page from My Survey Screen**

Store point ID with: Prefix ▼

Prefix / suffix: Stkd

3DCQ:5.875m 2DCQ:3.421m 1DCQ:4.776m abc 09:48

OK | | | | Page

OK

To accept changes and return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Fn About

To display information about the program name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Automatically select next closest point	Check box	The order of the points suggested for staking out. 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. When this box is not checked, the next point suggested for staking out is the subsequent one in the job.
Show additional page from My Survey Screen	Check box	The user-defined survey screen page to be shown in the Stakeout screen.
Page to show	Selectable list	The names of the available survey screen pages.
Store point ID with	Stake point ID Prefix Suffix	The staked points are stored with the same point IDs as the points to be staked. Adds the setting for Prefix / suffix in front of the original point IDs. Adds the setting for Prefix / suffix at the end of the original point IDs.
Prefix / suffix	Editable field	Available for Store point ID with: Prefix and Store point ID with: Suffix . The identifier with up to four characters is added in front of or at the end of the ID of the staked point.

Field	Option	Description
Only update stakeout values when distance is measured	Check box	TPS 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.
Automatically turn to point	Check box	TPS When this box is checked, the instrument positions automatically to the point to be staked.
Turn to	Position only	Available when Automatically turn to point is checked. TPS Instrument positions horizontally to the point to be staked.
	Position & height	TPS Instrument positions horizontally and vertically to the point to be staked.
Show direction message to next point	Instrument	TPS For each point which is selected for staking, angle and distance information is momentarily displayed in the message line. 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.
	Last point	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.

**Configuration,
Quality control page**

Next step

Page changes to the **Quality control** page.

Description of fields

Field	Option	Description
Check distance before storing	Check box	Allows a check to be made on the horizontal coordinate 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.
Limit	Editable field	Available when Check distance before storing is checked. Sets the maximum horizontal coordinate difference accepted in the position check.
Check cut/fill before storing	Check box	Allows a check to be made on the 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.
Limit	Editable field	Available when Check cut/fill before storing is checked. Sets the maximum vertical difference accepted in the height check.

Next step

Page changes to the **Heights** page.

Configuration, Heights page

Description of fields

Field	Option	Description
Allow height of point being staked to be edited	Check box	When this box is checked, the field Design height is displayed in Stakeout, Stake page. The design height is the height of the point to be staked. The value for Design height can be changed. When this box is not checked, the field Current height for the height of the current position is displayed in Stakeout, Stake page. The value for Current height cannot be changed.
Offset height of all points being staked	Check box	Allows a constant height offset to be applied to the height of the points being staked.
Height offset	Editable field	The height offset that is applied.

Next step

Page changes to the **Graphics** page.

Configuration, Graphics page

Description of fields

Field	Option	Description
Navigate direction		The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Stakeout application are based on this selection.

Field	Option	Description
	From instrument	TPS The direction of the orientation is from the instrument to the point to be staked.
	To instrument	TPS The direction of the orientation is from the point to be staked to the instrument.
	To north	The North direction shown in the graphical display based on the active coordinate system.
	From north	TPS The direction of the orientation is from the North direction to the point to be staked.
	To sun	GPS The position of the sun calculated from the current position, the time and the date.
	To last point	Time-wise, the last recorded point. If no points are yet staked, Navigate direction: To north is used for the first point to be staked.
	To point	A point from the working job.
	To point (cntrl job)	A point from the Control job selected in Choose Control Job .
	To line (cntrl job)	The direction of the orientation is parallel to a reference line from the Control job . Open the listbox to create, edit or delete a reference line.
	To line	The direction of the orientation is parallel to a reference line from the working job. Open the listbox to create, edit or delete a reference line.

Field	Option	Description
	Following arrow	The direction of the orientation is from the current position to the point to be staked. The graphical display shows an arrow pointing in the direction of the point to be staked.
Point ID or Line	Selectable list	Available for Navigate direction: To point (cntrl job) , Navigate direction: To point, Navigate direction: To line (cntrl job) and Navigate direction: To line . To select the point or line to be used for orientation.
Navigate using	Direction & distance In/out, left/right	The method of staking out. The direction from the orientation reference, the horizontal distance and the cut/fill is displayed. The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed.
Switch to bulls eye when 0.5m from target	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.
Beep faster when getting close to point	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 Start within . The closer the instrument is to the point to be staked the faster the beeps will be.
Distance to use	Height, Horizontal distance or Position & height	The type of distance to use for staking.

Field	Option	Description
Start within	Editable field	Available when Beep faster when getting close to point 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 **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.

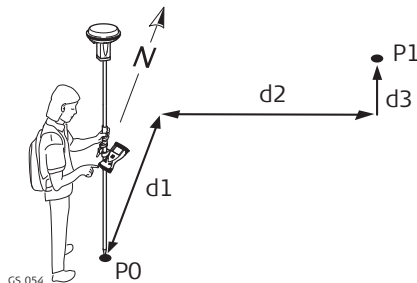
Field	Option	Description
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

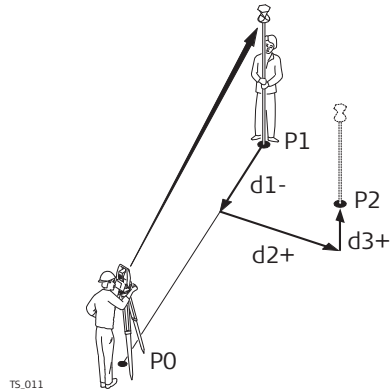
Page changes to the first page on this screen.

Diagram

This diagram shows an example for **Navigate using: In/out, left/right** with **Navigate using: To north**.

**GPS**

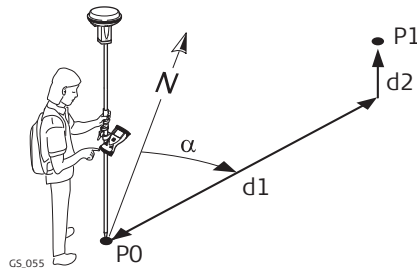
- P0 Current position
- P1 Point to be staked
- d1 Forwards or backwards
- d2 Right or left
- d3 Fill or cut



TPS

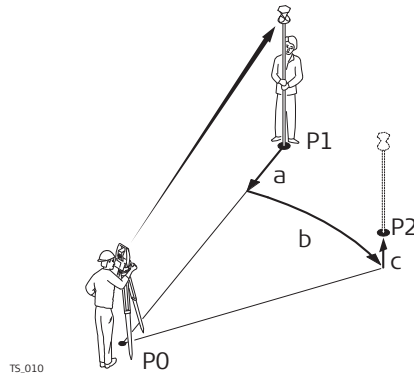
- P0 Station
- P1 Current position
- P2 Point to be staked
- d1 Forward or backwards
- d2 Right or left
- d3 Cut or fill

This diagram shows an example **Navigate using: Direction & distance** with **Navigate using: To north**.



GPS

- P0 Current position
- P1 Point to be staked
- d1 Distance
- d2 Cut or fill
- α Direction

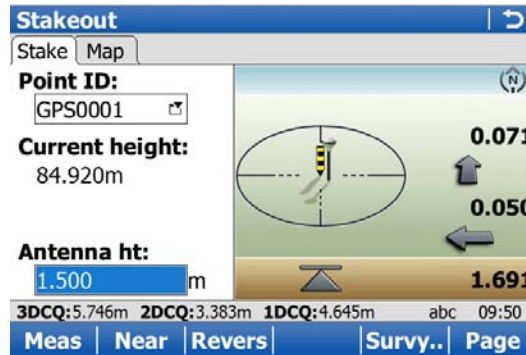


TPS

- P0 Station
- P1 Current position
- P2 Point to be staked
- a Distance
- b Horizontal angle
- c Cut or fill

Stakeout, Stake page

The pages shown are from a typical working style. An additional page is available when a user-defined survey screen page is used.



Meas

GPS To start measuring the point being staked. The key changes to **Stop**. The difference between the current position and the point being staked is still displayed.

TPS To measure a distance and store distance and angles.

Stop GPS

To end measuring the point being staked.

When **Automatically stop point measurement** is checked in **Quality Control, General** page recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**. After ending the measurements, the differences between the measured point and the point to be staked are displayed.

Store

GPS To store the measured point. When **Automatically store point** is checked in **Quality Control, General** page, the measured point is stored automatically. The key changes to **Meas**.

TPS To store angles and distance. Distance must be measured before.

Dist TPS

To measure a distance.

Near GPS

To search the **Control job** for the point nearest to the current position when the key is pressed. The point is selected as the point to be staked and is displayed in the first field on the screen. 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.

Available when **Meas** is displayed.

Revers GPS

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.

Surv..

To survey additional points which may be needed during staking out. To return to Stakeout application, press **Fn Quit** or **ESC**. Available when **Meas** is displayed.

Page

To change to another page on this screen.

Fn Config..

To configure the Stakeout application. Refer to "42.3 Configuring Stakeout".

Fn Conect and Fn Disco GPS

To dial the number of the base station configured in the active working style and to hang up immediately after the survey is completed. Available when **Meas** or **Store** is displayed and for real-time devices of type digital cellular phone or modem. Available for **Auto connect when measuring** unchecked in **RTK Rover Settings, General** page.

Fn Init GPS

To select an initialisation method and to force a new initialisation. Available when **Meas** or **Store** is displayed and for working styles allowing phase fixed solutions. Refer to "44.4 Initialisation for Real-Time Rover Operations".

Fn 2D Pos TPS

To position the telescope (X,Y) onto the point to be staked.

Fn 3D Pos TPS

To position the telescope (X,Y,Z) onto the point to be staked.

Fn Mnu.. TPS

To enter angle and distance values to stake out a point.

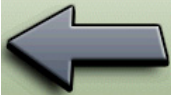
Fn Quit

To exit Stakeout application.

Description of the elements of the graphical display

The graphical display provides a guide to find the point to be staked out.

Element	Description
	Point to be staked / known point
	North

Element	Description
	Sun
	Defined line
	From instrument
	Follow arrow
	Forward arrow, distance to point
	Side arrow, distance to point
	Polar arrow, direction to point

Element	Description
	Height
	The current position and/or height is within the configured stake out limit for position and/or height.

Description of fields

Field	Option	Description
Point ID	Selectable list	The point ID of the point to be staked.
Antenna ht	Editable field	GPS The default antenna height. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.
Target height	Editable field	TPS The default prism height.
Current height	Display only	Available when Allow height of point being staked to be edited is not checked in Configuration, Heights page.

Field	Option	Description
		The orthometric height of the current position 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 Height offset configured in Configuration, Heights page is taken into account.
Design height	Editable field	Available when Allow height of point being staked to be edited is checked in Configuration, Heights. 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 Height offset configured in Configuration, Heights page is not taken into account. Changing the value for Design height changes the values displayed for cut and fill.

Next step

Page changes to the **Map** page. Refer to "28 MapView Interactive Display Feature" for information on the functionality and softkeys available.

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 "42.3 Configuring Stakeout" for information on configuring the check and the limits.

Access

If either of the configured difference limits are exceeded, the following screen is accessed automatically when the point is stored.

Stakeout Limit Exceeded

The availability of the fields depends on the configuration for **Navigate using**. The limits that have been exceeded are shown in bold and indicated by a !.

Stakeout Limit Exceeded	
Point ID:	GPS0001
Store point ID:	StkdGPS0001
Fill:	1.890m
2D distance (!):	0.275m
3D distance:	1.910m
Forward:	0.193m
Left:	0.196m
3DCQ:5.520m 2DCQ:3.262m 1DCQ:4.453m abc 09:51	
Back Store Skip	

Back

To return to the **Stakeout** screen without storing the point. Staking out of the same point continues.

Store

To accept the coordinate differences, store the point information and return to the **Stakeout** screen.

Skip

To return to the **Stakeout** screen without storing the point. According to filter and sort settings the next point is suggested for staking out.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Display only	The point ID of the point to be staked.
Store point ID	Editable field	The unique number which is used to store the staked point. Allows a different point ID to be typed in, if needed.
Cut	Display only	The negative height difference from the height of the staked point to the height of the point to be staked. To move down.
Fill	Display only	The positive height difference from the height of the staked point to the height of the point to be staked. To move up.
2D distance	Display only	Displays the horizontal difference from the staked point to the point to be staked.
3D distance	Display only	Displays the spatial difference from the staked point to the point to be staked.
ΔH_Z	Display only	The bearing from the staked point to the point to be staked.
ΔDist	Display only	Horizontal distance from the staked point to the point to be staked.
Forward	Display only	The horizontal distance from the current position to the point to be staked in the direction of the orientation.

Field	Option	Description
Back	Display only	The horizontal distance from the current position to the point to be staked in the reverse direction of the orientation.
Right	Display only	Horizontal distance from the staked point to the point to be staked orthogonal to the right of the orientation direction.
Left	Display only	Horizontal distance from the staked point to the point to be staked orthogonal to the left of the orientation direction.

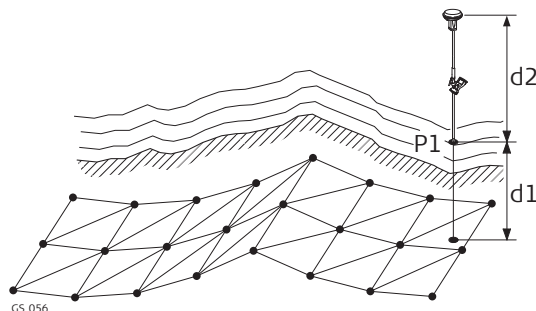
Description

A **D**igital **T**errain **M**odel 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.

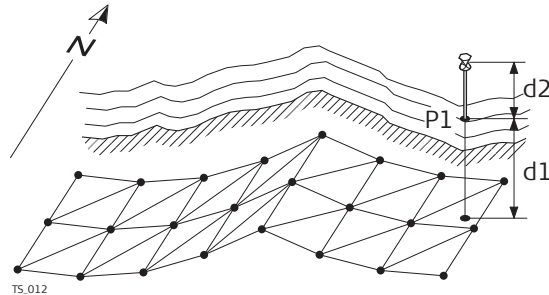
Staking a DTM can be used for

- 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 LGO. DTM jobs are stored in the \DBX directory on the active memory device.

Diagram**GPS**

- P1 Point to be staked
d1 Antenna height
d2 Cut or fill



TPS

P1 Point to be staked
d1 Cut or fill
d2 Reflector height

Access

Both applications are activated via a single Stakeout DTM licence key.

To stake out DTM heights only:

Select **Main Menu:Go to Work!\Stakeout+\Stake a DTM.**

To stake out positions of points and DTM heights:

Select **Main Menu:Go to Work!\Stakeout+\Stake points & DTM.**

Choose Control Job

Description of fields

Field	Option	Description
Control job	Selectable list	The positions of points in the job selected here are staked out. Heights to be staked out are taken from the DTM job.  Points which are measured during staking out are stored in the working job.
DTM	Selectable list	The DTM job to be used must be stored in the \DBX directory on the active memory device. Heights without positions are staked out relative to the selected DTM job.



The stake out procedure is identical as for the normal Stakeout application 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. Refer to "42.3 Configuring Stakeout", "42.4 Staking Out" and "42.5 Stakeout Difference Limit Exceeded".

43

43.1

Base Menu - Start base GPS

Start base over known point

Description

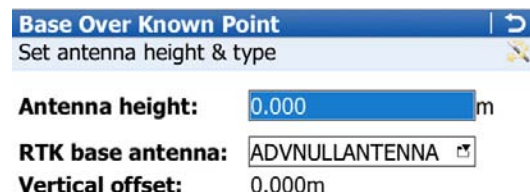
In this option, a known point stored in the working job is used to set up the RTK base.

Access

Select **Base Menu\Go to Work!\Start base over known point**.

Set antenna height & type

Type in the antenna height and select the antenna being used.



Next

To accept changes and access the subsequent screen.

Fn Quit

To exit the screen.



Description of fields

Field	Option	Description
Antenna height	Editable field	The height of the antenna that is being used.

Field	Option	Description
RTK base antenna	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 LGO. Open the list to define or edit additional antennas. Refer to Antennas for information on antennas.
Vertical offset	Display only	The vertical offset of the measurement reference point.

Next step

Next to access **Select known point**.

Select known point

Select the point to be used as base station.



A point could already be stored in the control job either by manual entry, by measuring or by transfer from LGO.



If a new point is to be created, open the selectable list for **Point ID** and press **Point ID**.



If an existing point is to be edited, open the selectable list for **Point ID** and press **Edit...**

Base Over Known Point		
Select known point		
Point ID:	00999	
Easting:	546750.075m	
Northing:	5250395.063m	
Elevation:	427.673m	

3DCQ:-,---m	2DCQ:-,---m	1DCQ:-,---m	abc	10:47
Next	Coord			Back

Next

To accept changes and access the subsequent screen.

Coord

To view other coordinate types. Local coordinates are available when a local coordinate system is active.

Back

To return to the previous screen.

Fn Quit

To exit the screen.

Next step

Next to access **Base setup complete**. Follow the instructions on the screen.

Description

To use the same coordinates as when the instrument was last used as a base. Available when the instrument has previously been used as a base and no point in the control job has the same point ID as the one last used.

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 **Base Menu\Go to Work!\Start base over last setup**.

Set antenna height & type

This screen is identical with the one in **Start base over known point**. Refer to **Start base over any point**.

Next step

Next to access **Last used RTK base point**.

Last used RTK 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 **Start base over any point** for information on the keys.

Next step

Next to access **Base setup complete**. Follow the instructions on the screen.

43.3

Start base over any point

Description

To use the coordinates of the current navigation position as base coordinates.

Access

Select **Base Menu\Go to Work!\Start base over any point.**

Set antenna height & type

This screen is identical with the one in **Start base over known point**. Refer to **Start base over any point**.

Next step

Next to access **Measure new point**.

Measure new point

Type in a point ID for this new point. Refer to **Start base over any point** for information on the keys.

Code information or annotations can be added in the rover menu in **View & edit data**.

The properties stored with the point are:

Class: **Nav**

Sub class: **GNSS Code Only**

Source: **Survey (Static)**

Instrument source: **GPS**

Next step

Next to access **Base setup complete**. Follow the instructions on the screen.

44

44.1

44.1.1

Survey - General GPS

Surveying Points

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 **Log data for post-processing** selected in the **Raw Data Logging Settings** screen.

Access

For RTK rover:

Select **Main Menu: Go to Work!**, **Survey**.



If configured for post-processed kinematic operations, the logging of moving observations begins.

Survey, Survey page

The fields shown are from a typical working style for static or post-processed kinematic operations. The screen described consists of four pages. The explanations for the softkeys given here are valid for the **Survey** page, the **Code** page and the **Annot** page. Refer to "28 MapView Interactive Display Feature" for information on the keys on the **Map** page. The fields and functionality of this screen vary slightly when accessed from other applications where individual point measurements are needed.

Survey: Job name	
Survey	Code Annot Map
Point ID:	GPS0001
Antenna height:	2.000 m
3D CQ:	5.797m
3DCQ:5.797m 2DCQ:3.410m 1DCQ:4.688m Q1 abc 09:50	
Meas	Near HdnPt.. Page

Meas

To start logging of static observations. The key changes to **Stop**.

Stop

To end recording of positions when enough data is collected. When **Automatically stop point measurement** is checked in **Quality Control, General**, recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**.

Store

To store the point information. When **Automatically store point** is checked in **Quality Control, General**, the measured point is stored automatically. The key changes to **Meas**.

Near

To compare the user's 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.

HdnPt..

To measure a hidden point. Refer to "48 Survey - Hidden Points".

Page

To change to another page on this screen.

Fn Config..

To configure SmartCodes, auto points and hidden point measurements. Refer to "20.5 SmartCodes", "46 Survey - Auto Points" and "48 Survey - Hidden Points".

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways: • To start a new sequence of point IDs type over the point ID. • For an individual point ID independent of the ID template Fn IndivID. Fn Run changes back to the next ID from the configured ID template.

Field	Option	Description
Antenna height	Editable field	The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.
3D CQ	Display only	The current 3D coordinate quality of the computed position.

44.1.2

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.

Access

For RTK rover:

Select **Main Menu: Go to Work!, Survey.**

Survey, Survey page

The fields shown are from a typical working style for real-time rover operations. The screen described consists of four pages. The explanations for the softkeys given here are valid for the **Survey** page, the **Code** page and the **Annot** page. Refer to "28 MapView Interactive Display Feature" for information on the keys on the **Map** page. The fields and functionality of this screen vary slightly when accessed from other applications where individual point measurements are needed.

Survey: Job name		↩
Survey Code Annot Map		
Point ID:	GPS0001	
Antenna height:	2.000 m	
3D CQ:	5.619m	
3DCQ:5.619m 2DCQ:3.444m 1DCQ:4.439m Q1 abc 10:30		
Meas	Near	HdnPt.. Page

Meas

To start logging of static observations. The key changes to **Stop**.

Stop

To end recording of positions when enough data is collected. When **Automatically stop point measurement** is checked in **Quality Control, General**, recording of positions ends automatically as defined by the stop criteria. The key changes to **Store**.

Store

To store the point information. When **Automatically store point** is checked in **Quality Control, General**, the measured point is stored automatically. The key changes to **Meas.**

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 screen opens where they can be corrected. Refer to "20.6 Code and Attribute Mismatch".

Near

To compare the user's 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.

HdnPt..

To measure a hidden point. Refer to "48 Survey - Hidden Points".

Page

To change to another page on this screen.

Fn Config..

To configure SmartCodes, auto points and hidden point measurements. Refer to "20.5 SmartCodes", "46 Survey - Auto Points" and "48 Survey - Hidden Points".

Fn Avg

To check the residuals for the averaged position. Available for **Mode: Average** in **Job Properties**:, **Averaging** page and for more than one measured coordinate triplet recorded for the same point. Refer to "5.3.3 Mean Page".

Fn Abs

To check the absolute difference between measurements. Available for **Mode: Average** in **Job Properties**:, **Absolute differences** page and for more than one measured coordinate triplet recorded for the same point. Refer to "5.3.3 Mean Page".

Fn Conect and Fn Disco

To dial the number of the base station configured in the active working style and to hang up immediately after the survey is completed. Available for real-time devices of type digital cellular phone or modem. Available for **Auto connect when measuring** unchecked in **RTK Rover Settings, General** page.

Fn Init..

To select an initialisation method and to force a new initialisation. Available for working styles allowing phase fixed solutions. Refer to "44.4 Initialisation for Real-Time Rover Operations".

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways: • To start a new sequence of point IDs type over the point ID. • For an individual point ID independent of the ID template Fn IndivID. Fn Run changes back to the next ID from the configured ID template.
Antenna height	Editable field	The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.
3D CQ	Display only	The current 3D coordinate quality of the computed position.

Description

Annotations can be used to add either field notes or comments to points being surveyed.

Access

For RTK rover:
Select **Main Menu: Go to Work!, Survey**. Go to the **Annot** page.
 If it is not already displayed, the **Annot** page can be configured to appear in the Survey application through the **My Survey Screen Settings** screen. Refer to "19.3 My Survey Screen"for more information.

Survey,
Annot page

Description of fields

Field	Option	Description
Annot 1 to Annot 4	Editable field	Type in the annotation. The annotation can be up to 16 characters long and include spaces.
		 When the ASCII input interface is configured to be used and an annotation is reserved for the incoming ASCII string, then no other information can be typed in for the particular annotation.
		 CE to clear the entry.
		 Last to recall all annotations entered for the previously surveyed point. Any annotations just entered are overwritten.
		 ENTER . The next line is highlighted.

Next step

Step	Description
1.	Meas to start the point measurement.
2.	Stop to end the point measurement.
3.	Store to store the point information including the annotations.

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 GPS operations, except for real-time base operations.

Requirements

- **Automatically start measuring point on entering survey:** **Timed** is configured in **Quality Control, Advanced** page. Refer to "11.4 Quality control".
- **Time at point** is configured for one of the lines in one of the survey screen pages. Refer to "19.3 My Survey Screen".

Access

For RTK rover:

Select **Main Menu: Go to Work!, Survey**.

**Survey,
Survey page**

Survey: Job name					↩
Survey	Code	Annot	Map		
Point ID:	GPS0001				
Antenna height:	2.000				m
Start time:	10:32:00				
3D CQ:	5.566m				
3DCQ:5.566m 2DCQ:3.416m 1DCQ:4.395m Q1 abc 10:32					
Meas	Near			HdnPt..	Page

Refer to "44.1 Surveying Points" for a description of keys.

Description of fields

Field	Option	Description
Start time	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. Type in the start time in hours, minutes and seconds for when the point measurement will begin. Press Meas. The point measurement does not start yet. The name of the field changes to Time to go.
Time to go	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. Then, data is logged as configured in the working style. Any measurement counter defined to be used in survey screen page is displayed and starts incrementing. The name of the field changes to Time at point.
Time at point	Display only	The time in hours, minutes and seconds from when the point is measured until point measurement is stopped. Press Stop and Store when enough data is collected. The name of the field changes to Start time.

44.4

44.4.1

Initialisation for Real-Time Rover Operations

Accessing Initialisation for Real-Time Rover Operations

Requirements

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

Access

For RTK rover:

- Select **Main Menu: Go to Work!, Survey**. Press **Init...**
- Access is possible from other screens where individual point measurements are needed, for example from **Inverse Pt - Pt** with **Surv...**

Re-initialise the RTK

Initialisation method	Description	Refer to chapter
Initialise while moving	The rover antenna can be moved during the initialisation process.	"44.4.2 Initialise while Moving"
Initialise while static	 The antenna setup must be static on a pillar, a tripod or on a pole with a quickstand.	"44.4.3 Initialise while Static"
Initialise on a known point	 The antenna setup must be static on a pillar, a tripod or on a pole with a quickstand.  The coordinates of the point must be stored in, or able to be converted to, the WGS 1984. They must be stored in the working job either by manual entry or by measuring.	"44.4.4 Initialise on Known Point"

44.4.2

Initialise while Moving

Initialise while moving step-by-step

Step	Description
1.	Does the instrument currently have a fixed solution? • If yes, continue with step 3. • If no, continue with the next row.
	The initialisation starts automatically.
2.	Continue with the row after step 3.
3.	Yes to start the initialisation. The current ambiguity solution is discarded.
	Meas is available but must not be pressed until the ambiguity solution is gained.
4.	The initialisation is gained when the ambiguities are solved.
5.	Continue with the surveying operation.

44.4.3

Initialise while static step-by-step

Initialise while Static

Step	Description
1.	Does the instrument currently have a fixed solution? • If yes, continue with step 3. • If no, continue with the next row.
	The initialisation starts automatically.
2.	Continue with step 6.
3.	Yes to start the initialisation. The current ambiguity solution is discarded.
	Stop is available but must not be pressed until the ambiguity solution is gained.
	The initialisation is gained when the ambiguities are solved.
4.	Any configurations for Automatically stop point measurement in Quality Control, General page are ignored. Stop when enough data is collected.
5.	When Automatically stop point measurement is not checked in Quality Control, General page, Store to store the point information.
6.	Continue with the surveying operation.

Initialise on known point step-by-step

Step	Description
1.	Does the instrument currently have a fixed solution? • If yes, continue with step 3. • If no, continue with step 4.
2.	Yes to start the initialisation. The current ambiguity solution is discarded.
3.	In Data , Points page, highlight the known point for the initialisation.
4.	OK starts the initialisation.
	Survey screen Point ID: The ID of the selected known point is displayed. Antenna height: The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited. Enter the correct antenna height.
	If desired, add a code.
	If desired, add an annotation.
	Stop is available but must not be pressed until the ambiguity solution is gained.
	The initialisation is gained when the ambiguities are solved.
5.	Any configurations for Automatically stop point measurement in Quality Control , General page are ignored. Stop when enough data is collected.

Step	Description
6.	When Automatically stop point measurement is not checked in Quality Control, General page, Store to store the point information.
	An average is automatically calculated with the known coordinates.
7.	Continue with the surveying operation.

Description

The Survey application is used for point measurement. Angles and distances for points can be measured and the calculated coordinates stored using **Meas**, **Dist** and **Store**.

Access

Select **Main Menu: Go to Work!\Survey**.

Survey,
Survey page

The fields shown are from a typical working style. The screen described consists of four pages. The explanations for the softkeys given here are valid for the **Survey** page, the **Offset** page, and the **Code** page. Refer to "28 MapView Interactive Display Feature" for information on the keys on the **Map** page.

The fields and functionality of this screen vary slightly when accessed from other applications where individual point measurements are needed.

Survey: Job name

Survey | Offset | Code | Map

Point ID:

TPS0001

Target height:

1.500

m

Hz:

99.9997g

V:

99.9997g

Horiz distance:

10.000m

Height difference:

0.080m

Hz: 99.9996g

V: 100.0000g

Q1 abc

11:31

Meas

Dist

Store

RmtHt.

Page

- Meas**
To measure and store distances and angles.
- Stop**
Available if **Measure mode: Continuous** and **Dist** was pressed. Stops the distance measurements. The key changes back to **Meas**.
- Dist**
To measure and display distances.

Store

To record data.

If **Measure mode: Continuous** and/or **Log auto points** is checked, records measured point and continues tracking.

RmtHt.

To access **Survey Remote Point**. Available if **Measure remote pts** is checked in **Configuration, Remote pt** page.

Page

To change to another page on this screen.

Fn Config..

To configure SmartCodes, auto points and remote point measurements. When **Fn Avg** or **Fn Abs** are active, this key is not available. Refer to "20.5 SmartCodes", "46 Survey - Auto Points" and to "50 Survey - Remote Point" for information on the fields and keys.

Fn Avg

To check the residuals for the averaged point. Available for **Mode: Average** in **Job Properties:, Averaging** page and for more than one measured coordinate triplet recorded for the same point. Refer to "5.3.3 Mean Page".

Fn Abs

To check the absolute difference between the measurements. Available for **Mode:** Average in **Job Properties:**, **Absolute differences** and for more than one measured coordinate triplet recorded for the same point. Refer to "5.3.3 Mean Page".

Fn 2 Face

Available for **Measure mode: Single** and **Measure mode: Single (fast)**. To take a measurement in Face I and Face II. The point stored is an average of the two measurements. When 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.

Fn IndivID and Fn Run

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 "19.1 ID templates" User Work settings ID templates.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for measured points. The configured point ID template is used. The ID can be changed: - To start a new sequence of point IDs overtype the point ID. - For an individual number independent of the ID template Fn Individ. Fn Run changes back to the next ID from the configured ID template.
Target height	Editable field	The last used target height is suggested when accessing the Survey application. An individual target height can be typed in.
Hz	Display only	The current horizontal angle.
V	Display only	The current vertical angle.
Horiz distance	Display only	The horizontal distance after Dist was pressed. No distance is displayed when accessing the screen and after Store or Meas .
Height difference	Display only	The height difference between station and measured point after Dist . Displays ----- when accessing the screen and after Store or Meas .
Easting	Display only	Easting coordinate of the measured point.
Northing	Display only	Northing coordinate of the measured point.
Elevation	Display only	Elevation of the measured point.

Description

Auto points are used to automatically log points at a specified rate. Additionally, individual auto points can be stored outside the defined rate.

Auto points can be collected in the Survey application. An **Auto** 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.

**Coding of auto points**

Logging of auto points is possible for TPS and in the GPS rover menu.

Coding of auto points is similar to coding manually occupied points. Refer to "20 Coding" for information on coding.

The differences are:

- Thematical coding: GPS Available for **Store points:To DBX (pts&codes)** in **Configuration, Log auto points** page.
- Free coding: TPS Always available.
- 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 working job.
- Codes of auto points can be changed when no auto points are being logged.

- Up to three attributes can be stored with a code.

Properties of auto points

The properties stored with auto points are:

- Class: Either **Meas** or, for **GPS** also **Nav**
- Sub class:
 - **GPS** **Code only**, **GPS code only**, **GPS fixed**, **GNSS Code Only** or **GNSS Fixed**.
 - **TPS** **TPS**
- Source: **Survey (Auto)** or **Srvy Auto Offset**
- Instrument source: GPS or TPS

Averaging of auto points

An average is never calculated for auto points even if a manually occupied point of class **Meas** already exists with the same point ID.

Access

Select **Main Menu: Go to Work!**, **Survey**. Press **Fn Config...**

Configuration,
Log auto points page

OK

To accept changes and return to the screen from where this screen was accessed.

Config..

To configure what is viewed in the **Auto** page in the Survey application. Available for **Log auto points** checked.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Log auto points	Check box	Activates the logging of auto points.  All other fields on the screen are active and can be edited.
Store points by	Time	Auto points are logged according to a time interval. The time interval is independent from the update interval for the position on the screen.

Field	Option	Description
	Distance	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.
	Height difference	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.
	Distance or height	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.
	Stop & Go	An auto point is stored when the position of the antenna/prism does not move more than the distance configured in Minimum distance between points within the Stop time . Once a point has been stored, the position must change more than the distance configured in Minimum distance between points before the routine starts again.
	User decides	An auto point is stored upon pressing Meas (GPS) / Store (TPS) in Survey, Auto page. In the beginning, the chain to which the auto points will be assigned must be started with Start . In the end, the chain must be closed with Stop .

Field	Option	Description
Log every	Editable field From 0.05s to 60.0s	Available unless Store points by: Distance or height . For Store points by: Distance and Store points by: Height difference . The difference in distance or height before the next auto point is logged. For Store points by: Time . The time interval before the next auto point is logged.
Max distance	Editable field	Available for Store points by: Distance or height . The value for the difference in distance before the next auto point is logged.
Max height	Editable field	Available for Store points by: Distance or height . The value for the height difference before the next auto point is logged.
Minimum distance between points	Editable field	Available for Store points by: Stop & Go . The distance within which the position is considered stationary.
Stop time	Editable field	Available for Store points by: Stop & Go . The time while the position must be stationary until an auto point is stored.
Store points 	To MDB (pts only)	 Changing this setting while auto points are being logged stops the logging. It must then be restarted. 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 MapView or output via format files.

Field	Option	Description
	To DBX (pts&codes)	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 MapView or output via format files.
Logging starts ☐ GPS	Automatically	Logging of auto points starts immediately when the Configuration screen is accessed.
	Controlled	Logging of auto points starts upon pressing Start on the Auto page in Survey .
Don't store auto log point if CQ exceeds limit ☐ GPS	Check box	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.
3D CQ limit ☐ GPS	Editable field	Available if Don't store auto log point if CQ exceeds limit is checked. 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.
Beep when auto logged point is stored ☐ GPS	Logging	Instrument beeps when storing an auto point.
	Never	Instrument never beeps.

Next step

IF the survey screen mask	THEN
is not to be configured	OK closes the screen and returns to the previous screen.
is to be configured	Config...

Configure Page

Configure Page 1

Name: Survey

1st line: Point ID

2nd line: Target height

3rd line: Line space full

4th line: Hz angle

5th line: V angle

6th line: Horiz distance

Hz: -°--'--' V: -°--'--' abc 16:05

OK Clear Default

OK

To accept changes and to return to previous screen.

Clear

To set all fields to **Line space full**.

Default

To recall the default settings.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Name	Editable field	The name of the page is shown as page name in Survey .

Field	Option	Description
Show in the Survey application	Check box	Shows or hides the page as a page in Survey .
1st line	Display only	Fixed to Point ID .
2nd line to 16th line	Angle right % completed Annotation 1 to Annotation 4 Antenna height Attrib (free) 01 to Attrib (free) 20 Attrib 01 to Attrib 20 Automation	For each line, one of the following options can be selected. Displays the horizontal angle difference between the backsight point and the current telescope position. Display only field for the percentage of the time for which the point has been occupied based on the setting for Stop criteria in screen Quality Control. Appears in the page during the point occupation if Quality Control is checked. Editable field for comments to be stored with the point. Input field for antenna height for static observations. Display only field for attributes for free codes. Editable field for attributes for codes. Unavailable for SmartStation. Select automation type.

Field	Option	Description
	Avg max #distances TPS	Input field for maximum number of distance measurements in the averaging EDM mode.
	Azimuth TPS	Display only field for the azimuth.
	Backsight pt ID TPS	Display only field for the point ID of the backsight point.
	Code	Editable field for codes.
	Code (free)	Editable field for free codes.
	Code desc (free)	Display only field for the description of free codes.
	Description	Display only field for the description of codes.
	Easting TPS	Display only field for Easting coordinate of measured point.
	GDOP GPS	Display only field for the current GDOP of the computed position.
	HDOP GPS	Display only field for the current HDOP of the computed position.
	Elevation TPS	Display only field for the height coordinate of the measured point.
	Height difference TPS	Display only field for the height difference between station and reflector.
	Horiz distance TPS	Display only field for horizontal distance.

Field	Option	Description
	Humidity GPS	Editable field for relative humidity to be stored with point.
	Hz angle TPS	Display only field for the horizontal angle.
	Instrument height TPS	Display only field for the instrument height.
	Line space full	Insert full line space.
	Line space half	Insert half line space.
	Linework	Selectable list with option for flagging a line/area.
	Measure mode TPS	Select EDM measurement mode.
	Measure TPS	Select EDM type.
	Moving antenna ht GPS	Input field for antenna height for moving observations.
	Msd PP obs GPS	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.
	Northing TPS	Display only field for Northing coordinate of measured point.
	Number of dists TPS	Display only field for number of averaged distances measured with EDM mode averaging.

Field	Option	Description
	Offset left/right TPS	Input field for horizontal distance offset for measured point, perpendicular to the line of sight.
	Offset height TPS	Input field for height offset for measured point.
	Offset in/out TPS	Input field for horizontal distance offset, in the direction of line of sight.
	Offset mode TPS	Select offset mode.
	PDOP GPS	Display only field for the current PDOP of the computed position.
	PPM atmos TPS	Display only field for atmospheric ppm.
	PPM geometric TPS	Display only field for geometric ppm value.
	PPM total TPS	Display only field for the total ppm value.
	Point ID	Editable field for the point ID.
	Pressure GPS	Editable field for atmospheric pressure.
	Prism constant TPS	Display only field for additive constant of currently selected reflector.
	Quality 1D GPS	Display only field for the current height coordinate quality of computed position.
	Quality 2D GPS	Display only field for the current 2D coordinate quality of computed position.

Field	Option	Description
	Quality 3D GPS	Display only field for the current 3D coordinate quality of computed position.
	RTK positions GPS	Display only field for the number of positions recorded over the period of point occupation. Appears in the page of real-time rover configurations.
	SD (last recorded) TPS	Display only field for the last recorded distance.
	Slope distance TPS	Display only field for measured slope distance.
	Station ID TPS	Display only field for current station ID.
	Station easting TPS	Display only field for current station Easting coordinates.
	Station height TPS	Display only field for current station height coordinates.
	Station northing TPS	Display only field for current station Northing coordinates.
	Std deviation TPS	Display only field of standard deviation in millimetres of averaged distances.
	Target TPS	Select a prism.
	Target height TPS	Input field for prism height.

Field	Option	Description
	Temp dry GPS	Editable field for dry temperature to be stored with point.
	Temp wet GPS	Editable field for wet temperature to be stored with point.
	Time at point GPS	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.
	Type	Display only field for the type of code, for example point code, line code or area code.
	V angle TPS	Display only field for vertical angle.
	V angle display TPS	Select vertical angle display.
	VDOP GPS	Display only field for the current VDOP of the computed position.

Requirements

- **Log auto points** in **Configuration, Log auto points** page.
- **GPS** The rover menu must be used.

Access

Select **Main Menu: Go to Work!, Survey**. Go to the **Auto** page.

Survey,
Auto page

Before logging of auto points has started, the page appears as shown:

Survey: My first job | ↩

Survey | Code | Auto | Map

Auto point ID: Time & date

Free Code: -----

Moving antenna ht: 0.000 m

Msd auto points: 0

3D CQ: -----m

3DCQ:-----m 2DCQ:-----m 1DCQ:-----m Fn abc 15:14

Stop | Meas | Page

Start

For **Logging starts: Automatically** in **Configuration, Log auto points** page, logging of auto points starts immediately when the **survey** screen is accessed and **Start** need not be pressed.

To start logging of auto points and offset points if configured or, for **Store points by: User decides**, to start the chain to which the auto points will be assigned. The first auto point is stored.

TPS **Measure mode: Continuous** becomes active. For **Measure: Prism** instrument locks onto prism. For **Measure mode-Long range (>4km)**, **Measure: Prism** is set and instrument locks onto the prism.

Stop

To end recording of auto points and offset points if configured or, for **Store points by: User decides**, to end the chain to which the auto points are assigned.

Meas GPS

Available for **Stop**. To store an auto point at any time.

Store TPS

Available for **Stop**. To store an auto point at any time.

Offst1..

To configure recording of the first type of offset points. Refer to "46.4.2 Configuring Offset Points".

GPS Available for **Store points: To DBX (pts&codes)** in **Configuration, Log auto points** page.

Offst2..

To configure recording of a second type of offset points. Refer to "46.4.2 Configuring Offset Points".

GPS Available for **Store points: To DBX (pts&codes)** in **Configuration, Log auto points** page.

Page

To change to another page on this screen.

Fn Config..

To configure auto points. Refer to "46.2 Configuring Auto Points".

Quit

To exit the Survey application. Point information logged until pressing **Fn Quit** is saved in the database.

Description of fields

Field	Option	Description
Auto point ID	Editable field	Available unless GPS auto points: Time & date/TPS auto points: Time & date in ID Templates . 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.
	Time & date	Available for GPS auto points: Time & date/TPS auto points: Time & date in ID Templates . The current local time and date is used as identifier for auto points.
Moving antenna ht GPS	Editable field	The default antenna height for auto points as defined in the active working style is suggested.
Target height TPS	Editable field	The default reflector height as defined in the active configuration set is suggested.
Code (auto)		The thematical code for the auto point.

Field	Option	Description
		- If a point code is selected then any open line/area is closed. The occupied point is stored with the selected code independently of any line/area. - If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The occupied point is assigned to that line. The line stays open until it is closed manually or another line code is selected. - If an area code is selected then the behaviour is as for lines.
	Selectable list	Available if Use a list box to view codes is checked. The attributes are shown as display only, editable field or selectable list fields depending on their definition.
	Editable field	Available if Use a list box to view codes is not checked. Codes can be typed in but not selected from a codelist. A check is performed to see if a code of this name already exists in the job. If so, the according attributes are shown. Configure a survey screen mask with a selectable list for code types to define if a point, line or area code is typed in.
Description	Display only	The description of the code.
Msd auto points	Display only	Available after pressing Start . The number of auto points logged since Start has been pressed.

Field	Option	Description
3D CQ 	Display only	The current 3D coordinate quality of the computed position.
Slope distance	Display only	The measured slope distance. When Start is pressed, Measure mode: Continuous is set and the slope distance is constantly updated.
Hz	Display only	The current horizontal angle.
V	Display only	The current vertical angle.

Next step

IF	THEN
auto points are to be logged	Start. Then, for Store points by: User decides , Meas whenever an auto point is to be logged.
offset points are to be configured	Offst1.. or Offst2... Refer to "46.4 Offset Points of Auto Points".

46.4

46.4.1

Offset Points of Auto Points

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 screens for the configuration 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 offset points

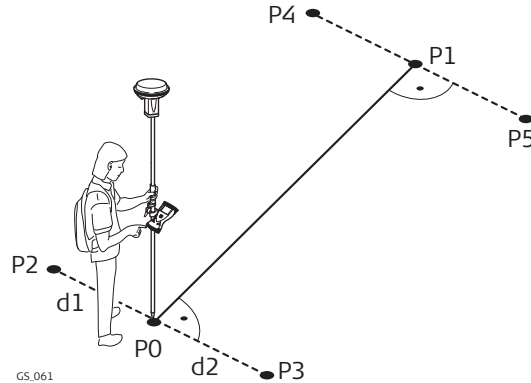
The computation of offset points depends on the number of auto points in one chain.

One auto point

No offset points are computed or stored.

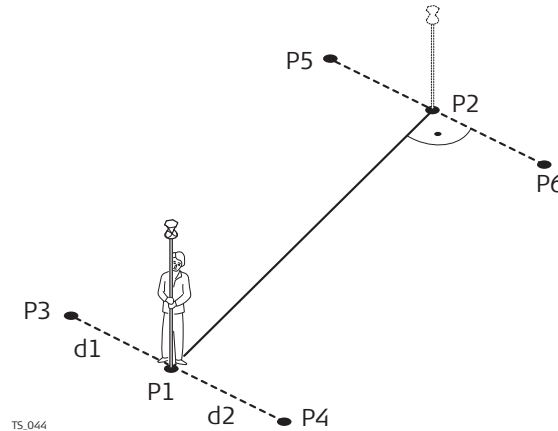
Two auto points

The configured offsets are applied perpendicular to the line between two auto points.



GPS

- 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



TPS

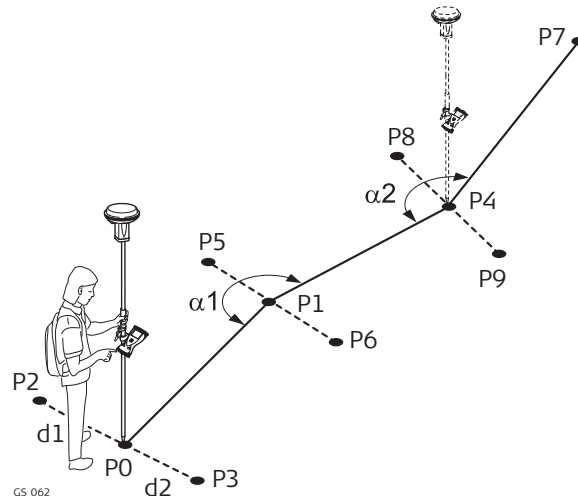
- P1 First auto point
- P2 Second auto point
- P4 First offset point for P1
- P3 Second offset point for P1
- P5 First offset point for P2
- P6 Second offset point for P2
- d1 Horizontal offset to the left
- d2 Horizontal offset to the right

Three or more auto points

The first offset points are computed perpendicular to the line between the first and the second auto point.

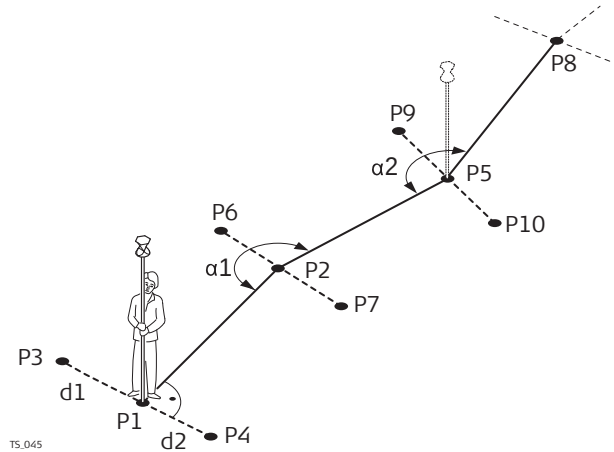
The last offset point is computed perpendicular to the line between the last auto point and the one before.

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.



GPS

- 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



TPS

- 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
- α_1 Angle between P1 and P5
- α_2 Angle between P2 and P8

46.4.2

Configuring Offset Points

Requirements

GPS Available for **Store points: To DBX (pts&codes)** in **Configuration, Log auto points** page.

Access

Press **Offst1..** or **Offst2..** in **Survey, Auto** page.

Auto Points - Offset 1, General page

OK

To accept changes and return to the screen from where this screen was accessed.

Offst2.. and Offst1..

To switch between configuring offset point type one and two.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Store offset 1 points and Store offset 2 points	Check box	Activates logging of offset points.  All other fields on the screen are active and can be edited with this setting.
Horiz distance	Editable field	The horizontal offset between -1000 m and 1000 m at which the offset point is collected.

Field	Option	Description
Height offset	Editable field	The height offset between -100 m and 100 m from the related auto point.
Identifier	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.
Prefix/suffix	Prefix	Adds the setting for Identifier in front of the auto point ID.
	Suffix	Adds the setting for Identifier at the end of the auto point ID.

Next step

Page changes to the **Code** page.

Auto Points - Offset 1, Code page

Auto Points - Offset 1

General Code

Point code: BM

Description: Bench Mark

3DCQ:0.020m 2DCQ:0.011m 1DCQ:0.016m Fn abc 14:18

OK +Attrib Last Default Page

OK

To accept changes and return to the screen from where this screen was accessed.

+Attrib

To create additional attributes for the selected code. Available if **Use a list box to view codes** is checked.

Name or Value

To highlight the attribute field or the field for the attribute value. The name of the attribute can be edited and an attribute value can be typed in. Available if **Use a list box to view codes** is checked. Available for attributes for which an attribute name can be typed in.

Last

To recall the last used attribute values for the selected code. Available if **Use a list box to view codes** is checked.

Default

To recall the default attribute values for the selected code. Available if **Use a list box to view codes** is checked.

Page

To change to another page on this screen.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point code	Selectable list	The thematical code for the offset point. Available if Use a list box to view codes is checked. The attributes are shown as display only, editable field or selectable list fields depending on their definition.
Code	Editable field	The thematical code for the offset point. Available if Use a list box to view codes is checked. Codes can be typed in but not selected from a codelist. A check is performed to see if a point code of this name already exists in the job. If so, the according attributes are shown.
Description	Display only	Available if Use a list box to view codes is checked. The description of the code.
Attributes	Editable field	Available if Use a list box to view codes is checked. Up to three attribute values can be stored.

Next step

IF	THEN
offset point configuration is finished	OK to return to the survey screen.
a second offset point is to be configured	Page and then Offst2.. or Offst1.. to change to configuration screen 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 Auto1235	OS1	Prefix	OS1Auto1234 OS1Auto1235 ...
Auto1234 Auto1235	OS1	Suffix	Auto1234OS1 Auto1235OS1 ...



Refer to "19.1 ID templates" for more information on point IDs.

Survey Cross Section

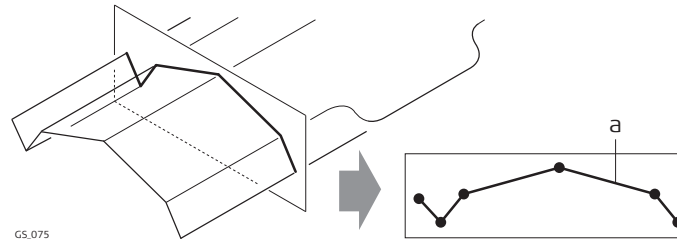
Overview

Description

The Survey Cross Section application allows for the automatic changing of codes during a survey. This function is useful when surveying multiple cross sections. Examples could include surveys of railway lines, roads, small waterways, driveways and paths.

The codes for the elements in the cross section to be surveyed are all stored and pre-defined in a template. The codes are then automatically changed after each point observation.

Diagram



a) Cross section element

Template

Templates are used to pre-define the order of the codes for the survey.

A template pre-defines

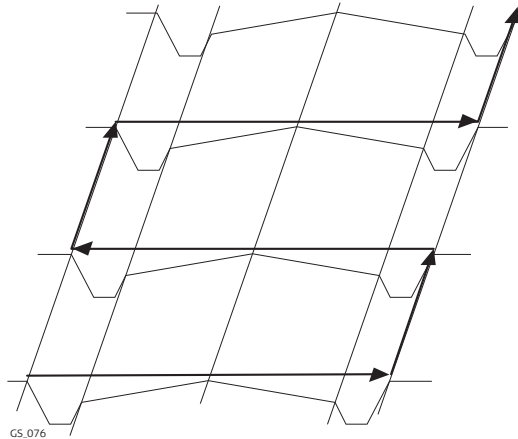
- the coding sequence of a cross section.
- the type of coding.

Cross section methods and directions

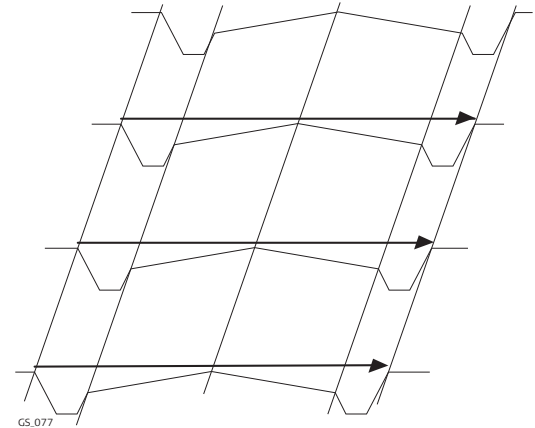
Templates can be applied

- to the ZigZag method or the Same Direction method.
- in either a forward direction or in a backward direction.

ZigZag



Same Direction



Coding of cross section elements

Survey Cross Section is possible for RTK base and TPS.

Codes can be attached to cross section elements. Refer to "20 Coding" for information on coding.

- Thematical coding: Available
 - Free coding: Available
 - Quick coding: Not available
-

Properties of cross section points

The properties stored with cross section points are:

- Class: Either **Meas** or for **GPS** also **Nav** depending on the position status when the point was measured.
 - Sub class:
 - **GPS** Code only, GPS code only, GPS fixed, GNSS Code Only or GNSS Fixed.
 - **TPS** TPS
 - Source: **Cross Section**
 - Instrument source: **GPS** or **TPS**
-

Averaging of cross section elements

The principles for averaging are identical to the principles use in the Survey application. Refer to "5.3.3 Mean Page" for information on averaging.

Exporting data

The points and lines are recorded as for all other applications. The data can be exported as normal.

Access

Select **Main Menu: Go to Work!\Survey+\Survey cross section.**

Description

Cross section templates

- pre-define the sequence of codes for a cross section.
- consist of elements.

Elements can be defined such that the surveyed points of a cross section are

- stored with a point code.
- stored with a free code.

During the process of surveying a cross section, the code for the next element to be measured is then selected and suggested automatically.

Templates

All cross section templates stored in the working job are listed in alphabetical order, including the number of elements in each cross section template.

Templates	
Templates	No. elements
Template 1	2
Template 2	4

OK

To select the highlighted cross section template and to start surveying a cross section.

New..

To create a cross section template.

Edit..

To edit the highlighted cross section template.

Delete

To delete the highlighted cross section template.

3DCQ:0.010m	2DCQ:0.005m	1DCQ:0.009m	Fn abc	10:00
OK	New..	Edit..	Delete	Copy..

Copy..

To create a cross section template based on the one currently highlighted.

Fn Quit

To exit the application.

Access

In **Templates**, press **New...**, **Copy..** or **Edit...**

**New Template/Edit
Template/Copy
Template,
General page**

Type in a name for the new cross section template.

Next step

Page changes to the **Elements** page.

**New Template/Edit
Template/Copy
Template,
Elements page**

New Template		
General Elements		
No.	Code	Code type
1	EL	Point
2	LHP	Free
3	KD	Free
4	SV	Point

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:01					
Store	Add	Edit..	Delete	Insert	Page

Store

To store the cross section template and to return to the screen from where this screen was accessed.

Add

To add one or more elements to the end of the current list.

Edit..

To edit the highlighted element.

Delete

To delete the highlighted element from the list.

Insert

To insert one element before the currently highlighted element of the list.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of columns

Field	Description
No.	The number of the element.
Code	The code assigned to the element. If no code is assigned to the element, ----- is displayed.
Code type	The type of the code assigned to the element.

Next step

Add, Edit.. or Insert accesses **Add Element/Edit Element/Insert Element**.

Add Element/Edit Element/Insert Element

The functionality of the screens adding, editing and inserting an element are similar. Differences are outlined.

Add Element | ➡

Element number: 5

Code type: Free codes

Store free code: Before pt is stored

Code (free): FL

Description: FenceLine

3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:01

OK | | | | Next

OK

To add the element at the end of the cross section template or to store the changes. To return to the screen from where this screen was accessed.

Next

In **Add Element**: To add the element to the end of the **Elements** list and stay in the **Add Element** screen to add further elements.
In **Edit Element**: To update the element in the **Elements** list and stay in the **Edit Element** screen to edit details of the next element in the list.

Prev

Available in **Edit Element**. To update the element in the **Elements** list and stay in the **Edit Element** screen to edit details of the previous element in the list.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Element number	Display only	For Add Element and Insert Element : The number of the element to be added. For Edit Element : Displayed as x/y. x Number of the element to be edited. y Total number of elements on the active template.
Code type	Free codes Thematic codes	The type of code to be used with the element. To store a code independent of the element as time-related information. To store a code together with the element.
Store free code	After pt is stored or Before pt is stored	Determines if a free code is stored before or after the point. Available for Code type: Free codes .
Code (free)	Selectable list	The code which will be stored before or after the point/line. Available for Code type: Free codes .
Code	Selectable list	The code which will be stored with the next point/line. Available for Code type: Thematic codes .

Field	Option	Description
Description	Display only	A line for a detailed description of the code.

Next step

OK adds the element or stores the changes.

Description

The fields on this screen indicate which cross section element is to be surveyed next.

Access

Press **OK** in **Templates**.

**Survey,
General page**

The pages shown are from a typical working style. An additional page is available when a user-defined survey screen page is used.

Survey: Job name	
General	Code Map
Point ID:	GPS0001
Antenna height:	2.000 m
Template:	Template 3
Element:	1/5
Code:	EL
Distance to last:	-----m
3D CQ:	0.009m
3DCQ:0.009m 2DCQ:0.005m 1DCQ:0.008m Fn abc 10:02	
Meas	End Survy.. Page

Meas

Available if a template has been opened with

Start

GPS To start measuring the next point of the cross section. The key changes to **Stop**.

TPS

To measure a distance and store distance and angles.

Stop **GPS**

To end measuring the point. The key changes to **Store**.

Store**GPS**

To store the measured point. The key changes to **Meas**.

TPS

To store angles and distance. Distance must be measured before.

Dist **TPS**

To measure a distance.

Start and End

To open and close the selected cross section template. While the template is open, the elements of the cross section can be surveyed.

Survey..

To manually measure a point that is not part of the cross section. The point is not treated as an element of the cross section. The open template remains open.

Available if a template has been opened with **Start**.

Page

To change to another page on this screen.

Fn Config..

To configure the Cross Section Survey application. Refer to "47.5 Configuring Survey Cross Section".

Fn Prev

To select the previous element of the cross section template. The currently measured element will not be stored.

Available when **End** is displayed.

Fn Next

To select the next element of the cross section template. The currently measured element will not be stored.

Available when **End** is displayed.

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for manually measured points. The configured point ID template is used. The ID can be changed in the following ways: • To start a new sequence of point IDs type over the point ID. • For an individual point ID independent of the ID template Fn IndivID. Fn Run changes back to the next ID from the configured ID template.
Antenna ht	Editable field	GPS The default antenna height. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.
Target height	Editable field	TPS The default prism height.
Template		The active template for the cross section.

Field	Option	Description
	Selectable list	The cross section template is closed. Opening the selectable list accesses Templates where a new template can be created and an existing template can be selected or deleted. Refer to "47.3 Creating/Editing a Cross Section Template".
	Display only	The cross section template is open.
Element	Display only	Displayed as x/y. x The number of the next element on active template. The number increases/decreases as moving across the cross section depending on the selection for Method in Configuration . y Total number of elements on active template.
Code	Display only	The name of the code. Point codes will be stored with the measured point. Free codes will be stored, depending on the configuration, before or after the measured point.
Distance to last	Display only	The horizontal distance from the current position to the last surveyed element position in the previous cross section. ----- is displayed for unavailable information.

Next step

IF	THEN
a cross section template is to be opened	select the desired template and press Start .
an element of a cross section is to be surveyed	GPS Meas, Stop and then Store . TPS Meas , or Dist and then Store .  Once the end of a cross section is surveyed then the next cross section will be measured. Depending on the Method selected in Configuration, General page, the measurement is either in the same direction or in the reverse direction.
a cross section template is to be closed	select the desired template and press End .
data is to be viewed graphically	Page . An element of a cross section template can also be surveyed from the Map page. Refer to "28 MapView Interactive Display Feature" for information on the functionality and softkeys available.
the application is to be exited	Fn Quit .

Access

In the survey screen of the cross section application, press **Config...**

**Configuration,
General page**
OK

To accept changes and return to the screen from where this screen was accessed.

Config..

To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "19.3 My Survey Screen"

Fn About

To display information about the program name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Method		Method by which subsequent cross sections will be surveyed. Refer to "47.1 Overview" for a diagram.

Field	Option	Description
	Zig-zag	Each new cross section is started at the same end as where the previous cross section finished.
	Same direction	Each new cross section is started at the same end as where the previous cross section started.
Direction	Forward	The way of surveying the cross section. This influences in which order the elements of a template will be applied. Refer to "47.1 Overview" for a diagram. The cross sections will be surveyed in the same way as the elements are defined in the selected template.
	Backward	The cross sections will be surveyed in the reverse way as the elements are defined in the selected template.
Show distance to last msd section	Check box	Activates a display only field in the survey screen. The horizontal distance from the current position to the last surveyed element position in the previous cross section will be displayed.
Show code attribute	Checkbox	When this box is checked, some attribute fields are displayed in the survey screen. Useful if the surveyor is stringing, to see that the correct string attribute value is being used.
Attribute to show	From 1 to 20	The number of attribute fields which is displayed in the survey screen. Available when Show code attribute is checked.

Field	Option	Description
Show additional page from My Survey Screen	Check box	When this box is checked, a user-defined survey screen page is shown in the survey screen.
Page to show	Selectable list	The names of the available survey screen pages. Available when Show additional page from My Survey Screen is checked.

Next step

OK returns to the screen from where this screen was accessed.

Description

Hidden points are points which cannot be measured directly by GPS, because, either they cannot be physically reached, or because satellites are obstructed, for example by trees or tall buildings.

- 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.
- Additional auxiliary points can be manually measured.
- Bearings can be computed from previously measured points.

In contrast to the COGO application, hidden point measurements is more of a measuring application than a calculation application.

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 "48.7 Hidden Point Measurement Including Heights" for information on configuring height offsets.

Device height and **Target height** configured in **Hidden Point Device Offsets** are applied when the hidden points are computed. **Δ height** in **Hidden Point Connection** is the value directly from the hidden point measuring device.

Coding of hidden points

- Thematical coding: Available in **Hidden Point Result** after the calculation of a hidden point. Thematical coding of hidden points is identical to coding of manually measured points.
- Free coding: Can be started while in **Hidden Point Connection**. Free coding of hidden points is identical to coding of manually measured points.
- Quick coding: Not available.

Properties of hidden points

The properties stored with hidden points are:

- Class: **Meas**
- Sub class: **Hidden Point**

- Source: **Bearing-Distance, 2 bearings, 2 distances, Chainage % offset** or **Backward brg-dst** depending on the hidden point measurement method used
- Instrument source: **GPS**

Averaging of hidden points



An average is calculated for hidden points if a point of class **Meas** already exists with the same point ID.

Azimuth is used throughout this chapter. This term must always be considered to mean also **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.

48.2

48.2.1

Hidden Point Methods

Bearing & Distance

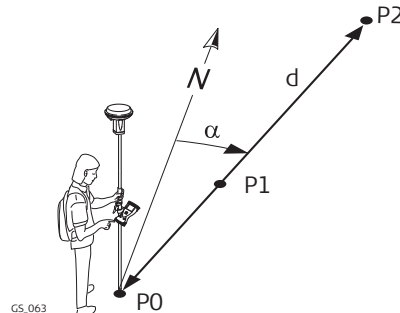
Description

One point must be known. It

- can already 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

α Bearing from P0 to P2

P1 Auxiliary point, optional

Unknown

P2 Hidden point

48.2.2

Using 2 Bearings

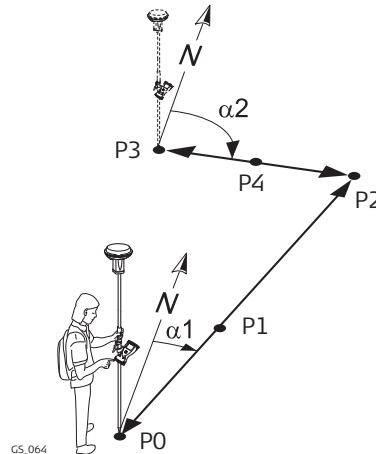
Description

Two points must be known. They

- can already 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 point.

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

48.2.3

Using 2 Distances

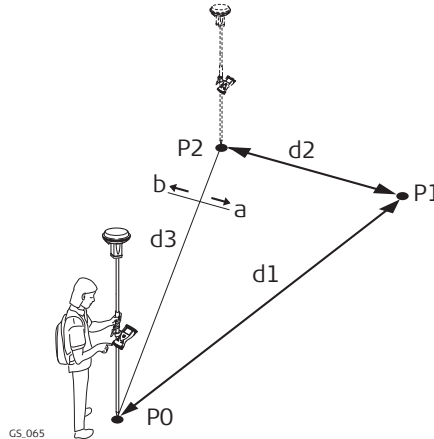
Description

Two points must be known. They

- can already 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

48.2.4

Chainage & Offset

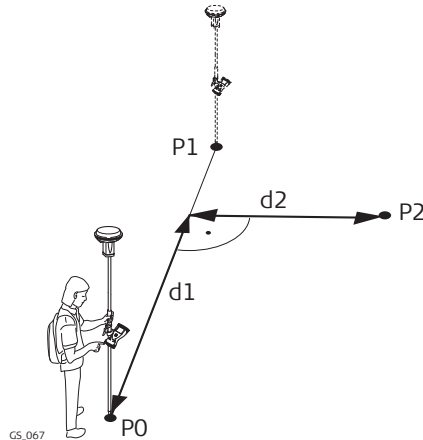
Description

Two points must be known. They

- can already 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

48.2.5

Backwards Bearing & Distance

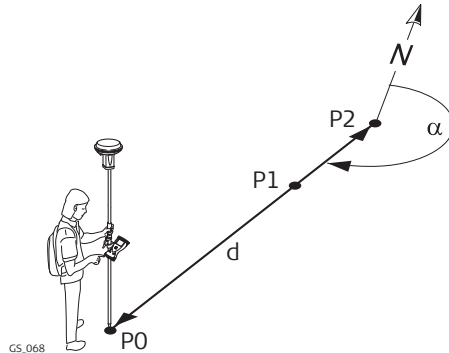
Description

In order to compute the hidden point, the measurements are taken from the hidden point. One point must be known. It

- can already 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

α Bearing from P2 to P0

d Distance from P2 to P0

P1 Auxiliary point, optional

Unknown

P2 Hidden point



Hidden point measurements are possible from the Survey application and when the Survey application screen is called from another application, for example from Stakeout.

Access

Press **HdnPt..** in the survey screen.

Hidden Point Connection

The setting for **Method** on this screen determines the availability of the subsequent fields and softkeys.

Hidden Point Interface	
Method:	Bearing & distance ▾
Point:	P101 
Azimuth:	20.0000 g
Horiz distance:	26.000 m

3DCQ:6.429m 2DCQ:4.139m 1DCQ:4.920m Q1 abc 10:47				
Calc				Survy..

Calc

To calculate the hidden point and to display the results.

EAO

Available for **Angle offset: New for each point** or **Angle offset: Permanent** in **Hidden Point Device Offsets**. To change or enter an External **Angle Offset**.

Hts..

To type in the device and target heights to be considered.

Sun

Available when **Azimuth** is highlighted. The azimuth from the direction of the sun to the known point is computed.

Azmth

Available when **Azimuth** is highlighted. To select or manually measure an auxiliary point and to compute the azimuth.

Posn ?

To determine chainage and offset of the current position relative to the line between the two known points. The values are displayed in **Chainage** and **Offset**. The point from where the chainage has been measured is selected in **Chainage from**.

Slope

Available when **Horiz distance** or **Chainage** is highlighted. To measure a slope distance and an elevation angle or percentage grade. The values are used to compute the horizontal distance.

Survy..

Available when a point field is highlighted. To measure the known point manually for the calculation of the hidden point.

Fn Config..

To configure hidden point measurements. Refer to "14 Instrument connections - All other connections".

Fn Quit

To exit the screen.

Description of fields

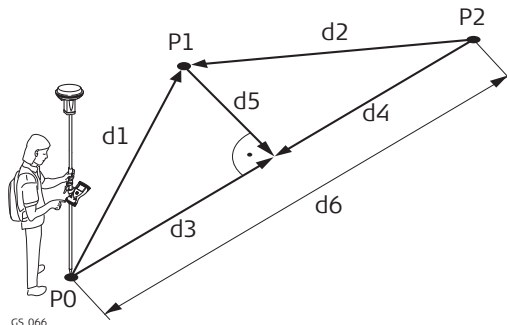
Field	Option	Description
Method	Selectable list	The method for measuring hidden points. Refer to "48.2 Hidden Point Methods" for a description of the methods.
Point	Selectable list	The point ID of the current position. This point is the known point for the calculation of the hidden point.  To type in coordinates manually for the known point open the selectable list and create a new point.
Point A	Selectable list	The point ID of the current position. This point is the first known point for the calculation of the hidden point.  To type in coordinates manually for the known point open the selectable list and create a new point.
Point B	Selectable list	The point ID of the current position. This point is the second known point for the calculation of the hidden point.  To type in coordinates manually for the known point open the selectable list and create a new point.
Azimuth	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.

Field	Option	Description
Horiz distance	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.
Location	Selectable list	Available for Method: Using 2 distances . The location of the hidden point relative to the line from Point A to Point B .
Chainage from	Selectable list	Available for Method: Chainage % offset . The chainage from one known point along the line between the two known points. Looking from the point selected in Chainage from , a positive chainage is towards the second known point. A negative chainage is into the opposite direction of the second known point.

Next step

Calc calculates the hidden point and displays the results in **Hidden Point Result**.

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 **Check chainage A**
- d4 **Check chainage B**
- d5 **Check offset**
- d6 **Check distance AB**

Hidden Point Result

Hidden Point Result				
Result	Code	Plot		
Point ID:	GPS0001			
3DCQ:0.008m 2DCQ:0.004m 1DCQ:0.007m Q1 abc 09:50				
Store			Next	Page

Store

To store the result.

Fn IndivID and Fn Run

To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template.

Next

To store the hidden point and to return to **Hidden Point Connection**. Another hidden point can be measured.

Fn Quit

To not store the hidden point and to exit the screen.

Description of fields

Field	Option	Description
Point ID	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.
Check distance AB	Display only	Available for Method: Using 2 bearings and Method: Using 2 distances . The computed horizontal distance between Point A and Point B .
Check bearing AB	Display only	Available for Method: Using 2 bearings and Method: Chainage % offset . The computed bearing from Point A to Point B .
Check distance A	Display only	Available for Method: Using 2 bearings and Method: Chainage % offset . The computed horizontal distance between Point A and the hidden point.
Check distance B	Display only	Available for Method: Using 2 bearings and Method: Chainage % offset . The computed horizontal distance between Point B and the hidden point.

Field	Option	Description
Check chainage A	Display only	Available for Method: Using 2 distances . The computed distance on the line from Point A to Point B from Point A to the point of intersection with Check offset .
Check chainage B	Display only	Available for Method: Using 2 distances . The computed distance on the line from Point B to Point A from Point B to the point of intersection with Check offset .
Check offset	Display only	Available for Method: Using 2 distances . The computed perpendicular distance from the hidden point to the line from Point A to Point B .

Next step

On the **Code** page, type in a code if desired.

On the **Map** page, measured distances are indicated by solid arrows, bearings are indicated by half solid and half dashed arrows.

Store stores the hidden point.

48.5

48.5.1

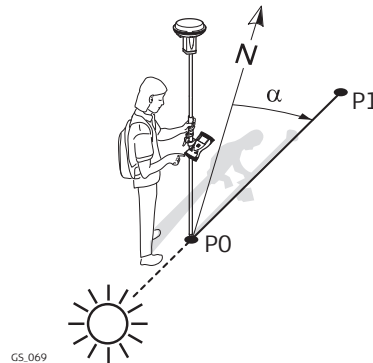
Computing an Azimuth

Using the Sun

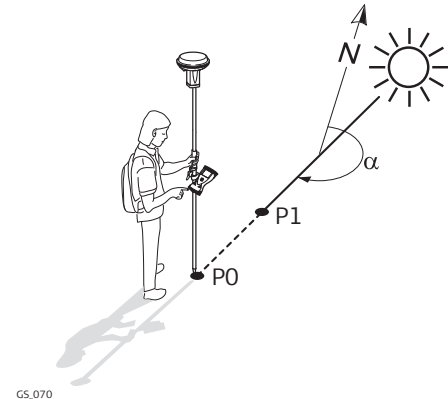
Description

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
 α Bearing from P0 to P1



P0 Known point
P1 Hidden point
 α Bearing from P0 to P1

Requirements

Bearing & distance, Using 2 bearings or **Back brng & distance** must be selected for Method.

Access

In **Hidden Point Connection** highlight **Azimuth**. Press **Sun**.
Follow the instructions on the screen.

48.5.2

Using Auxiliary Point

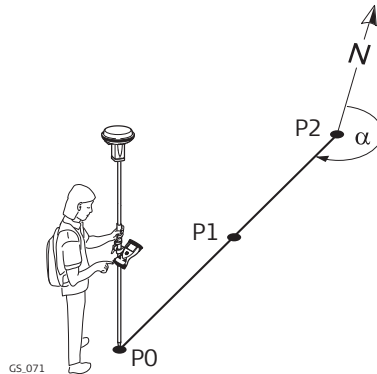
Description

The azimuth for a hidden point measurement can be computed using an auxiliary point. The auxiliary point

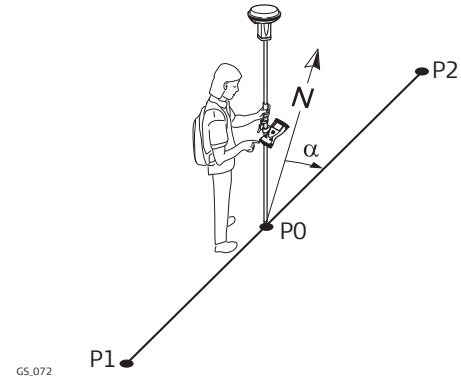
- can already exist in the job.
- can be manually measured during the hidden point measurements.
- can be manually typed in.

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
 α Bearing from P2 to P0



- P0 Known point
P1 Auxiliary point, **Azimuth Pt**
P2 Hidden point
 α Bearing from P0 to P2

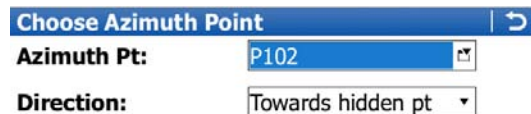
Requirements

Bearing & distance, Using 2 bearings or **Back brng & distance** must be selected for Method.

Access

In **Hidden Point Connection** highlight **Azimuth**. Press **Azmth**.

Choose Azimuth Point



OK

To accept changes and return to the screen from where this screen was accessed. The azimuth is computed and displayed in **Azimuth** in **Hidden Point Connection**.

Survy..

Available for **Azimuth Pt** being highlighted. To measure the auxiliary point manually for the calculation of the azimuth.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Azimuth Pt	Selectable list	The auxiliary point for the calculation of the azimuth.
Direction	Selectable list	The location of the auxiliary point relative to the hidden point.

Next step

OK closes the screen.

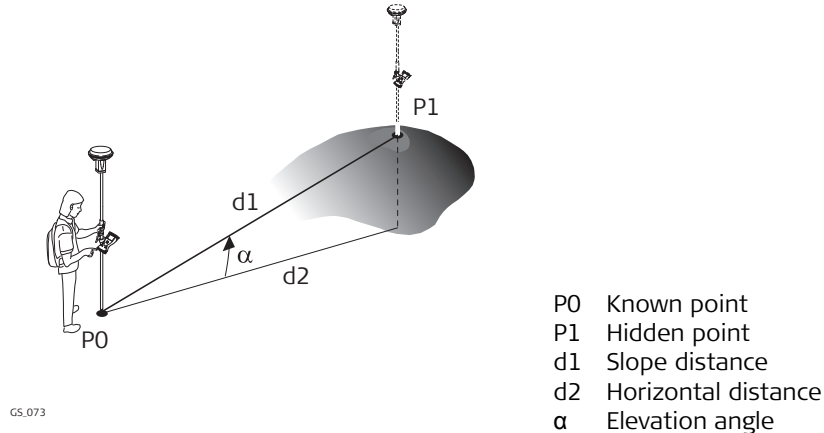
48.6

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

Requirements

Bearing & distance, Using 2 bearings or **Back brng & distance** must be selected for Method.

Access

In **Hidden Point Connection** highlight **Horiz distance**. Press **Slope**.

Slope distance

Slope distance	
Slope distance:	5.850 m
Elevation angle:	25.0000 g
Grade (%):	41.4 %
Horiz distance:	5.405m

OK

To take over the result.

3DCQ:0.010m	2DCQ:0.005m	1DCQ:0.009m	Q1 abc	09:53
OK				

Fn Quit

To exit the screen.

Description of fields

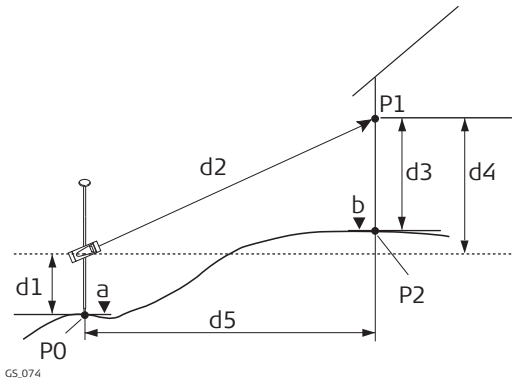
Field	Option	Description
Slope distance	Editable field	Type in a distance from the known point to the hidden point. When a hidden point measurement device is attached to the instrument to measure the distance, the value is automatically transferred.
Elevation angle	Editable field	Type in the elevation 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.

Field	Option	Description
Grade (%)	Editable field	The grade from the known point to the hidden point is automatically computed from the slope distance and the elevation angle.  The value for Grade (%) can be typed in instead of the value for Elevation angle . Then Elevation angle is computed automatically.
Horiz distance	Display only	The horizontal distance from the known point to the hidden point is automatically computed from the slope distance and the elevation angle.
Δ height	Display only	Available if using heights is configured. The height difference between the known point and the hidden point is automatically computed from the slope distance and the elevation angle.

Next step

OK returns to **Hidden Point Connection**. The horizontal distance is displayed in **Horiz distance**.

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 step-by-step

Step	Description
1.	Compute height for hidden points is checked in Configuration.
2.	Height offset: Device & target ht in Hidden Point Device Offsets.

Hidden Point Connection Description of fields

Field	Option	Description
Δ height	Selectable list	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.  For hidden point measurement methods using two known points, Δ height must be determined from each known point. Refer to "48.3 Hidden Point Measurements" for a description of all other fields on the screen.

Next step

Press **Hts...**

Device & Target Height Description of fields

Field	Option	Description
Device ht at pt A	Editable field	The height of the hidden point measurement device above Point A .
Target height	Editable field	The height of the target point above the hidden point when measured from Point A .
Device ht at pt B	Editable field	Available for hidden point measurement methods using two known points. The height of the hidden point measurement device above Point B .

Field	Option	Description
Target height	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 Point B .

Next step

OK closes the screen and returns to **Hidden Point Connection**.

There, **Δ 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.

Description

Hidden points cannot be measured directly by a TPS instrument, because they are not directly visible.

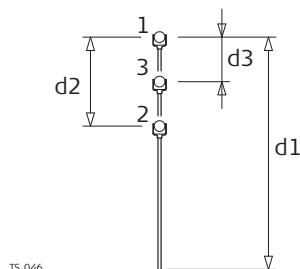
A hidden point can be calculated from measurements to prisms mounted on a hidden point rod. The spacing and length of the hidden point rod are known. The hidden point rod can be held at any angle, as long as it is stationary for all measurements.

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

Properties of hidden points

The properties stored with the hidden point and auxiliary points are:

- Class: **Meas**
- Sub class: **Hidden Point**
- Source: **COGO**
- Instrument source: **TPS**

Hidden point tasks

The Hidden Point application can be used for the following tasks:

- The hidden point application 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 manholes, without measuring from the manhole rim to the flow line, and then estimating 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 TPS Hidden Point application does not generate a report sheet.

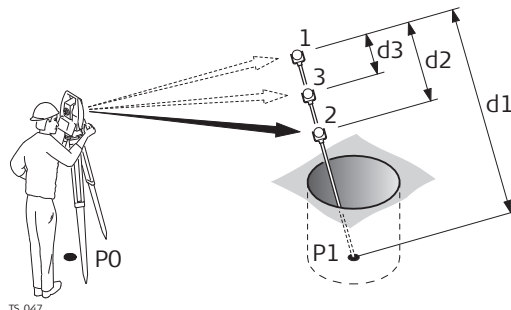
49.2

Accessing Hidden Point and Measuring

Access

Select **Main Menu: Go to Work!\Survey+\TPS hidden point.**

Diagram



- d1 Rod length
- d2 Distance from prism 1 to prism 2
- d3 Distance from prism 1 to prism 3

Measure Reflector 1, Hidden pt page

Measure Reflector 1	
Hidden pt	Survey Map
Aux point ID:	Aux0001
Hz:	99.9997g
V:	100.1002g
Slope distance:	10.000m
Height difference:	1.564m
Rod length:	2.500 m
Hz: 99.9996g V: 100.1000g Q1 abc 14:19	
Meas	Dist Store

Meas

To measure and store the prism, and access the next screen.

Dist

To measure a distance.

Store

To store data.

Page

To change to another page on this screen.

Fn Config..

To configure the **TPS hidden point** application. Refer to "49.3 Configuring Hidden Point".

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Aux point ID	Editable field	The point ID of the auxiliary point, the prism on the hidden point rod. The Auxiliary Points ID template is used.
Hz	Display only	The horizontal angle to prism 1, the auxiliary point, is displayed.
V	Display only	The vertical angle to prism 1, the auxiliary point, is displayed.
Slope distance	Display only	The slope distance to prism 1, the auxiliary point, is displayed.
Height difference	Display only	The height difference to prism 1, the auxiliary point, is displayed.

Field	Option	Description
Rod length	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, Result** page is accessed.

Hidden Point Result, Result page

The screenshot shows the 'Hidden Point Result' screen with the following data:

Field	Value
Point ID:	TPS0001
H _z :	115.7667g
V:	100.0981g
Slope distance:	10.185m
Ht Diff:	1.564m
Easting:	510.086m
Northing:	498.373m

At the bottom, there is a status bar showing 'Hz: 106.4000g V: 100.1001g Q1 abc 14:26' and navigation buttons: 'Store', 'Next', and 'Page'.

Store

To measure the prism and exit the application.

Next

To store the hidden point and to access **Measure Reflector 1** to take more hidden point measurements.

Page

To change to another page on this screen.

Fn IndivID and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Editable field	The name of the hidden point. The configured point ID template is used.
Hz	Display only	The calculated horizontal angle to the computed hidden point. ----- is displayed for unavailable information.
V	Display only	The calculated vertical angle to the computed hidden point. ----- is displayed for unavailable information.
Slope distance	Display only	The calculated slope distance to the computed hidden point. ----- is displayed for unavailable information.
Height difference	Display only	The calculated height difference from instrument to computed hidden point. ----- is displayed for unavailable information.
Easting, Northing and Height	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. **Page** changes to the **Plot** page. Measured distances are indicated by solid arrows.

49.3

Configuring Hidden Point

Access

Select **Main Menu: Go to Work!\Survey+\TPS hidden point**. Press **Fn Config...**

Configuration

Configuration

Page to show: Survey

Measure tolerance: 0.020 m

Delete aux points: Yes

No. of reflectors: 2

Rod length: 2.500 m

Distance R1-R2: 1.000 m

Hz: 100.0001g V: 81.5001g Q1 abc 14:17

OK Config..

OK

To accept changes and return to the screen from where this screen was accessed.

Config..

To configure the selected survey screen page. Refer to "19.3 My Survey Screen"

Fn About

To display information about the program name, the version number, the date of the version, the copyright and the article number.

Fn Quit

To exit the screen.

Description of fields

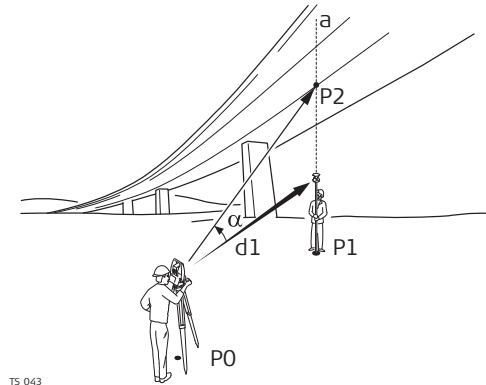
Field	Option	Description
Page to show	Selectable list	The user-defined survey screen page to be shown in Measure Reflector 1, Measure Reflector 2 and Measure Reflector 3 .
Measure tolerance	Editable field	Limit of the difference between input and measured spacing of the prisms.  For three prisms being used, limit for maximum deviation of the three measurements.
Delete aux points	Yes or No	The auxiliary points are deleted when the hidden point is stored. The auxiliary points are prism 1, prism 2 and prism 3 of the hidden point rod. The Auxiliary Points ID template is used for the auxiliary points. The Survey Points ID template is used for the computed hidden point.
No. of reflectors	2 or 3	Two or three prisms are used on the rod.
Auto position	Yes or No	Available for No. of reflectors: 3 . The third prism is aimed at automatically.
Rod length	Editable field	Total length of hidden point rod.
Distance R1-R2	Editable field	Spacing between the centres of prism 1 and prism 2.
Distance R1-R3	Editable field	Available for No. of reflectors: 3 . 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 screen from where this screen was accessed from.

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 station
- P1 Base point
- P2 Remote point
- d1 Horizontal distance to the base point
- α 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 **H_z dist tolerance** must be chosen. The horizontal distance to the remote point and to the base point should coincide.

Properties of remote points

The properties stored with auto points are:

- Class: **Meas**
 - Sub class: **TPS**
 - Source: **Survey (Rem Pt)**
 - Instrument source: **TPS**
-

Averaging of remote points

An average can be calculated for remote points if a measured point of class **Meas** already exists with the same point ID. The average flag for the point is **Auto**.

50.2

Accessing Remote Point

Description

Remote point measurements are possible from the Survey application when **Measure remote pts** is checked in the **Configuration, Remote pt** page and a valid distance measurement is available.

Access

Press **RmtHt.** in **Survey, Survey** page after one point is measured with **Dist.**

Survey Remote Point, Remote pt page

The screenshot shows the 'Survey Remote Point' screen. At the top is a title bar with the text 'Survey Remote Point' and a back arrow. Below the title bar is a tabbed interface with 'Remote pt' and 'Code' tabs. The main area contains several fields: 'Point ID:' with a value of 'TPS0002', 'Δ Ht BaseRem:' with '4.491m', 'Hz:' with '99.9999g', 'V:' with '81.5002g', 'Slope distance:' with '10.438m', 'Horiz distance:' with '10.000m', and 'Easting:' with '510 211m'. At the bottom, there is a status bar showing 'Hz: 99.9999g', 'V: 81.5002g', 'Q1 abc', and '12:08'. Below the status bar are three buttons: 'Store', 'Base pt', and 'Page'.

Store

Stores the remote point. Stays in this screen.

Base pt

Returns to the **Survey** screen. The distance measurement is cleared.

Page

To change to another page on this screen. The page available depends on the **Page to show** selected in the **Configuration, Remote pt** screen. Refer to "50.3 Configuring Remote Point".

Fn Individ and Fn Run

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 "19.1 ID templates".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Editable field	Displays the point ID for the remote point. The point ID in Survey Remote Point is always identical to the point ID in Survey .
Δ Ht BaseRem	Display only	The elevation difference between the base point and the remote point.
Hz	Display only	The current horizontal angle.
V	Display only	The current vertical angle.
Slope distance	Display only	The current slope distance to the remote point calculated from the horizontal distance to the base point and the current vertical angle.
Horiz distance	Display only	The horizontal distance measured to the base point.
Easting	Display only	Calculated Easting coordinate for the remote point.
Northing	Display only	Calculated Northing coordinate for the remote point.
Elevation	Display only	Calculated height for the remote point.

Next step

IF	THEN
if a remote point is to be stored	Store.
a new base point is to be measured	Base pt to return to the Survey screen.

Access

In **Survey** press **Fn Config..** to access **Configuration**.

Configuration,
Remote pt page

OK

To accept changes and return to the screen from where this screen was accessed.

Page

To change to another page on this screen.

Config..

To configure the selected survey screen page. Available when **Page to show** is highlighted. Refer to "19.3 My Survey Screen".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Measure remote pts	Check box	If checked, the remote point function is active. RmtHt. is added to the function keys in Survey after Dist is pressed.
Hz dist tolerance	Editable field	The horizontal distance to the remote point is equal to the horizontal distance of the base point. The value for Hz dist tolerance is the maximum tolerated length of the chord between the base point and the remote point.

Field	Option	Description
Page to show	Selectable list	All survey screen pages from Main Menu: User\Work settings\My Survey Screen can be selected.

51

51.1

Traverse TPS

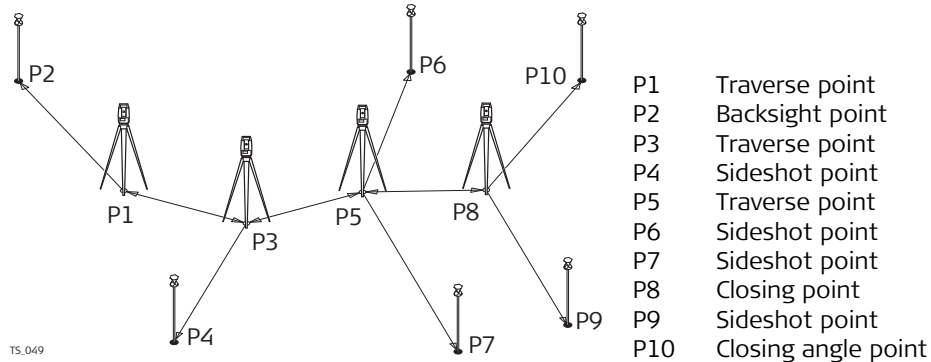
Overview

Description

The Traverse application 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.

Types of traverse

- External reference & closed loop
- Internal reference & position check
- Open end & position check
- Closed end traverse



Properties of Traverse points

The properties stored with the Traverse points are:

- Class: **Meas**
- Sub class: **TPS**

- Source: **Traverse**
- Instrument: **TPS**

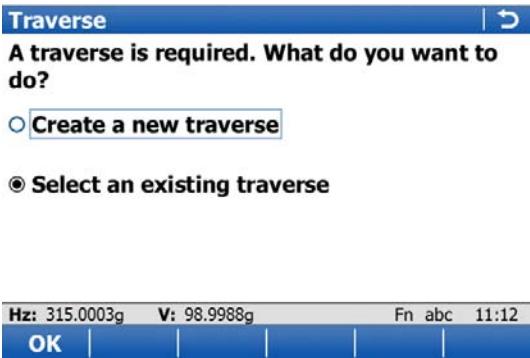
Averaging of Traverse points

An average point of class **Meas** is calculated by the Traverse application.

Access

Select Main Menu:Go to Work!\Survey+\Traverse.

Traverse



OK

To select the highlighted option and to continue with the subsequent screen.

Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".

Fn Quit

To exit the application.

Next step

IF	THEN
a traverse is to be created or selected	highlight the relevant option and press OK .
Traverse is to be configured	Fn Config... Refer to "51.6 Configuring Traverse".

51.3

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

New Traverse

Traverse ID:

Trav2

Description:

Field work

Operator:

ABC

- OK

To store the settings.
- Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".
- Fn Quit

To exit the application.

Hz: 315.0002g

V: 98.9984g

Fn abc

11:12

OK

Description of fields

Field	Option	Description
Traverse ID	Editable field	The ID of the traverse.
Description	Editable field	A line for a detailed description of the traverse, for example, work to be performed. Optional.
Operator	Editable field	The person's name who is creating the traverse. Optional.

Field	Option	Description
Date	Display only	The date of when the traverse was created. Available in the Edit Traverse screen.
Time	Display only	The time of when the traverse was created. Available in the Edit Traverse screen.
Status	Open Position closed Posn & angle closed Adjusted	The traverse is not closed in position. Available in the Edit Traverse screen. The traverse has been closed in position on a control point. Available in the Edit Traverse screen. The traverse has been closed both in position and angularly. Available in the Edit Traverse screen. The traverse data is the result from an adjustment. Available in the Edit Traverse screen.

51.4

Selecting an Existing Traverse

Access

In **Traverse**, select **Existing Traverse**. Press **OK**.

Existing Traverse

Existing Traverse		↩
Traverse ID:	Trav2	MY
Description:	Field work	
Operator:	ABC	
Date:	29.09.09	
Time:	11:11:23	
Status:	Open	

Hz: 314.9998g	V: 98.9986g	Fn abc	11:14
OK			Data..

OK

To accept the settings.

Data..

To display traverse data. Refer to "51.5 Traverse Data". Not available for adjusted traverses.

Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".

Fn Quit

To exit the application.

Description of fields

The fields are identical with those fields in the **Edit Traverse** screen. Refer to "51.3 Creating/Editing a Traverse".

Next step

ENTER when **Traverse ID** is highlighted. Accesses **Manage Traverses**.

Manage Traverses

All traverses of the working job are displayed.

Manage Traverses	
Traverse ID	Date
Trav1	29.09.09
Trav2	29.09.09

Hz: 314.9997g	V: 98.9986g	Fn abc	11:14
OK	New..	Edit..	Data..

OK

To confirm selection of highlighted traverse and return to **Select an existing traverse**.

New..

To create a new traverse. Refer to "51.3 Creating/Editing a Traverse".

Edit..

To edit the traverse ID and description of the highlighted traverse. Refer to "51.3 Creating/Editing a Traverse".

Data..

To display traverse data. Refer to "51.5 Traverse Data" for more information.

Fn Quit

To exit the application.

51.5

Traverse Data

Description

This screen allows the review and editing of traverse stations inside of a traverse and allows the user to access **Point Results** for editing.

Access

Data.. in **Manage Traverses**.

OR

Data.. in a **Confirmation** window of the **Point Results** screen.

Traverse Data

Traverse Data			
Points	Map		
Station ID	Backsight ID	No. sets	No. FS
BS1	PT01	1	1
PT02	BS1	1	1
PT03	PT02	1	1
PT04	PT03	1	1

Hz: 99.9997g	V: 98.9972g	Fn abc	13:19
OK	Edit..	Delete	Page

OK

To return to where this screen was accessed from.

Edit..

To access the **Point Results** screen. Refer to "51.8 Traverse Point Results".

Delete

To permanently delete the LAST traverse station.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of columns

Column	Description
Station ID	Point ID of the station.

Column	Description
Backsight ID	The backsight point measured from the current station ID.
No. sets	Number of measured sets.
No. FS	Number of measured foresight points.

Access

Select **Main Menu:Go to Work!\Survey+\Traverse**. Press **Fn Config...**

Configuration,
Parameters page

Configuration | ↩

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 My Survey Screen

Page to show: Code ▾

Hz: 315.0003g V: 98.9985g Fn abc 11:16

OK | | | | | Page

OK

To accept changes and to return to the screen from where this screen was accessed.

Config..

To edit the survey screen page currently being displayed. Available when a list item in **Page to show** is highlighted. Refer to "19.3 My Survey Screen". Available on the **Parameters** page.

Page

To change to another page on this screen.

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Measure sequence	B'F'...F'B"	All points are measured in face I, then measured in face II in reverse sequential order.
	B'F'...B"F"	All points are measured in face I, then measured in face II.

Field	Option	Description
	B'B''F'F'...	Backsight point is measured in face I immediately followed by face II. Other points are measured in face I, face II order.
	B'B''F''F'...	Backsight point is measured in face I immediately followed by face II. Other points are measured in alternating face order.
	B'F'...	All points are measured in face I only.
Foresight	Check box	Option to define if only one foresight point or multiple points are used during the sets.
When using automatic target aiming, automatically measure the targets	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.
Show additional page from My Survey Screen	Check box	The user-defined survey screen page to be shown in the Traverse screen.
Page to show	Selectable list	The names of the available survey screen pages.

Next step

Page changes to the **Quality control** page.

Configuration, Quality control page

Description of fields

Field	Option	Description
Check for errors before storing	Check box	The entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements.
Hz tolerance	Editable field	Tolerance for horizontal directions.
V tolerance	Editable field	Tolerance for vertical directions.
Distance tolerance	Editable field	Tolerance for distance.
Check for backsight height	Check box	The entered height tolerance for the backsight point is checked during the measurements to verify accurate pointing and measurements.
Height limit	Editable field	Tolerance for the backsight height.

Next step

Page changes to the **Report sheet** page.

Configuration, Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.

Field	Option	Description
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

Page changes to the first page on this screen.

51.7

51.7.1

Start traverse step-by-step

Traverse Methods

Starting Traverse

The quickest setup method is described.

Step	Description
1.	Start the Traverse application.
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 Configuration . Check the settings.
6.	OK to access Total Station Setup . Any standard setup method can be used.
7.	Set to set the station and orientation.
8.	A confirmation window is displayed. FS Pt..
9.	Foresight, 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.

Step	Description
10.	Meas 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 station, to return to the Point Results screen (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 station.
	After pressing Move , Traverse is exited. To continue with the traverse from the next station refer to "51.7.2 Continuing an Existing Traverse".

51.7.2

Continuing an Existing Traverse

Measure traverse step-by-step

Step	Description
1.	Start the Traverse application.
2.	Traverse Select Select 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 Config.. to change the working style settings.
5.	OK to access Backsight, Set: Enter Instrument height . Hz, V and Horiz distance The measured values are displayed. Calc azimuth The calculated azimuth from the current station point to the back-sight point. Δ hz dist and Δ height The difference between the computed and measured values.
	More to change between the displayed values.
6.	Meas to measure and record the backsight point.
7.	FS Pt.. to measure a foresight point.
8.	Foresight, Set:

Step	Description
	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.
	Survey.. to measure sideshot points.
9.	Meas 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 station.
12.	Repeat steps 1. to 11. until traverse is ready to be closed.

51.7.3

Closing Traverse

Close traverse step-by-step

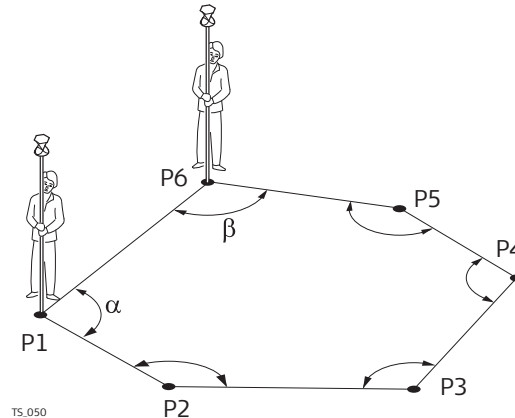
Step	Description
1.	Refer to paragraph "51.7.2 Continuing an Existing Traverse" to measure a traverse. Measure a backsight on a new station.
2.	The confirmation window in Foresight, Set: is displayed. Close.. to begin the process for closing the traverse.
3.	The confirmation window to select a known point is displayed. OK
4.	The Data: screen for the control job is displayed. Highlight the closing point.
5.	OK to select the highlighted point.
6.	Foresight, Set: Meas 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 application.
11.	Traverse Select Select an existing traverse.

Step	Description
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.	Meas to measure all sets.
18.	Point Results OK to view traverse results.
19.	Traverse Results OK to exit viewing traverse results.
20.	Quit to quit the Traverse application.
	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 station setup to measure a closing angle. The positional closure is calculated by comparing the control position of the initial station

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 station setup is on P1, and an assumed direction to backsight P6. Upon closing this 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.

Step	Description
1.	The first station setup is on P1 in the diagram shown. Begin the traverse, moving in the direction P1, P2...P6.
2.	When on the last setup point (P6 in the diagram shown), measure a backsight.
3.	Close
4.	Data: Select the closing point from the available list (P1 in the diagram shown). OK
5.	Measure all the sets to the closing point as per a standard traverse.

Step	Description
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.

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** screen, select **Page** to reach the **Backsight** page. **Fn Ctrl.**
OR
Anytime during the traverse: On the **Traverse Data** screen, highlight the first station setup then **Edit...** On the **Point Results** screen, select **Page** to reach the **Backsight** page. **Fn Ctrl.**

Point Results Confirmation

Point Results

Foresight Backsight Sta info Map

Point Target

Num

Hz ar

V ave

Dist a

Confirmation

Are you sure you want to create a control point P02 using backsight measurements?

Support ID: 6259

Hz: 50.0001g V: 98.9974g Fn abc 11:36

No Yes

No

To close the confirmation window without further action.

Yes

To store the point as control point.

Description

Point observation results are displayed on this screen.

Access

Is displayed automatically after measuring all sets from the current station.
OR
In **Traverse Data** press **Edit...**

**Point Results,
Foresight page and
Backsight page**

The softkeys are explained, except for the softkeys on the **Map** page.

Point Results		↩
Foresight Backsight Stn info Map		
Point ID:	P0003	
Target height:	1.941	m
Point type:	Foresight	
No. of used sets:	1/1	
Hz arc average:	90.0001g	
V average:	98.9977g	
Dist average:	125.500m	
Hz: 0.0001g V: 98.9974g Fn abc 12:57		
OK	+Sets..	Sets..
		More Page

OK

While measuring a traverse: Displays a confirmation window with traverse measurement options. Otherwise: To return to **Traverse Data**.

+Sets..

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.

Sets..

To include or exclude measured sets in the calculation of a foresight point. In the **Sets, Point** screen press **Use** to include or exclude a set and **Spread/Resid** to review the effect of using the set.

Close..

To set a point as a closing point if not selected before measurement. Or to revert a closing point to a normal foresight.

More

To display additional information.

Page

To change to another page on this screen.

Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".

Fn Edit..

To edit point code and annotations.

Fn Check..

Available on the **Foresight** page. To check inverse distances and closure between the selected point and a point from the fixpoint job.

Fn Ctrl

Available on the **Backsight** page of the initial station. Refer to "51.7.4 Creating a Control Point from Backsight by Azimuth".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Point ID	Selectable list or display only	Selected point ID.
Target height	Selectable list or display only	The target height of the target point.
Point type	Foresight , Closing point or Closing angle	The current point type. Available on the Foresight page.
No. of used sets	Display only	The number of sets out of all measured sets used for the calculation. Available on the Foresight page.
Number of sets	Display only	The number of sets the point was measured in. Available on the Backsight page.
Hz arc average	Display only	Average horizontal angle.
V average	Display only	Average vertical angle.
Dist average	Display only	Average distance.
Hz arc std dev	Display only	Standard deviation of horizontal angle.
V std dev	Display only	Standard deviation of vertical angle.
Dist std dev	Display only	Standard deviation of distance.
Hz spread	Display only	Spread of horizontal angle.
V spread	Display only	Spread of vertical angle.
Dist spread	Display only	Spread of distance.

**Point Results,
Stn info page**

Next step

Page changes to the **Stn info** page.

Description of fields

Field	Option	Description
Station ID	Display only	The station ID of the instrument station.
Instrument height	Editable field	Current instrument height. Editable.
Easting	Display only	Easting value of the station position.
Northing	Display only	Northing value of the station position.
Elevation	Display only	Orthometric height of the station 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

Page changes to the **Map** page which provides an interactive display of the data.

IF accessed	THEN
after sets measurement	OK opens a confirmation window with options that are dependent on traverse status: For an open traverse: Move to next station, return to Point Results, to survey a side-shot, to view traverse data or to quit the traverse application.

IF accessed	THEN
	For a closed traverse: Move to close angle, return to Point Results, to survey a sideshot, to adjust the traverse or to quit the traverse application.
from Traverse Data	OK returns to Traverse Data .

51.9

Traverse Results

Description

Traverse closure results are displayed on this screen.

Access

Is displayed automatically after the traverse closing point is measured or selected.
OR

Reslt.. in **Traverse Data** when a traverse is closed.

Traverse Results, Position page

Traverse Results	
Position	Angle
Starting point:	P01
Closing point:	P01
Length of error:	0.000m
Direction of error:	0.0000g
Δ elevation:	0.000m
Total distance:	376.953m
2D accuracy:	1/5
Hz: 359.9996g V: 98.9977g Fn abc 13:01	
OK	N & E
Data..	Page

OK

To move to close angle, to return to **Traverse Results**, to survey a sideshot, to adjust the traverse or to quit the Traverse application.

N & E or L & D

To view the misclosure error in north/east or length/direction.

Adjust..

To adjust the traverse.

Data..

To display traverse data.

Page

To change to another page on this screen.

Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Starting point	Display only	The point ID of the traverse start point.
Closing point	Display only	The point ID of the traverse closing point.
Length of error	Display only	The length of the misclosure error.
Direction of error	Display only	The direction of the misclosure error.
Δ north	Display only	Error in north.
Δ east	Display only	Error in east.
Δ elevation	Display only	Error in height.
Total distance	Display only	Total length of the traverse.
2D accuracy	Display only	Position ratio of misclosure.
1D accuracy	Display only	Height ratio of misclosure.

Next step

Page changes to the **Angle** page.

Traverse Results,
Angle page

Description of fields

Field	Option	Description
Foresight ID	Display only	Point ID of the closing angle point. Displays ----- if no values are available.
Known azimuth	Display only	Defined azimuth of closing line. Displays ----- if no values are available.

Field	Option	Description
Azimuth average	Display only	Mean value of the measured azimuth closing line. Displays ----- if no values are available.
Angular misclosure	Display only	Angular misclosure of traverse. Displays ----- if no values are available.

Next step

OK to move to close angle, to return to **Traverse Results**, to survey a sideshot, to adjust the traverse or to quit the Traverse application.

51.10

51.10.1

Traverse Adjustment

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.
- This option is protected and is only activated by the entry of a licence key.



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: **Reslt..** in **Traverse Data**, then **Adjust..** in **Traverse Results** to access **Traverse Adjustment**.

Traverse Adjustment, Method page

Traverse Adjustment

Method

Map

Traverse ID:

Trav2

Horiz adjustment:

Compass rule

Angle balance:

No distribution

Vert adjustment:

Equally

Hz: 359.9998g

V: 98.9977g

Fn abc 11:32

OK

Page

OK

To calculate the result.

Page

To change to another page on this screen.

Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Traverse ID	Display only	The ID of the traverse.
Horiz adjustment	Compass rule	Suitable for surveys, where angles and distances were measured with equal precision.
	Transit rule	Suitable for surveys, where angles were measured with a higher precision than the distances.
	No distribution	No distribution is made.
Angle balance	Equally	The angle misclosure is distributed equally.
	No distribution	No distribution is made.
Vert adjustment	Equally	The height error is distributed equally.
	By distance	The height error is distributed by distance.

Field	Option	Description
	No distribution	No distribution is made.

Next step

OK starts the adjustment calculation.

51.10.2

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

The screenshot shows a handheld device screen with the title 'Adjustment Results: Trav2'. Below the title is a tabbed interface with 'Position' selected. The main display area lists the following data:

Closure data type:	Adjusted
Starting point:	P01
Closing point:	P01
Length of error:	0.000m
Direction of error:	0.0000g
Δ elevation:	0.000m
Total distance:	376.953m

At the bottom, there is a status bar showing 'Hz: 359.9993g', 'V: 98.9975g', and 'Fn abc 13:01'. Below this is a blue navigation bar with four buttons: 'OK', 'N & E', 'More', and 'Page'.

OK

To access the next screen.

N & E or **L & D**

To view the misclosure error in north/east or length/direction.

More

To display the values for the unadjusted, the balanced and the adjusted solution.

Page

To change to another page on this screen.

Fn Config..

To configure the Traverse application. Refer to "51.6 Configuring Traverse".

Fn Quit

To exit the application.

Description of fields

Field	Option	Description
Closure data type	Adjusted, Unadjusted or Balanced	More to change between the options and display the values accordingly.
Starting point	Display only	The point ID of the traverse start point.
Closing point	Display only	The point ID of the traverse close point.
Length of error	Display only	The length of the misclosure error.
Direction of error	Display only	The direction of the misclosure error.
Δ north	Display only	Error in north.
Δ east	Display only	Error in east.
Δ elevation	Display only	Error in height.
Total distance	Display only	Total length of the traverse.
2D accuracy	Display only	Position ratio of misclosure.
1D accuracy	Display only	Height ratio of misclosure.

Next step

Page changes to the **Angle** page.

Adjustment Results,
Angle page

Description of fields

Field	Option	Description
Closure data type	Display only	More to change between the options.

Field	Option	Description
Known azimuth	Display only	Defined azimuth of closing line. Displays ----- if no values are available.
Azimuth average	Display only	Mean value of the measured azimuth closing line. Displays ----- if no values are available.
Angular misclosure	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. The **Point type** column shows the function for each point. **View..** 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

Page changes to the **Map** page. The **Map** page provides an interactive display of the data. **OK** accesses **Adjustment Store**.

Adjustment Store

Description of fields

Field	Option	Description
Traverse ID	Display only	The ID of the traverse.
Store adjusted job to	Selectable list	The location to save the adjusted job. The job can be saved to the CF card , SD card , USB or Internal memory .
New job	Editable field	The new job name. Once adjustment results have been reviewed and accepted, the adjusted position of the points are stored in a separate job.
Include survey points	Check box	Survey points can be included or not. Adjusted points are stored in the new job as a triplet of class ADJ (adjusted).
Store point ID with	Same point ID	Adjusted points are stored in the new job with the original point IDs.
	Prefix	Adjusted points are stored in the new job with a prefix in front of the original point IDs.
	Suffix	Adjusted points are stored in the new job with a suffix at the end of the original point IDs.
Prefix / suffix	Editable field	Available when Prefix or Suffix is selected in Store point ID with . The value that is added to the front or end of the original point ID.

Next step

Store.. stores the results.

Volume Calculations

Overview

Description

The Volume Calculations application allows surfaces to be measured and volumes (and other information) to be computed from these surfaces.

Volume calculations tasks

The Volume calculations application can be used for the following tasks:

- Measuring points (surface points and boundary points) defining a new surface or extending existing surfaces from the working 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 application

The Volume Calculations application must be activated via a licence key. Refer to "24.3 Load licence keys" for information on how to activate the application.



Volume Calculations are possible for RTK rover and TPS.

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.

Properties of measured points

The properties stored with measured points are:

- Class: Either **Meas** or for **GPS** also **Nav** depending on the position status when the point was occupied.
 - Sub class:
 - **GPS** **GPS float, GPS code only, GPS fixed, GNSS Float, GNSS Code Only or GNSS Fixed.**
 - **TPS** **TPS**
 - Source: **Survey**
 - Instrument source: **GPS** or **TPS**
-

Access

Select **Main Menu: Go to Work!\Survey+\Volume calculations.**

Volume Calculations

Volume Calculations

A surface is required. What do you want to do?

Create a new surface by measuring new points

Create a new surface from previously stored points

Select an existing surface

3DCQ:0.014m 2DCQ:0.007m 1DCQ:0.012m Fn abc 14:24

OK

OK

To select the highlighted option and to continue with the subsequent screen.

Fn Config..

To configure the Volume Calculations application. Refer to "52.3 Configuring Volume Calculations".

Fn Quit

To exit the screen.

Next step

IF	THEN
a Volume Calculations method is to be started	highlight the relevant option and press OK .
Volume Calculations is to be configured	Fn Config... Refer to "52.3 Configuring Volume Calculations".

Access

Select **Main Menu: Go to Work!\Survey+\Volume calculations**. Press **Fn Config...**

Configuration,
Report sheet page

Description of fields

Field	Option	Description
Create report sheet	Check box	To generate a report sheet when the application is exited. A report sheet is a file to which data from an application is written to. It is generated using the selected format file.
Report sheet	Selectable list	Available when Create report sheet is ticked. The name of the file to which the data will be written. A report sheet is stored in the \DATA directory of the active memory device. The data is always appended to the file. Opening the selectable list accesses the Report Sheets screen. On this screen, a name for a new report sheet can be created and an existing report sheet can be selected or deleted.
Format file to use	Selectable list	Available when Create report sheet is ticked. A format file defines which and how data is written to a report sheet. Format files are created using LGO. A format file must first be transferred from the data storage device to the internal memory before it can be selected. Refer to "24.1 Transfer user objects" for information on how to transfer a format file. Opening the selectable list accesses the Format Files screen where an existing format file can be selected or deleted.

Next step

Page changes to the first page on this screen.

52.4

52.4.1

Calculating Volumes

Create a New Surface by Measuring New Points

Access

Select **Create a new surface by measuring new points** in **Volume Calculations**.

Create a new surface by measuring new points

Description of fields

Field	Option	Description
Surface ID	Editable ID	The name/number of the new surface.

Next step

OK to access **Survey points to surface** or **Surface status**.

Survey points to surface, Survey page

The pages shown are from a typical working style. An additional page is available when a user-defined survey screen page is used.

Survey Surface Points	
Survey	Code Auto Map
Point ID:	GPS0001
Antenna height:	2.000 m
3D CQ:	0.015m
3DCQ:0.015m 2DCQ:0.008m 1DCQ:0.012m Fn abc 14:17	
Meas	Near »Bndry Done Page

Meas

GPS To start measuring the surface point. The key changes to **Stop**.

TPS To measure a distance and store distance and angles.

Stop **GPS**

To end measuring the surface point. When **Automatically stop point measurement** is checked in **Quality Control, General** page recording of positions ends automatically as defined by the stop criteria. The position mode icon changes to the moving icon. The key changes to **Store**.

Dist **TPS**

To measure a distance.

Store

To store the measured surface point. When **Automatically store point** is checked in **Quality control, General**, the measured point is stored automatically. The key changes to **Meas**.

Near GPS

To search the working 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 screen. After measuring and storing the nearest point, the next point suggested is the one which was suggested before the key was pressed.

Available when **Meas** is displayed.

»Bndry / »Surf

To change the type of point to be measured between surface point and boundary point.

Done

To finish measuring.

Page

To change to another page on this screen.

Fn Conect and Fn Disco GPS

To dial the number of the base station configured in the active working style and to hang up immediately after the survey is completed. Available when **Meas** or **Store** is displayed and for real-time devices of type digital cellular phone or modem. Available for **Auto connect when measuring** unchecked in **RTK Rover Settings, General** page.

Fn Init.. GPS

To select an initialisation method and to force a new initialisation. Available when **Meas** or **Store** is displayed and for working styles allowing phase fixed solutions. Refer to "44.4 Initialisation for Real-Time Rover Operations".

Fn IndivID and **Fn Run**

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 "19.1 ID templates".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Point ID	Editable field	The identifier for manually occupied points. The configured point ID template is used. The ID can be changed in the following ways: • To start a new sequence of point IDs type over the point ID. • For an individual point ID independent of the ID template Fn IndivID. Fn Run changes back to the next ID from the configured ID template.

Field	Option	Description
Antenna height	Editable field	GPS The default antenna height as defined in the active working style is suggested. Changing the antenna height here does not update the default antenna height as defined in the active working style. The changed antenna height is used until the application is exited.
3D CQ	Display only	The current 3D coordinate quality of the computed position.
Target height	Editable field	TPS The last used target height is suggested when accessing this screen. An individual target height can be typed in.
Hz	Display only	TPS The current horizontal angle.
V	Display only	TPS The current vertical angle.
Horiz distance	Display only	TPS The horizontal distance after Dist was pressed. No distance is displayed when accessing the screen and after Store or Meas .
Height difference	Display only	TPS The height difference between station and measured point after Dist . Displays ----- when accessing the screen and after Store or Meas .

Next step

Measure all points. Then press **Done**. Continue with "52.4.2 Create a New Surface from Previously Stored Points".

52.4.2

Create a New Surface from Previously Stored Points

Access

Select **Create a new surface from previously stored points** in **Volume Calculations**.



When accessing the **Edit Surface** screen after selecting **Create a new surface from previously stored points** the **Points** page is active. Any other time this screen is accessed the **General** page is active.

Create a new surface by measuring new points

Description of fields

Field	Option	Description
Surface ID	Editable ID	The name/number of the new surface.

Next step

OK to access **Survey points to surface** or **Surface status**.

Edit Surface, General page

Edit Surface | ↩

General | Points | Map

Surface ID: 222

No. of surface pts: 0

No. of boundary pts: 0

ID of last stored pt: ----

Date: ----

Time: ----

Surface status: Triangulation needed

3DCQ:0.012m 2DCQ:0.006m 1DCQ:0.010m Fn abc 14:18

OK | Page | Page

OK

To accept all settings and continue with the next screen.

Page

To change to another page on this screen.

Fn Config..

To configure the Volume Calculations application. Refer to "52.3 Configuring Volume Calculations".

Fn Del Srf

To delete the surface.

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Surface ID	Selectable list	Name of the surface to be triangulated.
No. of surface pts	Display only	Number of points inside the surface.
No. of boundary pts	Display only	Number of boundary points of the surface.
ID of last stored pt	Display only	ID of the last measured point of the chosen surface.
Date	Display only	Date of the last measured point of the chosen surface.
Time	Display only	Time of the last measured point of the chosen surface.
Surface status	Triangulation done	The surface has been triangulated and not been modified since the last triangulation.
	Triangulation needed	The surface has been modified since the last triangulation or no triangulation exists.

Next step

Page changes to the **Points** page.

Surface status, Points page

Edit Surface			
General	Points	Map	
Point ID	Boundary	Elevation	Point code
1032	No	1642.300	TOE
1008	No	1640.260	TOE
1018	No	1640.720	TOE
1033	No	1642.000	TOE

3DCQ:0.020m	2DCQ:0.011m	1DCQ:0.016m	Fn abc	14:19
OK	+All..	+One..	Bndry	Page

OK

To accept all settings and continue with the next screen.

+All..

To add all points from the working job to the surface.

+One..

To add one point from the working job to the surface.

Bndry

To use this point for the boundary.

Page

To change to another page on this screen.

Fn -One

To remove the marked point from the surface.

Fn -All

To remove all points from the surface.

Fn Quit

To exit the screen.

Next step

OK continues to **Surface Task Selection**. Refer to "52.4.4 Selecting the Surface Task".

52.4.3

Choosing an Existing Surface

Access

Select **Select an existing surface** in **Volume Calculations**.

Existing Surface

The fields available are identical with the fields in **Surface status, General** page. Refer to "52.4.2 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 **Selecting the Surface Task**.

Surface Task Selection

Description of the options

Options	Description
Measure more points to the surface	To measure points defining a new surface or extending existing surfaces and boundaries by surveying. Refer to "52.4.1 Create a New Surface by Measuring New Points".
Review & edit the surface	To view the surface summary and add/remove points from the surface. Refer to "52.4.2 Create a New Surface from Previously Stored Points".
Edit the boundary & triangulate surface	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 "52.4.5 Boundary Definition".
Calculate the volume	To compute the volume of a surface by a reference (3D point, entered elevation) or by the stockpile method. Refer to "52.4.6 Compute Volumes". Available when a valid triangulation of the surface exists.
End the application	To end the application and return to the screen from where Volume Calculations was accessed.

Next step

Select the task to do next. **OK** selects an option.

Edit Boundary,
Points page

Edit Boundary		
Points Map		
Point ID	Elevation	Point code
1044	1641.070	TOE
1000	1641.550	TOE
1001	1641.060	TOE
1007	1640.610	TOE
1008	1640.260	TOE
1009	1640.870	TOE
1010	1641.310	TOE
1011	1640.920	TOE
3DCQ:0.018m 2DCQ:0.010m 1DCQ:0.015m Fn abc 14:21		
OK +One.. Move ↑ Move ↓ Tools Page		

- OK
- To start calculating the triangulation.
- +One..
- To add points from the working job to the surface.
- ↑
- To move the focused point one step up within the boundary definition.
- ↓
- To move the focused point one step down within the boundary definition.
- Fn Tools
- To access to the **Boundary Tools Menu**.
- Page
- To change to another page on this screen.
- Fn -One
- To remove the marked point from the surface.
- Fn Quit
- To exit the screen.

Next step

IF you want to	THEN
check the triangulation results	OK to access Triangulation Results .

IF you want to	THEN
access the Tools menu	Tools accesses Boundary Tools Menu .

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.

The **Map** page contains a plot of the triangles of the surfaces triangulation and also its boundary.

Triangulation Results

Summary Details Map

Surface ID: S1

Area: 24727.081m²

No. of triangles: 217

No. of surface pts: 93

No. of boundary pts: 33

Fn abc 11:43

OK DXF Page

OK

To return to **Surface Task Selection**.

DXF

To go to a screen where the triangulation can be saved as a DXF.

Page

To change to another page on this screen.

Fn Config..

To configure the report sheet.

Fn Quit

To exit the screen.

Boundary Tools Menu

Description of fields

Field	Description
Add many points	Lists all points in the working job.
Remove all points	Method to remove all points that are indicated in Edit Boundary, Points page.

Field	Description
Sort points by time	Method to sort all points in Edit Boundary, Points page by the time they were stored.
Sort points by proximity	Method to sort all points Edit Boundary, Points page by the closest proximity.
Compute rubber band bndry	Method to define a new boundary as if a rubber band was placed around the points. The current list of boundary points will be ignored.

Next step

Select the task to do next. **OK** selects an option and returns to **Edit Boundary**.

Volume Calculation

Volume Calculation

Surface ID:

S1

No. of triangles:

217

Calculate using:

Stockpile

3DCQ:0.025m

2DCQ:0.014m

1DCQ:0.021m

Fn abc

14:23

OK

- OK

To compute the volume.
- Fn Config..

To configure the Volume Calculations application. Refer to "52.3 Configuring Volume Calculations".
- Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Surface ID	Selectable list	Surface chosen from the triangulated surfaces currently stored to the working job.
No. of triangles	Display only	Number of triangles from the triangulation of the surface.
Calculate using	Stockpile Surface to elevation	To calculate the volume of the triangulated surface. Volume between the triangulated surface and the plane defined by the boundary points of the surface. Volume between the triangulated surface and the height entered by the user.

Field	Option	Description
	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**.

Volume Calculation Results, Summary page

Volume Calculation Results | ➔

Summary Details Map

Surface ID: S1

Area: 24727.081m²

Net volume: 228439.470m³

3DCQ:0.015m 2DCQ:0.008m 1DCQ:0.013m Fn abc 14:24

OK | | | | Page

OK

To close the triangulation of the surface.

DXF

To export the triangulation results to a DXF file on the data or root directory of the CF Card.

Page

To change to another page on this screen.

Fn Config..

To configure the Volume Calculations application. Refer to "52.3 Configuring Volume Calculations".

Fn Quit

To exit the screen.

Description of fields

Field	Option	Description
Surface ID	Display only	Name of the surface used for the calculation. Available for Calculate using: Surface to elevation and Calculate using: Surface to point .

Field	Option	Description
Point ID	Display only	The point to which the volume is calculated. Available for Calculate using: Surface to point .
Elevation	Display only	The elevation of the point to which the volume is calculated. Available for Calculate using: Surface to elevation and Calculate using: Surface to point .
Area	Display only	Area of the base plane.
Net volume	Display only	Volume of the surface.
Volume cut	Display only	Volume of the base plane. Available for Calculate using: Surface to elevation and Calculate using: Surface to point .
Volume fill	Display only	Volume of the base plane. Available for Calculate using: Surface to elevation and Calculate using: Surface to point .

Next step

Page changes to the **Details** page.

Volume Calculation Results, Details page

Description of fields

Field	Option	Description
Minimum elevation	Display only	Minimal elevation of the triangulated surface.
Maximum elevation	Display only	Maximal elevation of the triangulated surface.
Average thickness	Display only	Average thickness of the calculated volume.

Field	Option	Description
Perimeter	Display only	Perimeter of the measured surface area (intersection of the measured surface to the reference datum).

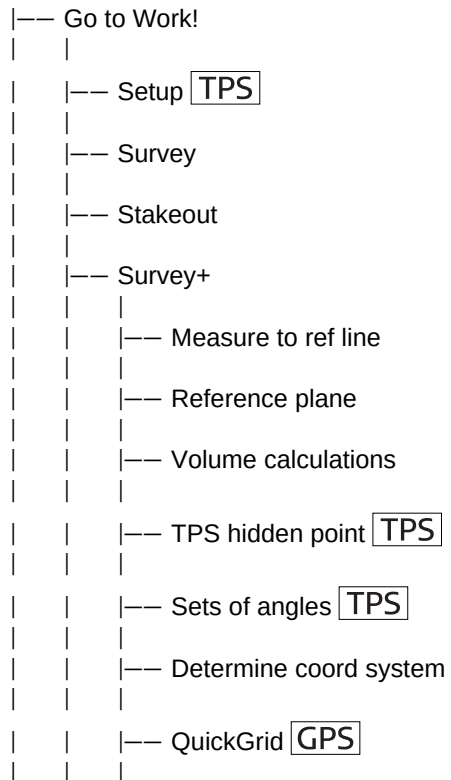
Next step

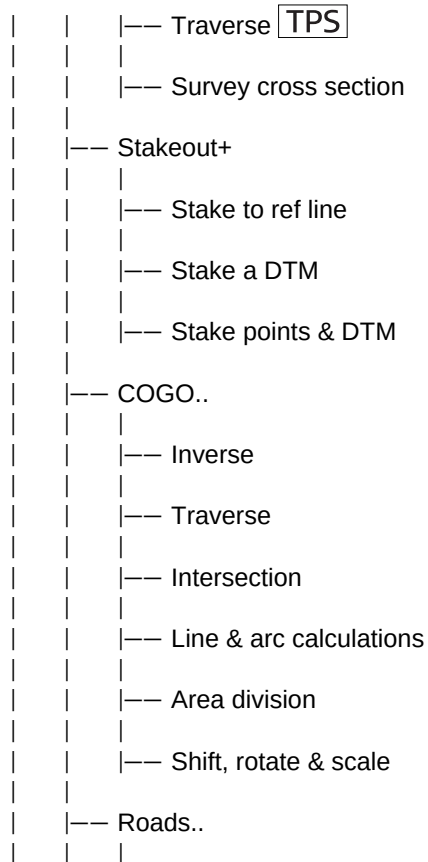
Page changes to the **Plot** page.

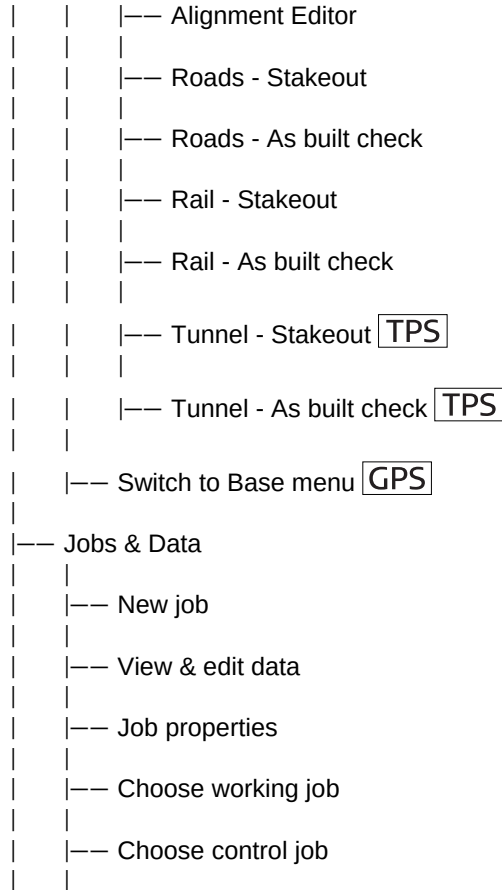
Appendix A

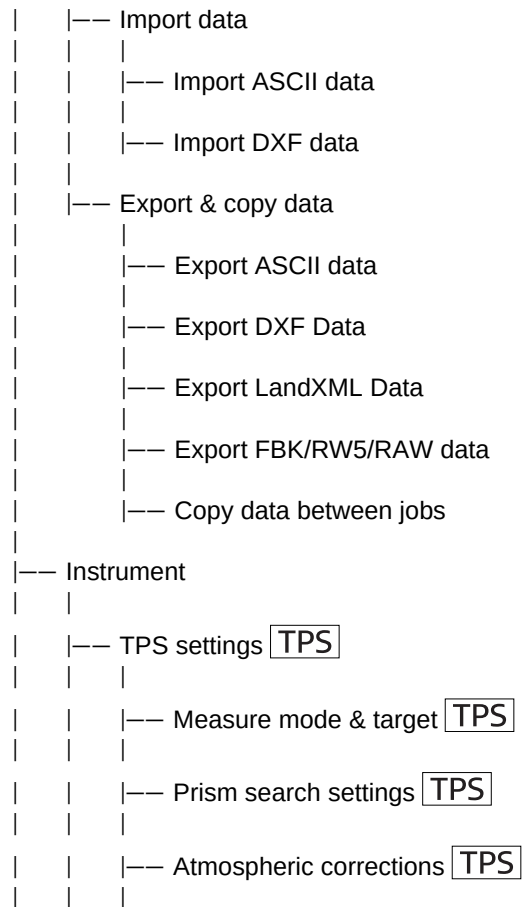
Menu Tree

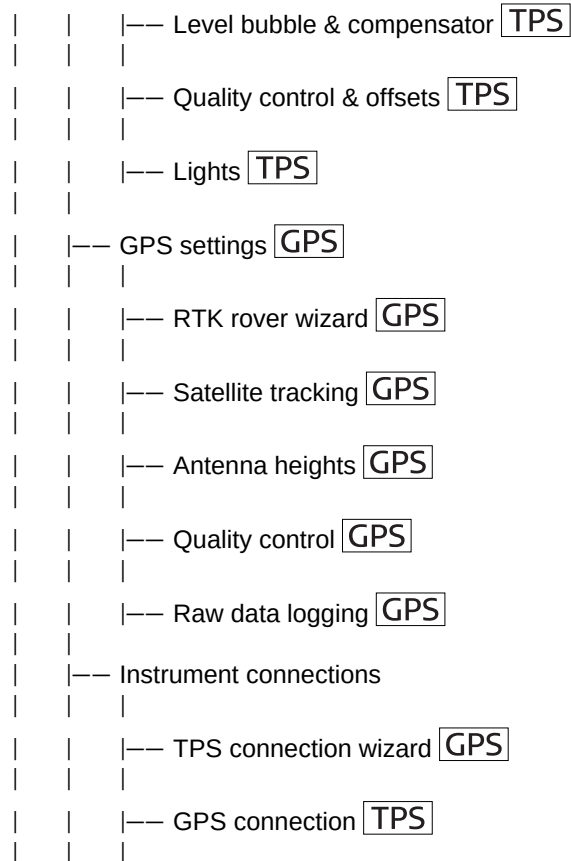
Menu tree for GNSS RTK rover and TPS

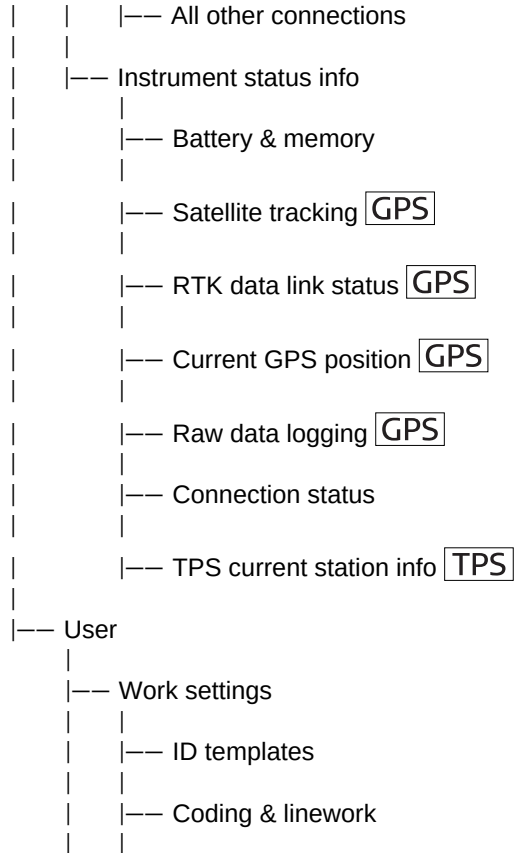






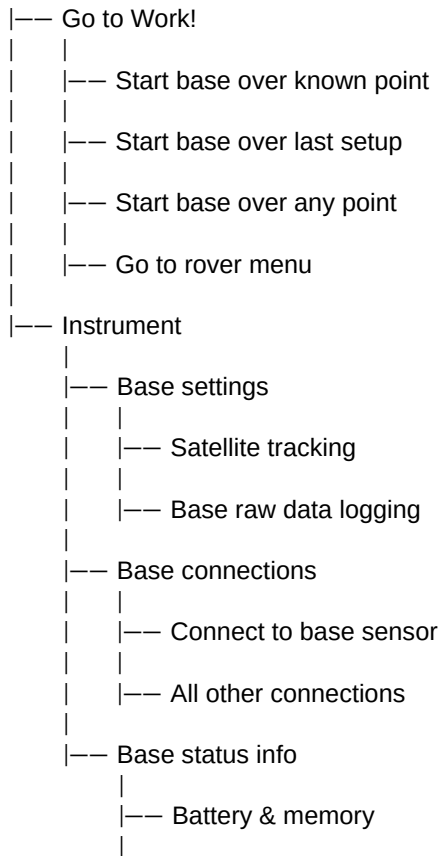






- | |-- My Survey Screen
- | |
- | |-- Hot keys & favourites
- |
- |-- Working style wizard
- |
- |-- System settings
- | |
- | |-- Regional settings
- | |
- | |-- SmartWorx options
- | |
- | |-- Screen & audio
- |
- |-- Tools & other utilities
- | |
- | |-- Transfer user objects
- | |
- | |-- Load firmware & Apps
- | |
- | |-- Load licence keys
- | |
- | |-- Field to office
- | |
- | |-- Format memory devices
- | |
- | |-- View contents of ASCII files
- |
- |-- About Leica Viva

Menu tree for GPS RTK base



- |-- Satellite tracking
 - |
 - |-- Current position
 - |
 - |-- Raw data logging
 - |
 - |-- Connection status
-

Appendix B

Internal Memory

Available memory

> 500 MB.

Data stored to the internal memory

The following are examples of the data types that can be stored to the internal memory.

- Applications
 - Codelists
 - Coordinate systems
 - Format files
 - Geoid and CSCS files
 - Jobs & Data
 - System languages
 - Working styles
-

Appendix C

Directory Structure of the Memory Device

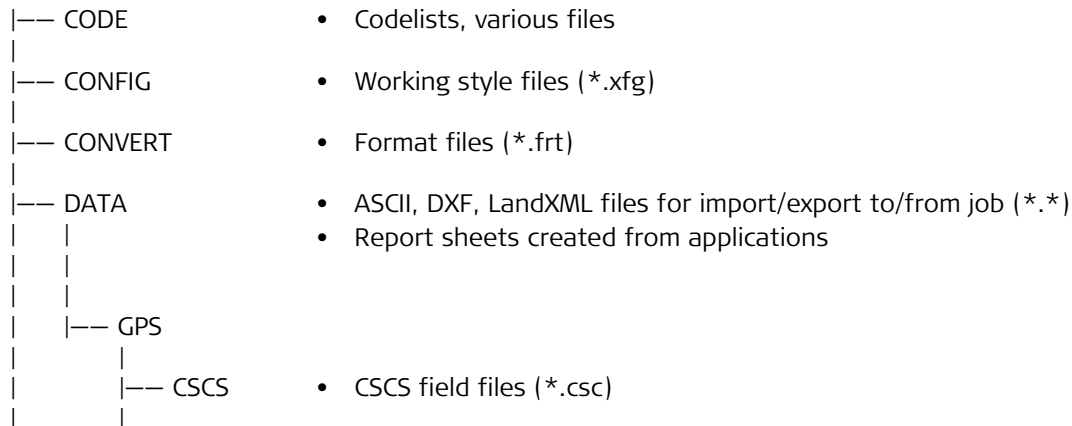
Description

On the memory 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 System 1200 and vice versa, with the exception of the following listed files which are not compatible between the systems:

- Working styles and configuration sets
- System.ram and VivaSystem.zip
- Licence files
- Language files, and
- Application files.

Directory structure



	-- GEOID	• Geoid field files (*.gem)
	-- RINEX	• RINEX files
	-- DBX	• DTM jobs, various files
		• Coordinate system file (Trfset.dat)
	-- JOB	• Job files, various files. Jobs are stored in a folder per job.
	-- DOWNLOAD	• Various files, downloaded by Field to office application (*.*)
	-- GPS	• Antenna file (List.ant)
		• GSM/Modem station list (*.fil)
		• Server list (*.fil)
	-- GSI	• GSI files (*.gsi)
		• ASCII files for export from job (*.*)
	-- SYSTEM	• Application files (*.axx)
		• Firmware files (*.fw)
		• Language files (*.s*)
		• Licence file (*.key)
		• System files (VivaSystem.zip)

Appendix D

D.1

Description

Ports at the instrument front panel

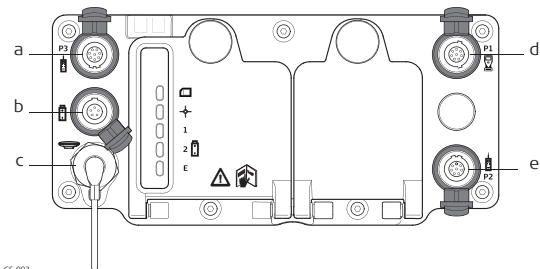
Pin assignments for port P1



Pin Assignments and Sockets

GS10

Some applications require knowledge of the pin assignments for the GS10 ports. In this chapter, the pin assignments and sockets for the ports of the GS10 are explained.

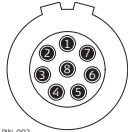


- a) Port P3: Power out, data in/out or remote interface in/out. 8 pin LEMO
- b) Port PWR: Power in. 5 pin LEMO
- c) Port ANT: GNSS antenna in
- d) Port P1: CS field controller in/out or remote interface in/out. 8 pin LEMO
- e) Port P2: Power out, data in/out or remote interface in/out. 8 pin LEMO

Pin	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

Pin	Signal Name	Function	Direction
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/USB_ID	RS232, general-purpose signal	In or out

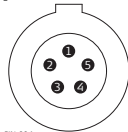
Pin assignments for port P2, and port P3



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

Pin	Signal Name	Function	Direction
5	ID2	Identification pin	In

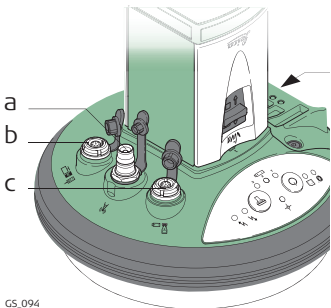
Sockets

Port P1	LEMO-1, 8 pin, LEMO EGI.1B.308.CLN
Port P2 and port P3:	LEMO-1, 8 pin, LEMO HMA.1B.308.CLNP
Port PWR:	LEMO-1, 5 pin, LEMO HMG.1B.305.CLNP

Description

Some applications require knowledge of the pin assignments for the GS15 ports. In this chapter, the pin assignments and sockets for the ports of the GS15 are explained.

Ports at the instrument underside



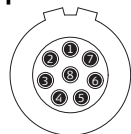
- a) Port 1 (USB and serial)
- b) QN-connecter
- c) Port 2
- d) Port 3

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/USB_ID	RS232, general-purpose signal	In or out

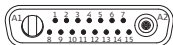
Pin assignments for port P2



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	-

Pin	Signal Name	Function	Direction
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	-

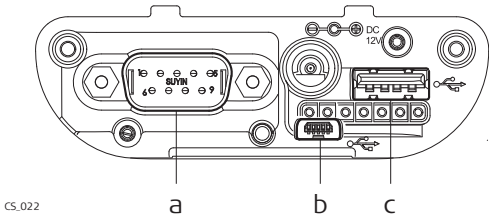
Sockets

Port 1:	LEMO-1, 8 pin, LEMO EGI.1B.308.CLN
Port 2:	LEMO-1, 8 pin, LEMO HMA.1B.308.CLNP
Port 3:	15 pin RS232:RS232, 15 pin, DE15

Description

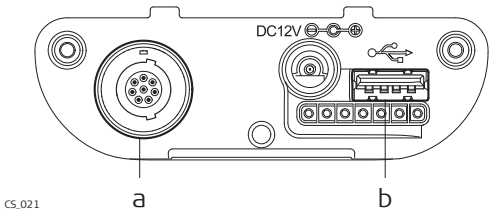
Some applications require knowledge of the pin assignments for the CS10/CS15 ports. In this chapter, the pin assignments and sockets for the ports of the CS10/CS15 are explained.

Ports at the instrument bottom panel - DSUB9 connector



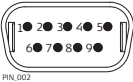
- a) DSUB9 port
- b) USB Mini port
- c) USB A Host port

Ports at the instrument bottom panel - Lemo connector



- a) Lemo port (USB and serial)
- b) USB A Host port

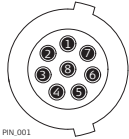
Pin assignments for RS232 serial port



Pin	Signal Name	Function	Direction
1	NC	Not connected	-
2	RxD	RS232, receive data	In
3	TxD	RS232, transmit data	Out

Pin	Signal Name	Function	Direction
4	NC	Not connected	-
5	GND	Signal Ground	-
6	NC	Not connected	-
7	RTS	RS232, request to send	Out
8	CTS	RS232, clear to send	In
9	NC	Not connected	-

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-28 V	In
8	TRM_ON/USB_ID	RS232, general purpose signal	In or out

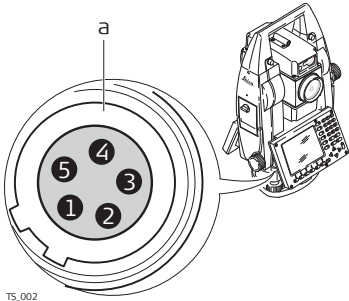
Sockets

9 pin RS232:	RS232, 9 pin, DE9
8 pin LEMO-1:	LEMO-1, 8 pin, LEMO EGI.1B.308.CLN

Description

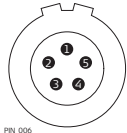
Some applications require knowledge of the pin assignments for the instrument port. In this chapter, the pin assignments and socket for the port 1 of the TPS1200+ instrument are explained.

Ports at the TPS instrument



a) Port 1

Pin assignments for port P1



Pin	Name	Description	Direction
1	PWR_IN	Power input, + 12 V nominal (11 - 16 V).	In
2	-	Not used.	-
3	GND	Single ground.	-
4	RX-	RS232, receive	In
5	TX-	RS232, transmit	Out

Sockets

Port 1: For TPS1200+: LEMO-0, 5 pin, LEMO ENA.OB.305.CLN

Appendix E

E.1

Cables

GPS Cables

Power cables

Name	Description
GEV97	• Allows GS10 (power port) to be externally powered • LEMO-1, 5 pin, 30° / LEMO-1, 5 pin, 30° • 1.8 m
GEV71	• Allows powering of any device from car battery. • Crocodile clips / LEMO-1, 5 pin , 30° (female) • 4.0 m
GEV172	• Allows GS10 (power port) to be externally powered from two external batteries • LEMO-1, 5 pin / LEMO-1, 5 pin, 30° • 2.8 m
GEV219	• Allows CS10/CS15 (with LEMO CBC01 connector module) to be externally powered via the LEMO port • Allows GS10/GS15 (port 1) to be externally powered • LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30° • 1.8 m
GEV235	• Allows CS10/CS15 (with either connector modules) to be externally powered via the power jack • Wall adapter / 3 mm barrel connector • 1.5 m

Y cables

Name	Description
GEV172	• Allows GS10 (power port) to be externally powered from two external batteries • LEMO-1, 5 pin / LEMO-1, 5 pin, 30° • 2.8 m
GEV205	• Allows connections between GS10/GS15 (port 1), an external radio in GFU1200 housing and the GEB71, with GS10/GS15 and a radio being externally powered • LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135° (female) / LEMO-1, 5 pin • 1.8 m
GEV215	• Allows connections between CS10/CS15 (with LEMO CBC01 connector module), the GS10/GS15 (port 1) and the GEB71, with the GS10/GS15 being powered from the GEB71. • LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30° / LEMO-1, 5 pin, 30° • 2.0 m

Radio programming cables

Name	Description
GEV231	• Allows an “SLR” radio device to be externally powered and programmed by a computer • 15 pin (GS15 slot-in port) (female) / 9 pin, RS232 serial / LEMO-1, 5 pin • 1.8 m
GEV171	• Allows a radio within a GFU1200 device to be externally powered and programmed by a computer • LEMO-1, 8 pin, 135° (female) / 9 pin, RS232 serial / LEMO-1, 5 pin • 1.8 m

Radio cables

Name	Description
GEV67	• Allows System 500 GFU housings to be connected to a GS10 (port 2 and 3), or GS15 (port 2) • LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135° / LEMO-1, 5 pin, 30° • 0.5 m
GEV125	• Allows a Satel modem (not inside housing) to be connected to a GS10 (port 2 and 3), or GS15 (port 2) • LEMO-1, 8 pin, 30° / 15 pin, RS232 serial • 1.8 m
GEV232	• Allows System 1200 GFU housings to be connected to a GS10 (port 2 and 3), or GS15 (port 2) • LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 30° (female) • 2.8 m
GEV233	• Allows System 1200 GFU housings to be connected to a GS10 (port 2 and 3), or GS15 (port 2) • LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 30° (female) • 0.8 m

Serial data transfer cables

Name	Description
GEV160	• Allows serial connection between GS10 (port 2 and 3), or GS15 (port 2) to a computer to stream NMEA or RTK data • LEMO-1, 8 pin, 30° / 9 pin, RS232 serial • 2.8 m

Name	Description
GEV162	- Allows serial connection between GS10/GS15 (port 1) to a computer to stream NMEA or RTK data - Allows serial connection between CS10/CS15 (with LEMO CBC01 connector module) and, for example, a hidden point device, ASCII input device, or computer. - Allows serial connection between CS10/CS15 (with 9 pin serial CBC02 connector module) and GS10/GS15 (port 1). This connection is useful when using third-party software such as Carlson SurvCE on the CS10/CS15 and a cable connection is required to the GS10/GS15. - LEMO-1, 8 pin, 135° / 9 pin, RS232 serial 2.8 m
GEV163	- Allows serial connection between CS10/CS15 (with LEMO CBC01 connector module) and GS10/GS15 port 1. This connection is useful when using third-party software such as Carlson SurvCE on the CS10/CS15 (with LEMO CBC01 connector module) and a cable connection is required to the GS10/GS15. - LEMO-1, 8 pin, 30° / LEMO-1, 8 pin, 135° 1.8 m

USB to serial converter cables

Name	Description
GEV195	- Allows GS10 (port 2 and 3) or GS15 (port 2) 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 CS10/CS15 or GS10/GS15 hardware. - LEMO-1, 8 pin, 30° / USB type A 2.0 m

Name	Description
GEV218	- Allows CS10/CS15 (with LEMO CBC01 connector module) and GS10/GS15 (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 CS10/CS15 or GS10/GS15 hardware. - LEMO-1, 8 pin, 135° / USB type A 2.0 m

USB data transfer cables

Name	Description
GEV223	- Allows USB data transfer between CS10/CS15 (both connector modules) and a computer. - USB Type A / Mini USB Type B 1.8 m
GEV234	- Allows a CS10/CS15 (with 9 pin serial CBC02 connector module) to connect to a GS10/GS15 (port 1). This cable is for when a cable connection is needed between CS10/CS15 and GS10/GS15 when the CS10/CS15 is using the CBC02 connector module. - Allows a USB connection between the USB port of a computer and the GS10/GS15 (port 1) - Allows a USB connection between the USB port of a computer and the CS10/CS15 (with LEMO CBC01 connector module) - LEMO-1, 8 pin, 135° / USB type A 1.65 m

Name	Description
GEV237	- Allows a CS10/CS15 (with LEMO CBC01 connector module) to connect to a GS10/GS15 (port 1). This cable is for when a cable connection is needed between CS10/CS15 and GS10/GS15 when the CS10/CS15 is using the CBC01 connector module. - LEMO-1, 8 pin, 135° / LEMO-1, 8 pin, 135° 1.65 m

Antenna cables

Name	Description
GEV108	- TNC connector / TNC connector 30 m
GEV119	- TNC connector / TNC connector 10 m
GEV120	- TNC connector / TNC connector 2.8 m
GEV134	- TNC connector / TNC connector 50 m
GEV141	- TNC connector / TNC connector 1.2 m
GEV142	- TNC connector / TNC connector (male) 1.6 m
-	- TNC connector / TNC connector 70 m

E.2

TPS Cables

Power cables

Name	Description
GEV52	- Allows TPS1200+ to be externally powered - LEMO-0, 5 pin, 30° / LEMO-1, 5 pin 1.8 m

Radio / Y cables

Name	Description
GEV186	- Allows connections between TPS1200+, an external battery and TCP527/TCP528 - LEMO-0, 5 pin, 30° / LEMO-0, 8 pin, 30° / LEMO-1, 5 pin 1.8 m

Serial data transfer cables

Name	Description
GEV102	- Allows serial connection between TPS1200+ and a computer - Allows serial connection between TPS1200+ and CS10/CS15 (with 9 pin serial CBC02 connector module) - LEMO-0, 5 pin, 30° / 9 pin, RS232 serial 2.0 m
GEV162	- Allows serial connection between CS10/CS15 (with 9 pin serial CBC02 connector module) and a computer - LEMO-1, 8 pin, 135° / 9 pin, RS232 serial 2.8 m

Name	Description
GEV187	- Allows connections between TPS1200+, an external battery and a computer - LEMO-0, 5 pin, 30° / 9 pin, RS232 serial / LEMO-1, 5 pin, 30° 2.0 m
GEV217	- Allows serial connection between TPS1200+ and CS10/CS15 (with LEMO CBC01 connector module) - LEMO-1, 8 pin, 135° / LEMO-0, 5 pin, 30° 1.8 m

USB to serial converter cables

Name	Description
GEV189	- Allows TPS1200+ 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 TPS1200+ or DNA hardware - LEMO-0, 5 pin, 30° / USB type A 2.0 m

USB data transfer cables

Name	Description
GEV234	- Allows a USB connection between the USB port of a computer and the CS10/CS15 (with LEMO CBC01 connector module) - LEMO-1, 8 pin, 135° / USB type A 1.65 m

Appendix F

F.1

NMEA Message Formats GPS

Overview

Description

National **M**arine **E**lectronics **A**ssociation is a standard for interfacing marine electronic devices. This chapter describes all NMEA-0183 messages which can be output by the instrument.

Access

Select **Main Menu: Instrument\Instrument\All other connections\NMEA 1 or NMEA 2**. Press **Mesgs**.



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**.

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	• -- = alphanumeric characters identifying the talker Options: GP = GPS only GL = GLONASS only GN = Global Navigation Satellite System • ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message.	GPGGA

Special format fields

Symbol	Field	Description	Example
A	Status	- A = Yes, Data Valid, Warning Flag Clear - V = No, Data Invalid, Warning Flag Set	V
III.II	Latitude	- Degreesminutes.decimal - Two fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes. - Leading zeros are always included for degrees and minutes to maintain fixed length.	4724.538950
yyyy.yy	Longitude	- Degreesminutes.decimal - Three fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes. - Leading zeros are always included for degrees and minutes to maintain fixed length.	00937.04678 5
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

Symbol	Field	Description	Example
hhmmss.ss	Time	- hoursminutesseconds.decimal - 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. - Leading zeros are always included for hours, minutes and seconds to maintain fixed length.	115744.00
mmddyy	Date	- Monthdayyear - two fixed digits of month, two fixed digits of day, two fixed digits of year. - Leading zeros always included for month, day and year to maintain fixed length.	093003
No specific symbol	Defined field	- Some fields are specified to contain predefined constants, most often alpha characters. - 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, hhmmss.ss, llll.ll, yyyyyy.yy.	M

Numeric value fields

Symbol	Field	Description	Example
x.x	Variable numbers	- Integer or floating numeric field - Optional leading and trailing zeros. Decimal point and associated decimal-fraction are optional if full resolution is not required.	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.

F.3

GGA - Global Positioning System Fix Data

Syntax

\$--GGA,hhmmss.ss,llll.ll,a,yyyyy.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, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Valid fix for GNSS P recise P ositioning S ervice mode, for example WAAS 4 = Real-time position, ambiguities fixed
xx	Number of satellites in use, 00 to 26.
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.

Field	Description
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
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed

Examples

User-defined Talker ID = GN

\$GNNGGA,113805.50,4724.5248541,N,00937.1063044,E,4,13,0.7,1171.281,M,-703.398,
M,0.26,0000*42

F.4

GGK - Real-Time Position with DOP

Syntax

\$--GGK,hhmmss.ss,mmddyy,IIII.II,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
mmddyy	UTC date
IIII.II	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed
xx	Number of satellites in use, 00 to 26.
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

Field	Description
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

\$GNNGK,113616.00,041006,4724.5248557,N,00937.1063064,E,3,12,1.7,EHT1171.742,M
*6D

User-defined Talker ID = GN

\$GNNGK,113806.00,041006,4724.5248557,N,00937.1063064,E,3,13,1.4,EHT1171.746,M
*66

F.5

GGK(PT) - Real-Time Position with DOP, Trimble Proprietary

Syntax

\$PTNL,GGK,hhmmss.ss,mmddyy,IIII.II,a,yyyyy.yy,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
mmddyy	UTC date
IIII.II	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Not existing 3 = Real-time position, ambiguities fixed 4 = Real-time position, ambiguities not fixed
xx	Number of satellites in use, 00 to 26.
x.x	PDOP
EHT	Ellipsoidal height

Field	Description
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
<LF>	Line Feed

Examples

Standard Talker ID

\$PTNL,GGK,113616.00,041006,4724.5248557,N,00937.1063064,E,3,12,1.5,EHT1171.742
,M*4C

User-defined Talker ID = GN

\$PTNL,GGK,113806.00,041006,4724.5248557,N,00937.1063064,E,3,13,1.2,EHT1171.746
,M*43

F.6

GGQ - Real-Time Position with CQ

Syntax

\$--GGQ,hhmmss.ss,mmddyy,IIII.II,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
mmddyy	UTC date
IIII.II	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed
xx	Number of satellites in use, 00 to 26.
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.

Field	Description
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed

Examples

Standard Talker ID

\$GNGGQ,113615.50,041006,4724.5248556,N,00937.1063059,E,3,12,0.009,1171.281,M
*22

\$GPGGQ,113615.50,041006,,,,08,,*67

\$GLGGQ,113615.50,041006,,,,04,,*77

User-defined Talker ID = GN

\$GNGGQ,113805.50,041006,4724.5248541,N,00937.1063044,E,3,13,0.010,1171.281,M
*2E

F.7

GLL - Geographic Position Latitude/Longitude

Syntax

\$--GLL,IIII.II,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>

Description of fields

Field	Description
\$--GLL	Header including talker ID
IIII.II	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
hhmmss.ss	UTC time of position
A	Status A = Data valid V = Data not valid
a	Mode indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F 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

Standard Talker ID

\$GNGLL,4724.5248556,N,00937.1063059,E,113615.50,A,D*7B

User-defined Talker ID = GN

\$GNGLL,4724.5248541,N,00937.1063044,E,113805.50,A,D*7E

Syntax

```
$--GNS,hhmmss.ss,IIII.II,a,yyyyy.yy,a,C--C,xx,x.x,x.x,x.x,x.x,xxxx*hh<CR><LF>
```

Description of fields

Field	Description
\$--GNS	Header including talker ID
hhmmss.ss	UTC time of position
IIII.II	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
C--C	Mode indicator N = Satellite system not used in position fix or fix not valid A = Autonomous; navigation fix, no real-time fix D = Differential; real-time position, ambiguities not fixed R = Real-time kinematic; ambiguities fixed
xx	Number of satellites in use, 00 to 99
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.
x.x	Geoidal separation in metres

Field	Description
x.x	Age of differential data
xxxx	Differential base station ID, 0000 to 1023
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed

Examples

Standard Talker ID

\$GNGNS,113616.00,4724.5248557,N,00937.1063064,E,RR,12,0.9,1171.279,-
703.398,0.76,0000*6C

\$GPGNS,113616.00,,,,,08,,,,*69

\$GLGNS,113616.00,,,,,04,,,,*79

User-defined Talker ID = GN

\$GNGNS,113806.00,4724.5248547,N,00937.1063032,E,R,13,0.7,1171.283,-
703.398,0.76,0000*39

Syntax

```
$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x*hh<CR><LF>
```

Description of fields

Field	Description
\$--GSA	Header including talker ID
a	Mode M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to change automatically between 2D and 3D
x	Mode 1 = Fix not available 2 = 2D 3 = 3D
xx	Numbers of the satellites used in the solution. This field is repeated 12 times. 1 to 32 = PRN numbers of GPS satellites 33 to 64 = Numbers of WAAS and WAAS like satellites 65 to 96 = Slot numbers of GLONASS satellites
x.x	PDOP
x.x	HDOP
x.x	VDOP
*hh	Checksum
<CR>	Carriage Return

Field	Description
<LF>	Line Feed

Examples

Standard Talker ID

\$GNGSA,A,3,01,11,14,17,19,20,24,28,,,,,1.5,0.9,1.2*26

\$GNGSA,A,3,65,66,67,81,,,,,,,,,1.5,0.9,1.2*29

User-defined Talker ID = GN

\$GNGSA,A,3,01,11,14,17,19,20,23,24,28,,,65,66,67,81,,,,,,,,,1.2,0.7,1.0*27

Syntax

```
$--GSV,x,x,x,xx,xx,xx,xxx,xx,.....*hh<CR><LF>
```

Description of fields

Field	Description
\$--GSV	Header including talker ID
x	Total number of messages, 1 to 4
x	Message number, 1 to 4
xx	Number of theoretically visible satellites according to the current almanac.
xx	PRN (GPS) / Slot (GLONASS) number of satellite
xx	Elevation in degrees, 90 maximum, empty when not tracking
xxx	Azimuth in degrees true north, 000 to 359, empty when not tracking
xx	S ignal to N oise R ation C/No 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
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed



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

Standard Talker ID

\$GPGSV,3,1,11,01,55,102,51,11,85,270,50,14,31,049,47,17,21,316,46*7A

\$GPGSV,3,2,11,19,31,172,48,20,51,249,50,22,00,061,,23,11,190,42*7E

\$GPGSV,3,3,11,24,11,292,43,25,08,114,,28,14,275,44,,,,*45

\$GLGSV,2,1,06,65,16,055,42,66,64,025,48,67,46,262,42,68,01,245,*64

\$GLGSV,2,2,06,81,52,197,47,83,07,335,,,,,,,,*68

User-defined Talker ID = GN

\$GNGSV,3,1,10,01,55,100,51,11,86,263,50,14,31,049,47,17,22,316,46*65

\$GNGSV,3,2,10,19,30,172,48,20,52,249,51,23,12,190,42,24,12,292,42*6C

\$GNGSV,3,3,10,25,09,114,,28,14,274,44,,,,,,,,*62

F.11

LLK - Leica Local Position and GDOP

Syntax

\$--LLK,hhmmss.ss,mmddyy,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
mmddyy	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 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed
xx	Number of satellites used in computation
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

Field	Description
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

\$GNLLK,113616.00,041006,764413.024,M,252946.774,M,3,12,1.7,1171.279,M*0F

\$GPLLK,113616.00,041006,,,,,08,,, *57

\$GLLLK,113616.00,041006,,,,,04,,, *47

User-defined Talker ID = GN

\$GNLLK,113806.00,041006,764413.021,M,252946.772,M,3,13,1.4,1171.283,M*04

Syntax

```
$--LLQ,hhmmss.ss,mmddyy,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
mmddyy	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 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed
xx	Number of satellites used in computation
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

Field	Description
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

```
$GNLLQ,113616.00,041006,764413.024,M,252946.774,M,3,12,0.010,1171.279,M*12
$GPLLQ,113616.00,041006,,,,,08,,, *4D
$GLLLQ,113616.00,041006,,,,,04,,, *5D
```

User-defined Talker ID = GN

```
$GNLLQ,113806.00,041006,764413.021,M,252946.772,M,3,13,0.010,1171.283,M*1A
```

Syntax

```
$--RMC,hhmmss.ss,A,IIII.II,a,yyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>
```

Description of fields

Field	Description
\$--RMC	Header including talker ID
hhmmss.ss	UTC time of position fix
A	Status A = Data valid V = Navigation instrument warning
IIII.II	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
a*hh	Mode Indicator A = Autonomous mode D = Differential mode

Field	Description
	N = Data not valid
< CR >	Carriage Return
< LF >	Line Feed

Examples

Standard Talker ID

\$GNRMC,113616.00,A,4724.5248557,N,00937.1063064,E,0.01,11.43,100406,11.43,E,D*1C

User-defined Talker ID = GN

\$GNRMC,113806.00,A,4724.5248547,N,00937.1063032,E,0.00,287.73,100406,287.73,E,D*10

F.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
x.x	Speed over ground in km/h
K	Fixed text K for km/h
a	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed



Examples

The Magnetic declination is set in the instrument in **Regional Settings, Angle** page.

Standard Talker ID

```
$GNVTG,11.4285,T,11.4285,M,0.007,N,0.013,K,D*3D
```

User-defined Talker ID = GN

```
$GNVTG,287.7273,T,287.7273,M,0.002,N,0.004,K,D*3E
```

F.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>	C arriage R eturn
<LF>	L ine F eed



This message is given high priority and is output as soon as it is created. Latency is therefore reduced to a minimum.

Examples

Standard Talker ID

\$GPZDA,091039.00,01,10,2003,-02,00*4B

User-defined Talker ID = GN

\$GNZDA,113806.00,10,04,2006,02,00*76

Appendix G

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. <value>: 0 = Factory default configuration profile
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 command	Description
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. <mode>: • 0 = Disable network registration unsolicited result code • 1 = Enable network registration unsolicited result code <stat>: • 0 = Not registered, ME is not currently searching a new operator to register to • 1 = Registered, home network • 2 = Not registered, but ME is currently searching a new operator to register to • 3 = Registration denied • 4 = Unknown • 5 = Registered, roaming

AT command	Description
AT+COPS=[<mode>[,<format>[,<oper>],<AcT>]]]	Forces an attempt to select and register the GSM\UMTS network operator. <mode>: • 0 = Automatic choice • 1 = Manual choice <format>: • 0 = Alphanumeric long form • 1 = Short format alphanumeric • 2 = Numeric, 5 digits <oper>: • Network operator in format defined by <format> <AcT>: Access technology selected: • 0 = GSM • 2 = UTRAN
AT+COPS?	Returns the currently registered network operator.
AT+COPS=?	Returns a list of all available network operators in form of: <stat>, long alphanumeric <oper>, short alphanumeric <oper>, numeric <oper>,<AcT>: <stat>: Operator availability: • 0 = Unknown • 1 = Available • 2 = Current • 3 = Forbidden

AT command	Description
	<AcT>: Access technology selected: • 0 = GSM • 1 = GSM Compact • 2 = UTRAN
AT+CPIN=<pin> [,<newpin>]	Sends the PIN to the phone.
AT+CPIN?	Returns the status of the PIN request: • READY = Phone can be used • SIM PIN = PIN is not set, phone not ready for use. • SIM PUK = PUK is required to use the device • ERROR = No SIM card inserted
AT+CSQ	Reports received signal quality indicators in form of: <signal strength><bit error rate>
AT+CSQ=?	Returns the supported ranges.
AT+FLO=<type>	Selects the flow control behaviour of the serial port in both directions. • 0 = Flow control None • 1 = Flow control Software (XON-XOFF) • 2 = Flow control Hardware (CTS-RTS)

Appendix H

H.1

Glossary

A

A (parameter)

For horizontal alignments:

$$A^2 = R * L$$

R = Radius of the connecting circular curve.

L = Length of the spiral.

Arc

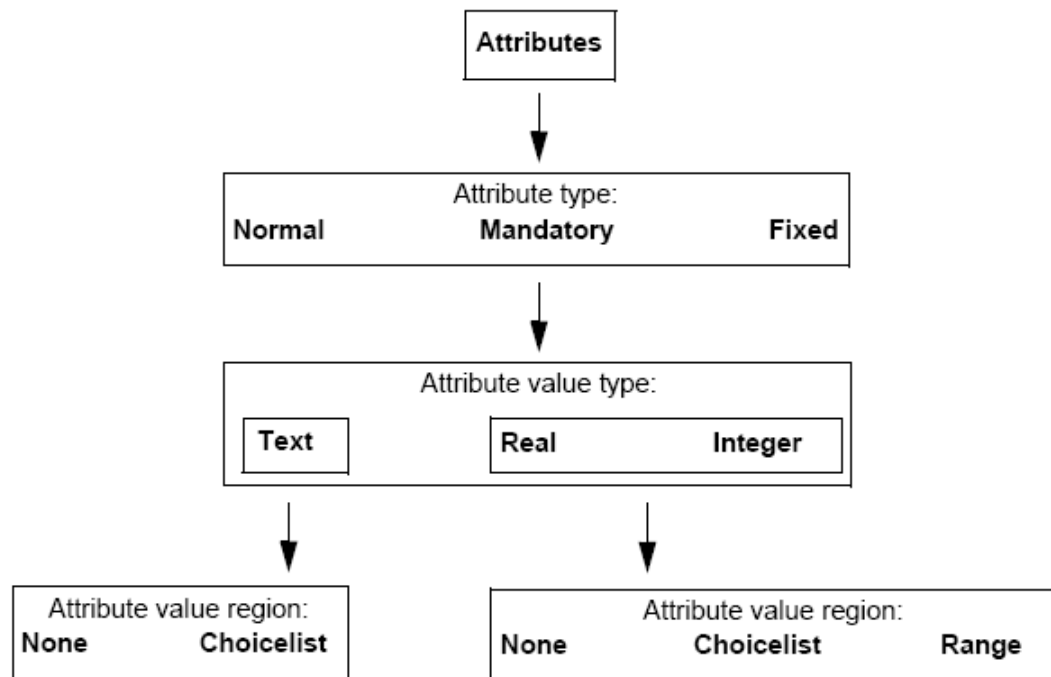
Refer to "Curve".

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.

- 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 LGO 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 LGO.
- 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 LGO.

Attribute value regions

The attribute value region defines if the attribute values must be selected from a predefined list.

- None: An input for the attribute must be typed in. New attributes with this attribute value region can be created in LGO 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 LGO.
- Selectable list: An input for the attribute is selected from a predefined list. New attributes with this attribute value region can be created in LGO.

Attribute value types

The attribute value type defines which values are accepted as input.

- Text: Any input for the attribute is interpreted as text. New attributes with this attribute value type can be created in LGO 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 LGO.
- 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 LGO.

Averaging mode

Averaging Mode

The averaging mode defines the checks which are performed when more than one set of measured coordinates are recorded for the same point. The selected averaging mode also affects the behaviour of the instrument when editing a point and calculating averages.

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
Ctrl	Type	Control points. Automatically assigned to entered points or manually assigned to calculated points from COGO.
	Instrument source	GPS, TPS or LGO
	Number of triplets	One
Adj	Type	Adjusted points using the adjustment program.
	Instrument source	LGO
	Number of triplets	One
Ref	Type	• Reference point received by a real-time rover

Class	Characteristic	Description
	Instrument source Number of triplets	Station point set by Setup application. GPS, TPS or LGO One
Avge	Type Instrument source Number of triplets	Averaged point calculated when more than one coordinate triplet of class MEAS exist for the same point ID unless Averaging Mode: Off . GPS or TPS One
Meas	Type Instrument source Number of triplets	- Measured points differentially corrected using real-time phase, real-time code or post-processing. - Measured points with angles and distances. - Calculated from some applications. GPS, TPS or LGO Multiple. With more than one measured coordinate triplet, the average for the position and the height can be computed.
Nav	Type Instrument source Number of triplets	Navigated points using uncorrected code solutions of a single epoch or SPP positions. GPS Multiple
Est	Type	Estimated points from LGO .

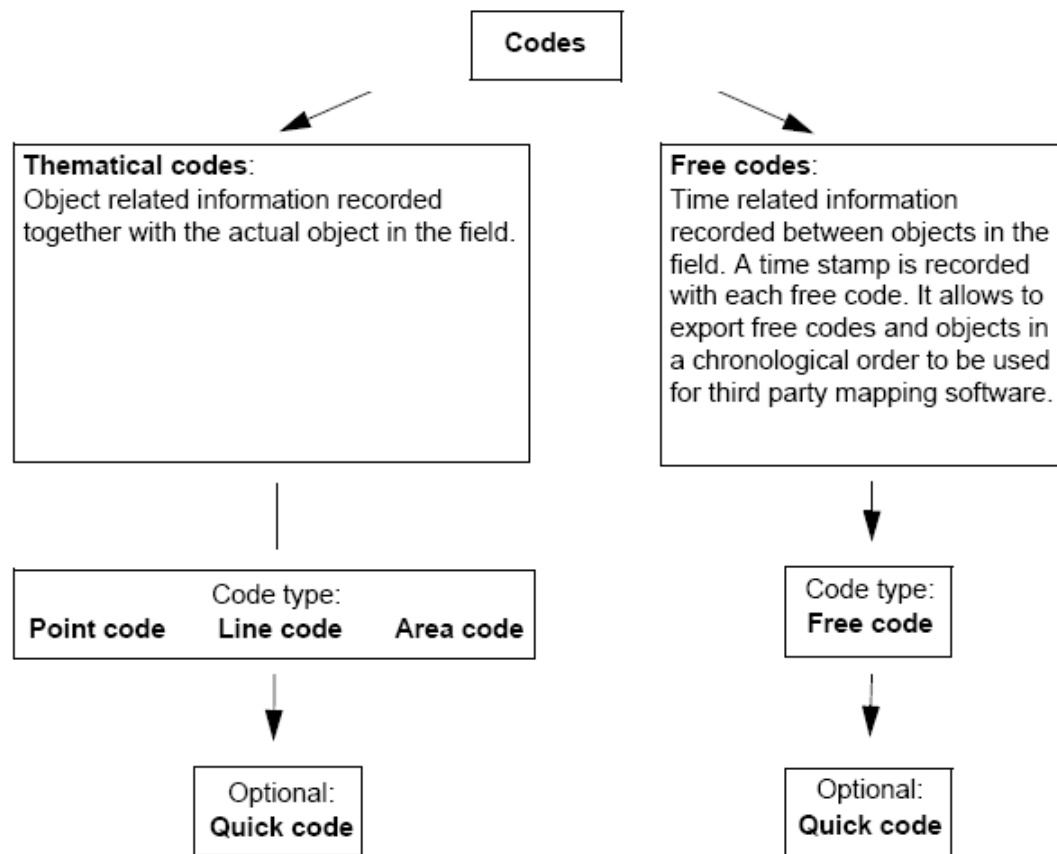
Class	Characteristic	Description
	Instrument source Possible number of triplets	LGO. One
None	Type Instrument source Possible number of triplets	Measured points with angles. TPS Unlimited

Code

Description

A code is a description which can be stored with an object or alone.

Structure of codes



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

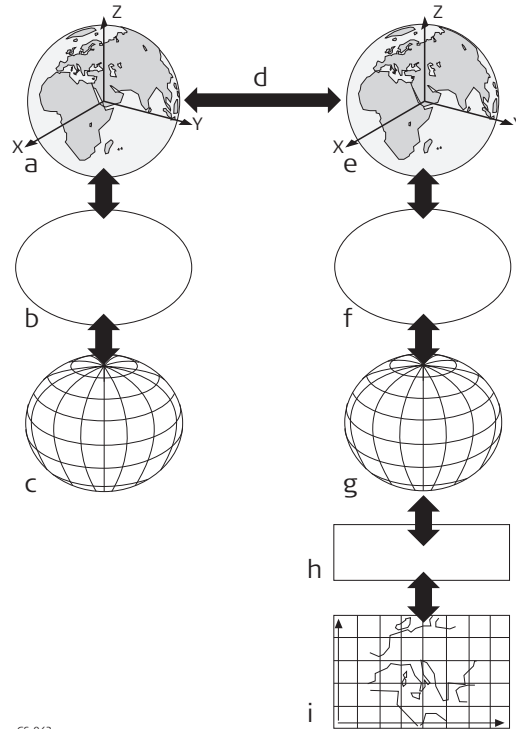
The code type defines how and for which objects a code can be used. It is possible to create a code of the same name but of different code types both on the instrument and in LGO. Example: The code Oak can exist with code type point code and with code type line code.

Point code:	To record a code directly with a point. Thematical point coding.
Line code:	To record a code directly with a line. Thematical line coding.
Area code:	To record a code directly with an area. Thematical area coding.
Free code:	To record a code based on time in between objects.
Quick code:	To start a point occupation and store the code by typing in one, two or three predefined digits.

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



GS_042

- 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.

Creation: In LGO with export onto a data storage device or the internal memory of the instrument.

Extension: *.csc

CSCS model

Description

Country Specific Coordinate System 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
Grid	1 Determination of preliminary grid coordinates by applying the specified transformation, ellipsoid and map projection.

Type	Description
	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.
Cartesian	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.
Geodetic	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 GPS

Description

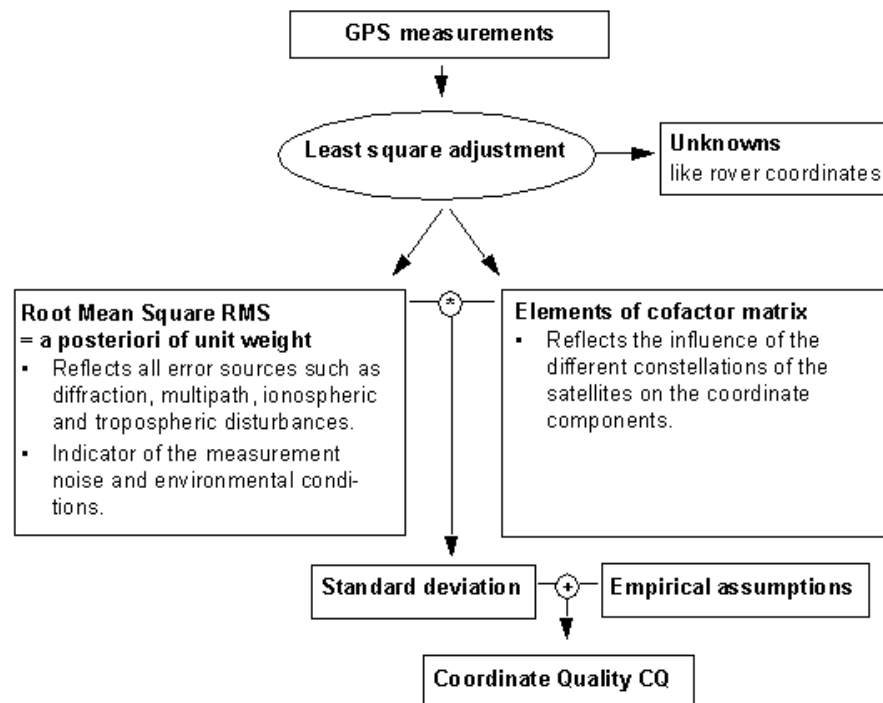
The **Coordinate Quality** is

- 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 particularly 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

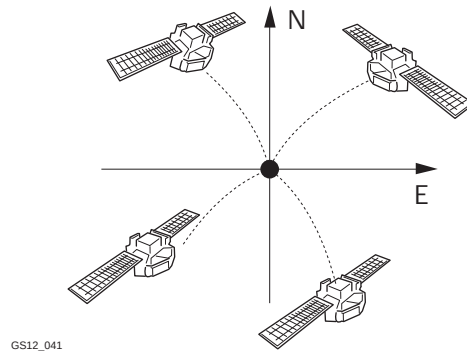
For a phase fixed solution: Centimetre level

For a code solution:

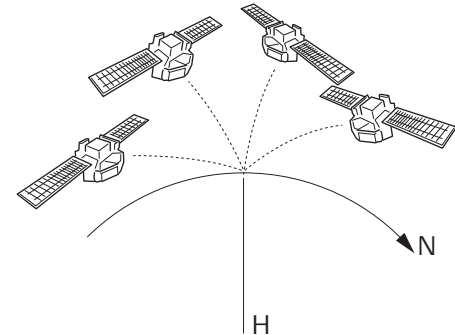
From 0.4 m to 5 m.

Position CQ versus height CQ

All GPS 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 weakens the height position compared to the plan position.



Position determination with satellites appearing in all four quadrants.



Height determination with satellites appearing in two quadrants.

Coordinate quality for TPS

Description

The **Coordinate Quality** is an indicator for the estimated quality of the point coordinates. The coordinate quality of the measurements is used in point averaging.

Column	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.

$$\rho = \frac{200}{\pi}$$

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
 $\sigma_{Hz} = \sigma_V$.
 σ_{Hz} : Standard deviation of horizontal circle reading.
 σ_V : Standard deviation of vertical circle reading.

Standard deviation of distance measurement

$$\sigma_D = c_D + \text{ppm} * D$$

σ_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:

TXA1200

Angular accuracy:

2" = 6.1728×10^{-4} gon $\Rightarrow \sigma_{Hz, V} = 2'' * \sqrt{2}$

EDM accuracy:

2 mm + 2 ppm for an IR measurement

Slope distance:

150 m

Hz:

210 gon

V:

83 gon

1D CQ = 0.00207 m $\cong$ 2.1 mm

2D CQ = 0.00303 m $\cong$ 3.0 mm

3D CQ = 0.00367 m $\cong$ 3.7 mm

Working Example 2

Instrument:	TXA1200
Angular accuracy:	$2'' = 6.1728 \times 10^{-4} \text{ gon} \Rightarrow \sigma_{Hz}, V = 2'' \cdot \sqrt{2}$
EDM accuracy:	2 mm + 2 ppm for an IR measurement
Slope distance:	7000 m
Hz:	210 gon
V:	83 gon

1D CQ = 0.0927 m
2D CQ = 0.0972 m
3D CQ = 0.1343 m

1D CQ = 0.00054 m $\cong$ 0.5 mm
2D CQ = 0.00120 m $\cong$ 1.2 mm
3D CQ = 0.00132 m $\cong$ 1.3 mm

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.

H.3

D

Data

Data is a generic term for points, lines and areas.

Device

The hardware which is connected to the chosen port.

GPS 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.

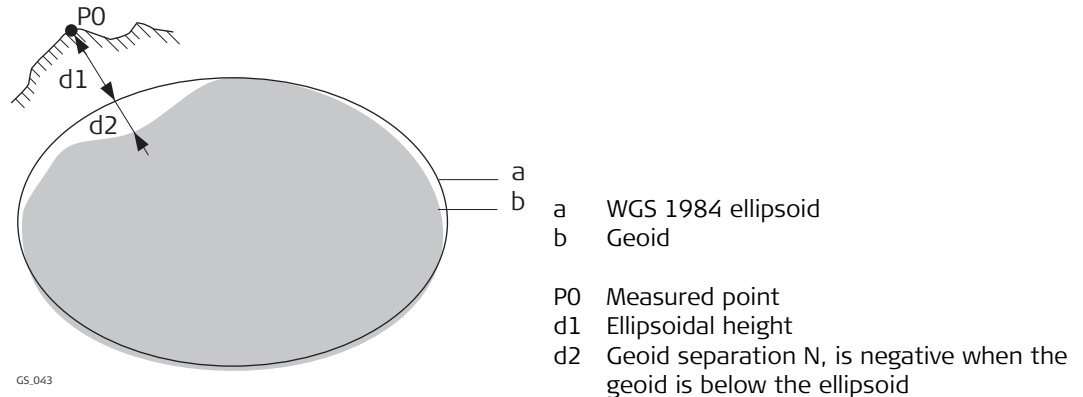
TPS Devices are used to transmit and receive measurement data.

Geoid model

Description

GPS operates on the WGS 1984 ellipsoid and all heights obtained by measuring baselines are ellipsoidal heights. Existing heights are usually 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

$$\text{Orthometric Height} = \text{Ellipsoidal Height} - \text{Geoid Separation } N$$



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.

Creation: In LGO with export onto a data storage device or the internal memory of the instrument.

Extension: *.gem

GPS mode

Current active instrument is GPS.

GPS points

The coordinates of GPS 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).

GPS points are stored as class **Meas** or class **Nav**:

- **Class Meas:** If there are 5 or more satellites, and the distance to the reference is not too great for the prevailing ionospheric conditions, SmartStation will compute a GPS real-time position. The CQ indicator for this type of point is about 0.01 m to 0.05 m.
- **Class Nav:** If the reference stops working, or if the communication link between the reference and SmartStation fails, SmartStation will only compute a navigation position. The CQ indicator for this type of point is about 3 m to 20 m.

GPS surveying techniques GPS

Depending on the surveying task and the instruments being used, certain GPS surveying techniques are possible. The three existing types of GPS surveying techniques are:

GPS surveying technique	Characteristic	Description
Static	Way of working	• Base set up over a point with accurately known coordinates. • Rover set up over a point with known or unknown coordinates. • Data recorded at both instruments simultaneously at the same data rate, typically 15 s, 30 s or 60 s. • Post-processing is compulsory.
	Use	For long baselines, geodetic networks, tectonic plate studies.
	Accuracy	High over long and very long baselines.
	Working speed	Slow

GPS surveying technique	Characteristic	Description
Post-processed kinematic	Way of working	• Base set up as static over a point with accurately known coordinates. • Rover moves from one point to another. The instrument remains turned on while moving. • Static and moving raw observations are collected. • Post-processing is compulsory.
	Use	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.

GPS surveying technique	Characteristic	Description
Real-time, base and rover	Way of working	• Base set up as static over a point with accurately known coordinates in WGS 1984. • Rover equipment is set up on a pole and moves from one unknown point to another. • A data link, for example a radio or digital cellular phone, transmits satellite data from the base to the rover. • 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. • Ambiguities are solved, coordinates of the surveyed points are calculated and displayed. • applications as on conventional instruments like stakeout or COGO can be performed. • Post-processing is optional.
	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.

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.

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 active working style must be a real-time rover configuration allowing for phase fixed solutions. A minimum of five satellites on L1 and L2 is required.

The three existing types of initialisation methods are:

Initialisation method	Characteristic	Description
Moving	Principle	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.
	Antenna setup	On a pole.
	Beginning of initialisation	Immediately.
	Use	For fast initialisations over distances up to 30 km.
Static	Principle	The rover instrument is kept stationary at the beginning of the GNSS operation.
	Antenna setup	On a pole with a quickstand.
	Beginning of initialisation	Immediately.

Initialisation method	Characteristic	Description
	Use	If it is proving difficult to initialise while moving and no known point is available.
Known point	Principle	The rover instrument is kept stationary over a point with known coordinates at the beginning of the GNSS operation.
	Antenna setup	On a pole with a quickstand.
	Beginning of initialisation	After selecting the known point.
	Use	If it is proving difficult to initialise while moving and to speed up an initialisation while static.

Instrument source

The instrument source describes where the coordinate triplet was measured or entered. The options are **GPS**, **TPS**, **LGO** or **Level**.

Interface

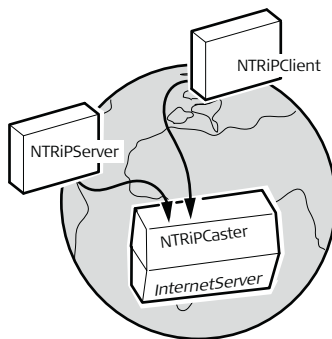
The procedures, codes and protocols that enable two entities to interact for an exchange of data. Each interface is given a meaningful display name which enables easy distinction between interfaces.

Ntrip

Networked Transport of RTCM via Internet Protocol

- 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 GPS instrument itself. This setup means the GPS instrument 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 Internet.

Ntrip Source

The Ntrip Source generates data streams. This setup could be based on sending out real-time corrections.

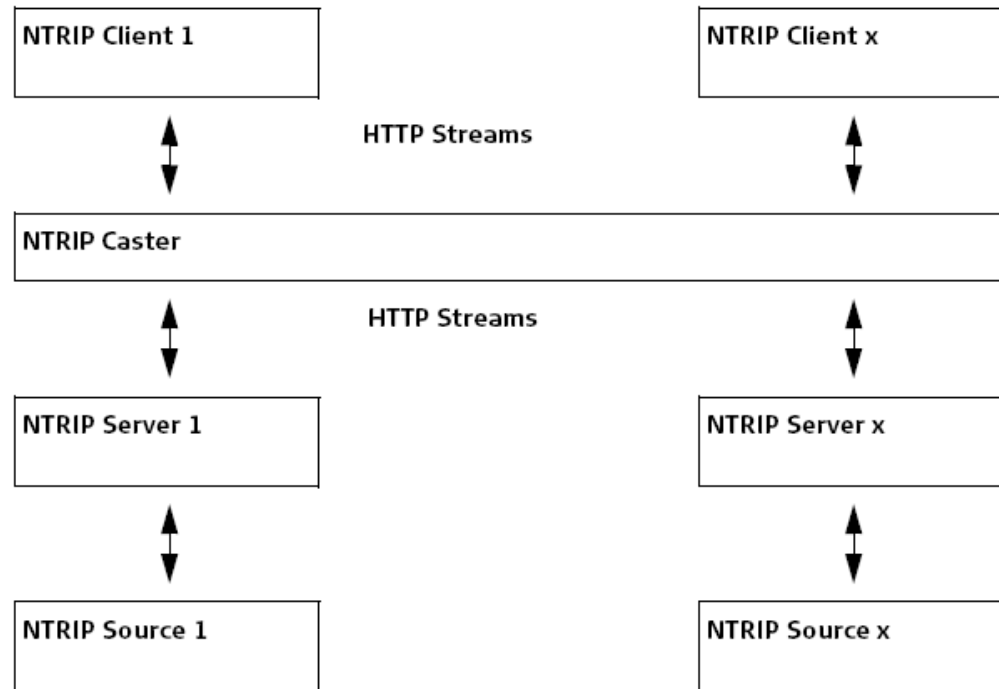
Ntrip system components

Ntrip consists of three system components:

- Ntrip Clients

- Ntrip Servers

- Ntrip Caster



Objects

Objects

- are points, lines and areas.
 - have a unique identification ID. This ID is the point ID, the line ID and the area ID.
 - can have a code attached. This code is either a point code, a line code or an area code depending on the type of object.
-

H.9

Parabola

Parameter A

Port

P

Parabolic vertical curve with constant rate of grade change.

Refer to "A (parameter)".

A connection through which a separate device can communicate with the instrument.

Source

The source describes the application or functionality that generated a coordinate triplet and the method with which it was created.

Source	Originated from application/functionality	Instrument source
ASCII file	Convert Data, Import ASCII/GSI Data to Job	GPS or TPS
Arc base pt	COGO, Arc Calculation - Base Point	GPS or TPS
Arc centre pt	COGO, Arc Calculation - Centre Point	GPS or TPS
Arc offset pt	COGO, Arc Calculation - Offset Point	GPS or TPS
Arc segment pt	COGO, Arc Calculation - Segmentation	GPS or TPS
Backward brg-dst	Hidden point measurements, Backward Bearing and Distance	GPS
Bearing-Distance	Hidden point measurements, Bearing and Distance	GPS
Chainage % offset	Hidden point measurements, Chainage and Offset	GPS
COGO Area Div	COGO Area Division	GPS or TPS
COGO Shift/Rtn	COGO, Shift, Rotate & Scale (Manual) COGO, Shift, Rotate & Scale (Match Pts)	GPS or TPS
COGO Traverse	COGO, Traverse	GPS or TPS
Copied Point	Convert Data, Copy points between jobs	GPS or TPS
Cross Section	Survey Cross Section	GPS or TPS
Using 2 bearings	Hidden point measurements, Double Bearing	GPS

Source	Originated from application/functionality	Instrument source
Using 2 distances	Hidden point measurements, Double Distance	GPS
GSI file	Convert Data, Import ASCII/GSI Data to Job	GPS or TPS
Hidden Point	Hidden Point, auxiliary points	TPS
Intsct (Brg Brg)	COGO, Intersection - Bearing - Bearing	GPS or TPS
Intsct (Brg Dst)	COGO, Intersection - Bearing - Distance	GPS or TPS
Intsct (Dst Dst)	COGO, Intersection - Distance - Distance	GPS or TPS
Intsct (4 Pts)	COGO, Intersection - By points	GPS or TPS
LandXML	Design to Field in LGO converting data from LandXML software to be used in the field	LGO
Line Base Pt	COGO, Line Calculation - Base Point	GPS or TPS
Line Offset Pt	COGO, Line Calculation - Offset Point	GPS or TPS
Line Segmt Pt	COGO, Line Calculation - Segmentation	GPS or TPS
None	No information on the source is available	GPS or TPS
RefLine (Grid)	Reference Line, staked out in a defined grid	GPS or TPS
RefLine (Meas)	Reference Line, measured	GPS or TPS
RefLine (Seg)	Reference Line, segmented	GPS or TPS
RefLine (Stake)	Reference Line, staked out	GPS or TPS
Ref Plane (Meas)	Reference Plane, measured	GPS or TPS
Ref Plane (Scan)	Reference Plane, scan	TPS
RoadRunner	Road Runner	GPS or TPS

Source	Originated from application/functionality	Instrument source
Sets of Angles	Sets of Angles	TPS
Setup (Known BS)	Setup, Known Backsight Point	TPS
Setup (LocCoord)	Setup, Local Coordinates	TPS
Setup (Loc Rsct)	Setup, Local Resection	TPS
Setup (Ori&Ht)	Setup, Orientation and Height Transfer	TPS
Setup (Resect)	Setup, Resection	TPS
Setup (Resect H)	Setup, Resection Helmert	TPS
Setup (Set Az)	Setup, Set Azimuth	TPS
Srvy Auto Offset	Survey Auto Points, automatically recorded with offsets	GPS or TPS
Stakeout	Stakeout	GPS or TPS
Survey	Survey, measured	TPS
Survey (Auto)	Survey Auto Points, automatically recorded	TPS
Survey (Event)	Survey, Event input	GPS
Survey (Instant)	Survey, measured with Pt Occupation: Instantaneous in CONFIGURE Point Occupation Settings	GPS
Survey (Rem Pt)	Survey, Remote Point	TPS
Survey (Static)	Survey, measured with Pt Occupation: Normal in CONFIGURE Point Occupation Settings	GPS
Traverse	Traverse	TPS

Source	Originated from application/functionality	Instrument source
Unknown	-	GPS or TPS
User Application	Customised applications	GPS or TPS
User entered	Manually entered point	GPS or TPS

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
COGO	Indirect coordinate determination with application COGO.	GPS or TPS
None	Direction is available but no coordinates. Height is available but no position coordinates.	TPS Level
TPS	Measured with distances and angles.	TPS
Fixed (Height)	Manually entered and fixed in height.	GPS or TPS

Sub class	Description	Instrument source
Fixed (Position)	Manually entered and fixed in position.	GPS or TPS
Fixed (Pos & Ht)	Manually entered and fixed in position and height.	GPS or TPS
GNSS Code Only	Direct coordinate determination with code solution.	GPS
GNSS Fixed	Direct coordinate determination with phase fixed solution.	GPS
GNSS Float	Direct coordinate determination with autonomous solution coming from LGO .	GPS
Hidden Point	Indirect coordinate determination with hidden point measurements.	GPS or TPS

Tangent

Refer to straight.

TPS mode

Current active instrument is TPS.

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
Classic 3D	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.
	Use	When measurements are to be kept homogenous.
	Requirements	• 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. • Parameters of the local ellipsoid. • Parameters of the local map projection, to convert between grid coordinates and geodetic coordinates. • Parameters of the local geoid model, to convert between orthometric and ellipsoidal heights. This information is not compulsory.
	Area	Especially wide networks with large height differences. Local grid coordinates must be accurate.
	Advantage	• Accuracy of the measurements is maintained.

Transformation	Characteristic	Description
	Disadvantage	• It can be used over any area as long as the local coordinates, including heights, are accurate. • The local ellipsoid and map projection must be known for the local grid coordinates. • 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.
Onestep	Principle	Transforms coordinates directly from WGS 1984 to local grid and vice versa without knowledge about the local ellipsoid or the map projection. Procedure: 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. 2) The results of 1. are preliminary grid coordinates for the WGS 1984 points. 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. 4) The height transformation is a single dimension height approximation.

Transformation	Characteristic	Description
	Positions and heights	The position and height transformations are separated.
	Use	When measurements are to be forced to tie in with local existing control. For example: 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.
	Requirements	• 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. • Additional height information for one point enables the transformation of heights. • Parameters of the local geoid model. This information is not compulsory. • No parameters of the local ellipsoid. • No parameters of the local map projection.
	Area	• 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.

Transformation	Characteristic	Description
	Points and transformation parameters	- For areas without large height differences. The transformation parameters determined depend on the number of available points with position information. - One point: Classic 2D with shift in X and Y. - Two points: Classic 2D with shift in X and Y, rotation about Z and scale. - More than two points: Classic 2D with shift in X and Y, rotation about Z, scale and residuals.
	Points and height transformation	The type of height transformation performed depends on the number of available points with height information. - No point: No height transformation. - One point: Heights are shifted to fit to the height control point. - Two points: Average height shift between the two height control points. - Three points: Tilted plane through the three height control points to approximate the local heights. - More than three points: Best fitting average plane.

Transformation	Characteristic	Description
	Advantage	• Errors in height do not propagate into errors in position since the height and position transformations are separated. • If local heights have low accuracy or do not exist, a transformation of position can still be calculated and vice versa. • The height points and position points do not have to be the same points. • No parameters of the local ellipsoid and map projection is required. • 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.
	Disadvantage	• 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. • The accuracy in height depends on the undulation of the geoid. The bigger the geoid variations the less accurate the results are.

Transformation	Characteristic	Description
Twostep	Principle	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: 1) 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. 2) The coordinates are projected onto a preliminary grid, but this time using the true map projection of the local points. 3) A 2D transformation is applied, exactly as with the Onestep transformation.
	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.
	Requirements	• 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. • Parameters of the local ellipsoid.

Transformation	Characteristic	Description
	Area	- Parameters of the local map projection. - Parameters of a pre-transformation. 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	- Errors in height do not propagate into errors in position since the height and position transformations are separated. - If local heights have low accuracy or do not exist, a transformation of position can still be calculated and vice versa. - The height points and position points do not have to be the same points. - Fits much better over larger areas than a Onestep transformation. Reason:

Transformation	Characteristic	Description
	Disadvantage	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. • The local ellipsoid must be known. • The map projection must be known. • A pre-transformation must be known. A null transformation can be used. • 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.

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 chainage P.

WGS 1984

WGS 1984 is the global geocentric datum to which all GPS positioning information is referred to.

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