Leica TPS1200
Applications
Field Manual

Version 5.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a TPS1200 series instrument.

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

Product identification

The type and the 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 authorized 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

- CompactFlash and CF are trademarks of SanDisk Corporation
- Bluetooth is a registered trademark of Bluetooth SIG, Inc

All other trademarks are the property of their respective owners.

Available documentation

Refer to the following resources for all TPS1200 documentation and software:

- the SmartWorx DVD
- http://www.leica-geosystems.com/downloads

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1 Application Programs - Getting Started

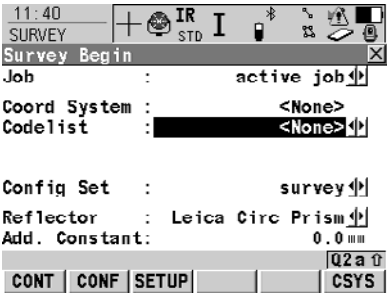
1.1 Starting an Application Program

Access an application program step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select an application program from the menu.
3.	Press **CONT (F1)** to access a **Begin** screen.
☞	Some application programs are protected. They are activated through a specific licence key. This can either be typed in **Main Menu: Tools...\Licence Keys** or the first time the application program is started.
☞	Four application programs can be open at one time. **XX Begin** is shown for the application program opened first, but not for the following application programs.

XX Begin

SURVEY Survey Begin is shown as an example. Additional fields are available for particular application programs.



CONT (F1)
To accept changes and access the subsequent screen.

CONF (F2)
To configure the application program.

SETUP (F3)
To set up the station.

CSYS (F6)
To select a different coordinate system.

Description of fields

Field	Option	Description
<Stakeout Job:>	Choicelist	• Available for Stakeout. • The job containing the points to be staked.
<Fixpoint Job:>	Choicelist	• Available for Traverse. • The job containing points for the control points, to begin, to check and to end the traverse.
<Job:>	Choicelist	• The active job. • For Stakeout and Reference Line: points which are occupied after staking out are stored in this job.

Field	Option	Description
<Coord System:>	Output	• The coordinate system currently attached to the selected **<Job:>**.
<Codelist:>	Choicelist	• No codes are stored in the selected **<Job:>**. All codelists from **Main Menu: Manage...\Codelists** can be selected.
	Output	• Codes have already been stored in the selected **<Job.>**.
<DTM Job:>	Choicelist	• Available for Stakeout if **<Use DTM: DTM only>** and **<Use DTM: DTM & Stake Job>** in **STAKEOUT Configuration**, **Heights** page. • Available for Reference Line if **<Heights: Use DTM Model>** in **REFLINE Configuration, Heights** page. • To select a DTM to be staked and to select the active DTM layer to be used. Heights are then staked out relative to the selected DTM.
<Config Set:>	Choicelist	• The active configuration set.
<Reflector:>	Choicelist	• The active reflector.
<Add. Constant:>	Output	• The additive constant stored with the chosen reflector.

Description of fields for Determine Coordinate System

Field	Option	Description
<Name:>	User input	A unique name for the coordinate system. The name may be up to 16 characters in length and may include spaces. Input is mandatory. ☞ Entering the name of an existing coordinate system will allow that system to be updated.
<WGS84Pts Job:>	Choicelist	The job from which the points with WGS84 coordinates will be taken.
<Local Pts Job:>	Choicelist	The job from which the points with local coordinates will be taken.
<Method:>	Choicelist	Method used to determine the coordinate system.

Next step

IF the application program	THEN
is to be accessed	**CONT (F1)** accepts the changes and starts the application program. Refer to the relevant chapters.
is to be configured	**CONF (F2)**. Refer to the relevant chapters.

1.2 Configuration of a Logfile

Description

A logfile is a summary of the calculations done while using an application program. The logfile is written to the \DATA directory of the CompactFlash card or internal memory if fitted. The creation of a logfile can be activated while configuring an application program.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select an application program from the menu.
3.	Press **CONT (F1)** to access a **Begin** screen.
4.	Press **CONF (F2)** to access **XX Configuration**.
5.	Press **PAGE (F6)** until the **Logfile** page is active.

XX Configuration, Logfile page

Description of fields

Field	Option	Description
<Write Logfile:>	**Yes** or **No**	To generate a logfile when the application program is exited.
<File Name:>	Choicelist	Available for **<Write Logfile: Yes>**. The name of the file to which the data should be written.
<Format File:>	Choicelist	Available for **<Write Logfile: Yes>**. A format file defines which and how data is written to a logfile. Format files are created using LGO.

Next step

PAGE (F6) changes to the first page on this screen.

2 COGO

2.1 Overview

Description

- COGO is an application program for **co**ordinate **geo**metry calculations such as:
  - coordinates of points.
  - distances between points.
  - bearings between points.
- The calculations can be made from:
  - existing point data in the job, known distances or known azimuths.
  - measured points.
  - entered coordinates.

- Changing coordinates of a point which has been previously used in COGO does not result in the point being recomputed.

COGO calculation methods

- The COGO calculation methods are:
  - Inverse.
  - Traverse.
  - Intersections.
  - Line calculations.
  - Arc calculations.
  - Shift, Rotate & Scale (Manual)
  - Shift, Rotate & Scale (Match Pts)
  - Area Division

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.

2.2 Accessing COGO

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **COGO** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **COGO COGO Menu** All COGO calculation methods and the option to end COGO are listed. Select the COGO calculation method to be started.
4.	Press **CONT (F1)** to access the screen for the COGO calculation method.
☞	The screens for each COGO calculation method can be accessed directly by pressing a configured hot key or **USER**. The currently active configuration set and job are used.

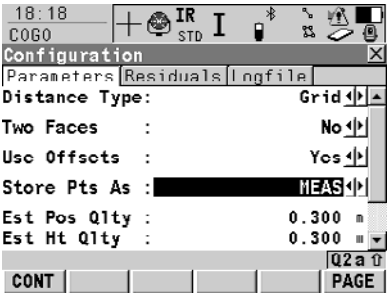
2.3 Configuring COGO

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **COGO** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **COGO Configuration**.

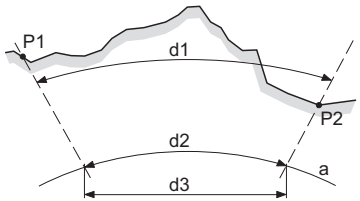
COGO Configuration, Parameters page

The explanations for the softkeys given below are valid for all pages.



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

Description of fields

Field	Option	Description
<Distance Type:>	**Grid**, **Ground** or **Ellipsoid**	The type of distances and offsets to be accepted as input, shown as output and used in the calculation.
 TPS12_170		a Ellipsoid **Known** P1 First known point P2 Second known point **Unknown** d1 Ground distance d2 Ellipsoid distance d3 Grid distance
<Two Faces:>	**Yes** or **No**	Defines if the instrument measures the second face automatically after storing the first or not.
<Use Offsets:>	**Yes** or **No**	Activates the use of offsets in the COGO calculations. Input fields for the offsets are available in **COGO XX**.
<Store Pts As:>	**MEAS** or **CTRL**	To store the cogo point with point class MEAS or with point class CTRL.

Field	Option	Description
		Points stored with point class MEAS can be stored with the same point ID. The averaging functionality (configured under job management) can then be used to calculate an average for these points. Points stored with point class CTRL can only be stored with a unique point ID. A message is always displayed when a point is about to be stored with an already existing point ID. The user can then decide to either keep the existing point or overwrite the existing point.
<Est Pos Qlty:>	User input	The estimated value for the position quality assigned to all calculated COGO points which is used for the averaging calculation.
<Est Ht Qlty:>	User input	The estimated value for the height quality assigned to all calculated heights which is used for the averaging calculation.
When the Intersections method=TPS Obs-TPS Obs, the following fields apply:		
<Compute Ht:>	**Using Average**, **Use Upper Height** or **Use Lower Height**	Defines the height being used.

Next step

PAGE (F6) changes to the **Residuals** page.

COGO Configuration, Residuals page

This page applies to COGO Shift, Rotate & Scale (Match Pts).

Description of fields

Field	Option	Description
<Easting:>, **<Northing:>** or **<Height:>**	User input	The limit above which Easting/Northing/Height residuals will be flagged as possible outliers.
<Residual Distbtn:>		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^{XX}	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.

Next step

PAGE (F6) changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".

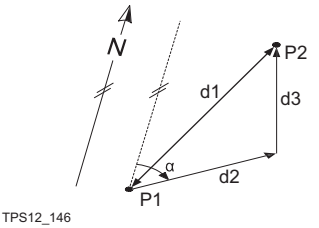
<Azimuth:> is used throughout this chapter. This should always be considered to also mean **<Bearing:>**.

2.4 COGO Calculation - Inverse Method

2.4.1 Overview

Description

It is possible to compute an inverse result between point, line and arc elements:



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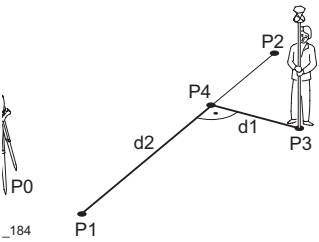
Option 1: inverse between point - point

To compute an inverse between two known points.

Known elements:
- P1 First known point (From)
- P2 Second known point (To)

Unknown elements:
- α Direction from P1 to P2
- d1 Slope distance between P1 and P2
- d2 Horizontal distance between P1 and P2
- d3 Height difference between P1 and P2



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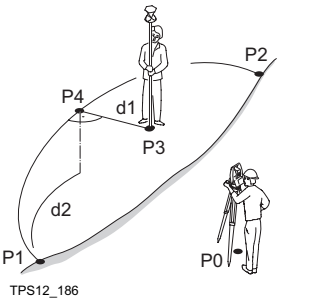
Option 2: inverse between point - line

To compute an inverse between a known point and a given line (the inverse is computed as the perpendicular between the known point and the given line).

Known elements:
- P0 Instrument station
- P1 Starting point
- P2 End point or the direction from P1 to P2
- P3 Offset point

Unknown elements:
- P4 Base point
- d1 The perpendicular offset to the base point
- d2 The distance along the line



TPS12_186

Option 3: inverse between point - arc

To compute an inverse between a known point and a given arc (the inverse is computed as the perpendicular between the known point and the given arc).

Known elements:
- P0 Instrument station
- P1 Starting point
- P2 End point
- P3 Offset point
- P4 Second point or arc radius or arc/chord length

Unknown elements:
- P4 Base point
- d1 The perpendicular offset to the base point
- d2 The distance along the arc

The coordinates of the points must be known. The points:

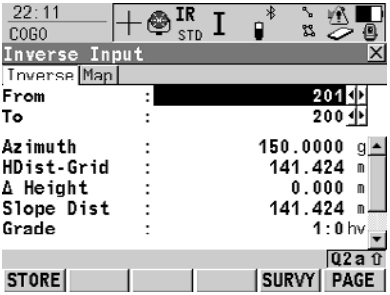
- may be taken from the active job.
- may be measured during the COGO calculation.
- may be entered manually.

2.4.2 Inverse Between Two Known Points

Access

Refer to "2.2 Accessing COGO" to access **COGO Inverse**.

Calculating



STORE (F1)
To store the result.

SURVY (F5)
To measure a known point for the calculation.

SHIFT CONF (F2)
To configure the program.

PAGE (F6)
To change to another page on the screen.

Description of fields

Field	Option	Description
<From:> or <To:>	Choicelist	The point ID of the two known points. To type in coordinates for a known point open the choicelist. Press **NEW (F2)** to create a new point.
<Azimuth:>	Output	The direction from the first point to the second point.
<HDist-XX:>	Output	The horizontal distance between the two points.
<ΔHeight:>	Output	The height difference between the two points.
<Slope Dist:>	Output	The slope distance between the two points.
<Grade:>	Output	The grade between the two points.
<ΔEasting:>	Output	The difference in Easting between the two points.
<ΔNorthing:>	Output	The difference in Northing between the two points.

Storing the results step-by-step

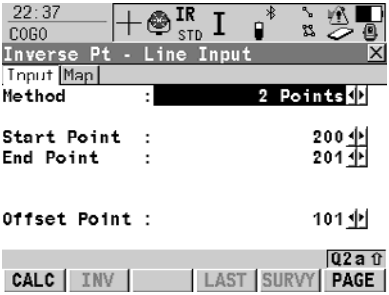
Step	Description
1.	Press **STORE (F1)** to store the inverse result to the active job. There are no points stored to the database, only the inverse result.
2.	Inverse results can be exported from the job using a format file. The format file is created with Format Manager in LEICA Geo Office.

2.4.3 Inverse Between a Known Point and a Line

Access

Refer to "2.2 Accessing COGO" to access **COGO Inverse**.

Calculating



CALC (F1)
To calculate the result.

INV (F2)
To calculate the inverse between two points.

LAST (F4)
To select the values for distance and offset from previous COGO inverse calculations.

SURVY (F5)
To measure a known point for the calculation..

SHIFT CONF (F2)
To configure the program

SHIFT MODIF (F4)
To modify the original azimuth, distance or offset value.

PAGE (F6)
To change to another page on the screen.

Description of fields

Field	Option	Description
<Method:>		**2 Points** or **Pt/Brg/Dist**. The method for calculating the inverse result.
<Start Point:>	Choicelist	The point ID defining the start of the line.
<End Point:>	Choicelist	The point ID defining the end of the line.
<Azimuth:>	Output	The direction from the first point to the second point.
<HDist-XX:>	Output	The horizontal distance between the two points.
<Offset Point:>	Choicelist	The point ID defining an offset to the line.

Storing the results step-by-step

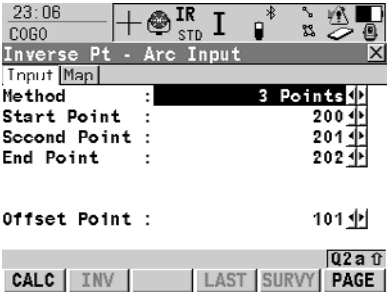
Step	Description
1.	Press **CALC (F1)** to calculate the inverse result.
2.	Press **STORE (F1)** to store the inverse result to the active job. There are no points stored to the database, only the inverse result.
3.	Inverse results can be exported from the job using a format file. The format file is created with Format Manager in LEICA Geo Office.

2.4.4 Inverse Between a Known Point and an Arc

Access

Refer to "2.2 Accessing COGO" to access **COGO Inverse**.

Calculating



CALC (F1)
To calculate the result.

INV (F2)
To calculate the inverse between two points.

LAST (F4)
To select the values for distance and offset from previous COGO Inverse calculations.

SURVY (F5)
To measure a known point for the calculation.

SHIFT CONF (F2)
To configure the program.

SHIFT MODIF (F4)
To modify the original azimuth, distance or offset value.

PAGE (F6)
To change to another page on the screen.

Description of fields

Field	Option	Description
<Method:>		**3 Points** or **2 Points/Radius** or **2 Tgnts/Radius** or **2 Tgnts/Arc Lngt** or **2 Tgnts/Chrd Lngt**. The method for calculating the inverse result.
<Start Point:>	Choicelist	The point ID defining the start of the arc.
<Second Point:>	Choicelist	The point ID defining a second point on the arc.
<End Point:>	Choicelist	The point ID defining the end of the arc.
<Arc Length:>	User Input	The arc length.
<Azimuth:>	Output	The direction from the first point to the second point.
<Chord length:>	User Input	The chord length of the arc.
<HDist-XX:>	Output	The horizontal distance between the two points.
<Offset Point:>	Choicelist	The point ID defining an offset to the arc.
<PI Point:>	Choicelist	The point ID defining the intersection of the tangents.

Field	Option	Description
<Point 1:>	Choicelist	The point ID (with PI Point) defining the 1st tangent.
<Point 2:>	Choicelist	The point ID (with PI Point) defining the 2nd tangent.
<Radius:>	User Input	The radius of the arc.

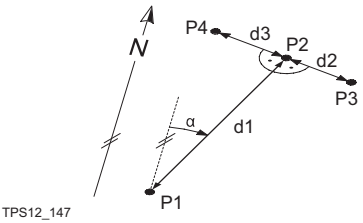
Storing the results step-by-step

Step	Description
1.	Press **CALC (F1)** to calculate the inverse result.
2.	Press **STORE (F1)** to store the inverse result to the active job. There are no points stored to the database, only the inverse result.
3.	Inverse results can be exported from the job using a format file. The format file is created with Format Manager in LEICA Geo Office.

2.5 COGO Calculation - Traverse Method

Diagram

COGO traverse calculation with offset for a single point



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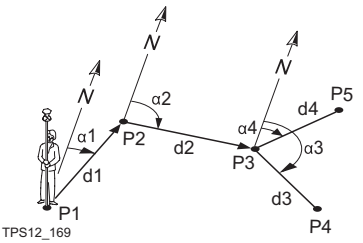
Known

P1	Known point
α	Direction from P1 to P2
d1	Distance between P1 and P2
d2	Positive offset to the right
d3	Negative offset to the left

Unknown

P2	COGO point without offset
P3	COGO point with positive offset
P4	COGO point with negative offset

COGO traverse calculation without offset for multiple points



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Known

P1	Known point
α1	Direction from P1 to P2
α2	Direction from P2 to P3
α3	Direction from P3 to P4
α4	Direction from P3 to P5
d1	Distance between P1 and P2
d2	Distance between P2 and P3
d3	Distance between P3 and P4
d4	Distance between P3 and P5

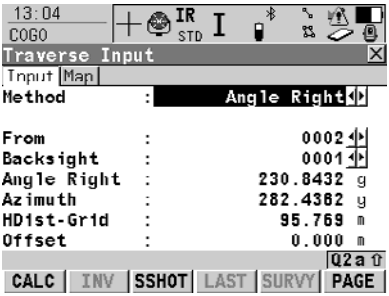
Unknown

P2	First COGO point
P3	Second COGO point
P4	Third COGO point - sideshot
P5	Fourth COGO point

Access

Refer to "2.2 Accessing COGO" to access **COGO Traverse Input**.

COGO Traverse Input, Input page



CALC (F1)
To calculate the COGO point.

INV (F2)
To calculate the values for the azimuth, distance and the offset from two existing points. Available if **<Azimuth:>**, **<HDist-XX:>** or **<Offset:>** is highlighted.

SSHOT (F3)
To calculate the point as a sideshot.

LAST (F4)
To select the values for the distance and the offset from previous COGO inverse calculations. Available if **<Azimuth:>**, **<HDist-XX:>** or **<Offset:>** is highlighted.

SURVY (F5)
To measure a point for the COGO calculation. Available if **<From:>** or **<Backsight:>** is highlighted.

SHIFT CONF (F2)
To configure the COGO application program.

SHIFT MODIF (F4)
To type in numbers for the multiplication, division, addition and subtraction with the original azimuth, distance or offset value. The standard rules of mathematical operations apply. Available if **<Azimuth:>**, **<Angle Right:>**, **<HDist-XX:>** or **<Offset:>** is highlighted.

Description of fields

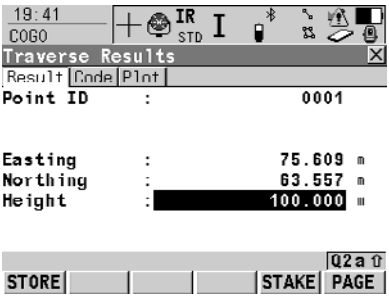
Field	Option	Description
<Method:>	**Azimuth** or **Angle Right**	The direction from the known point to the COGO point.
<From:>	Choicelist	The point ID of the known point. ☞ To type in coordinates for a known point open the choicelist when **<From:>** is highlighted. Press **NEW (F2)** to create a new point.
<Backsight:>	Choicelist	The point ID of a point used as backsight. Available for **<Method: Angle Right>**.
<Angle Right:>	User input	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 counter clockwise angles. Available for **<Method: Angle Right>**.
<Azimuth:>	Output	The direction from the known point to the COGO point. For **<Method: Angle Right>** this is calculated from **<Angle Right:>**.

Field	Option	Description
<HDist-XX:>	User input	The horizontal distance between the known point and the COGO point.
<Offset:>	User input	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.

Next step
CALC (F1) calculates the result and accesses **COGO Traverse Results**.

COGO Traverse Results, Result page

The calculated coordinates are displayed.



STORE (F1)
To store the result and return to **COGO Traverse Input**, **Input** page.

COORD (F2)
To view other coordinate types unless **<Coord System: None>**.

STAKE (F5)
To access the Stakeout application program and stake out the calculated COGO point.

SHIFT INDIV (F5) or **SHIFT RUN (F5)**
To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template.

SHIFT QUIT (F6)
Does not store the COGO point and exits COGO calculation.

Description of fields

Field	Option	Description
<Point ID:>	User input	The identifier for the COGO point depending on the point ID template configured. The point ID can be changed. • To start a new sequence of point ID's overtype the point ID. • **SHIFT INDIV (F5)** for an individual point ID independent of the ID template. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.

Next step
PAGE (F6) changes to the **Code** page.

COGO
Traverse Results
Code page

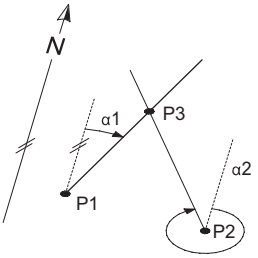
The settings for **<Thematc Codes:>** in **CONFIGURE Coding & Linework** determines the availability of the fields and softkeys. They are identical to those of thematical coding with/without codelist. Refer to "TPS1200 System Field Manual" for information on coding.

Next step
PAGE (F6) changes to the **Plot** page.

2.6 COGO Calculation - Intersections Method

Diagram

Bearing - Bearing

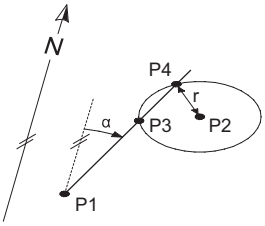


TPS12_148

Known
- P1 First known point
- P2 Second known point
- α1 Direction from P1 to P3
- α2 Direction from P2 to P3

Unknown
- P3 COGO point

Bearing - Distance

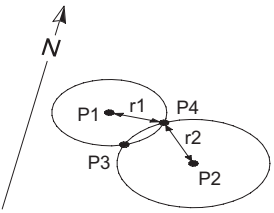


TPS12_149

Known
- P1 First known point
- P2 Second known point
- α Direction from P1 to P3 and P4
- r Radius, as defined by the distance from P2 to P4 and P3

Unknown
- P3 First COGO point
- P4 Second COGO point

Distance - Distance

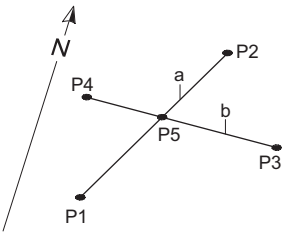


TPS12_150

Known
- P1 First known point
- P2 Second known point
- r1 Radius, as defined by the distance from P1 to P3 or P4
- r2 Radius, as defined by the distance from P2 to P3 or P4

Unknown
- P3 First COGO point
- P4 Second COGO point

By Points

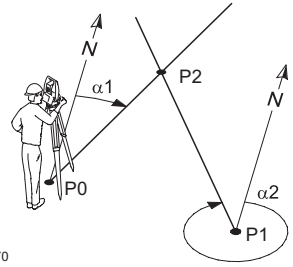


TPS12_151

Known
- P1 First known point
- P2 Second known point
- P3 Third known point
- P4 Fourth known point
- a Line from P1 to P2
- b Line from P3 to P4

Unknown
- P5 COGO point

TPS Observation - TPS Observation



GPS12_170

Known
P0 First known point (TPS Stn)
P1 Second known point (TPS Stn)
á1 Direction from P0 to P2
á2 Direction from P1 to P2
Unknown
P2 COGO point

Access

Refer to "2.2 Accessing COGO" to access **COGO Intersection Input**.

COGO Intersection Input, Input page

The setting for **<Method:>** in this screen determines the availability of the subsequent fields and softkeys. The softkeys are identical to those available for traverse COGO calculations. Refer to "2.5 COGO Calculation - Traverse Method" for information on the softkeys.

Description of fields

Field	Option	Description
<Method:>	Choicelist	The type of intersection COGO calculation.
<1st Point:>, **<2nd Point:>**, **<3rd Point:>** or **<4th Point:>**	Choicelist	The point ID of the known point. For **<Method: By Points>**, these are the start and end points of the lines. ☞ To type in coordinates for a known point open the choicelist when this field is highlighted. Press **NEW (F2)** to create a new point.
<1st TPS Stn:> or **<2nd TPS Stn:>**	Choicelist	Only for **<Method: TPS Obs- TPS Obs>**. The point ID of the known point.
<TPS Measmnt:>	Choicelist	Only for **<Method: TPS Obs- TPS Obs>**. The point ID of the TPS measurement made from the selected station for **<1st TPS Stn:>** or **<2nd TPS Stn:>**.
<Azimuth:>	User input	The direction from the first known point to the COGO point. For **<Method: Brng & Brng>** and **<Method: Brng & Dist>**. For **<Method: TPS Obs- TPS Obs>** the option is an output field.
<Offset:>	User input	Input optional.

Field	Option	Description
	User input	• For **<Method: Brng & Brng>** and **<Method: Brng & Dist>**. 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. • For **<Method: By Points>**: The offset of the line in the direction start point to end point. A positive offset is to the right, a negative offset is to the left.
<HDist-XX:>	User input	The horizontal distance between the two known points. Available for **<Method: Brng & Dist>** and **<Method: Dist & Dist>**.

Next step

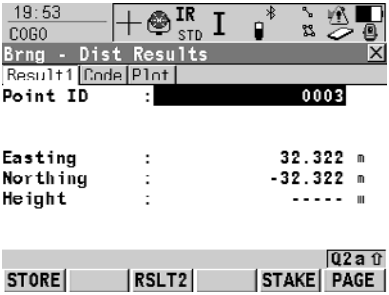
CALC (F1) calculates the result and accesses **COGO XX Results**.

For **<Method: Brng - Dist>**, two results are calculated. They are displayed on the **Result1** page and the **Result2** page. For simplicity, the title **Result** is used in the following.

COGO XX Results, Result page

The calculated coordinates are displayed.

The majority of softkeys is identical to those available for traverse COGO calculations. Refer to "2.5 COGO Calculation - Traverse Method" for information on the identical softkeys.



STORE (F1)
To store the result and return to **COGO Intersection Input**, **Input** page. For **<Method: Brng - Dist>**, each result must be stored individually on the relevant page.

RSLT1 (F3) or **RSLT2 (F3)**
To view the first and second result. Available for **<Method: Brng - Dist>**.

STAKE (F5)
To access the Stakeout application program and stake out the calculated COGO point.

Description of fields

Field	Option	Description
<Point ID:>	User input	The identifier for the COGO point depending on the point ID template configured. The point ID can be changed. • To start a new sequence of point ID's overtype the point ID. • **SHIFT INDIV (F5)** for an individual point ID independent of the ID template. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.
<Ortho Ht:> or **<Local Ell Ht:>**	User input	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. For **<Method: TPS Obs- TPS Obs>** the option is an output field.
<Ht Computed:>	Output	The height modus being used in the COGO calculation.

Next step
PAGE (F6) changes to the **Code** page.

COGO XX Results, Code page

The settings for **<Thematc Codes:>** in **CONFIGURE Coding & Linework** determines the availability of the fields and softkeys. They are identical to those of thematical coding with/without codelist. Refer to TPS1200 Technical Reference Manual for information on coding.

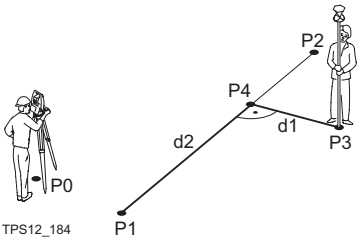
Next step
PAGE (F6) changes to the **Plot** page.

2.7 COGO Calculation - Line/Arc Calculations Method

The functionality of all screens and fields are similar for both the COGO line and COGO arc calculations. For simplicity, both COGO calculation methods are explained in this chapter. The screen names, field names and explanations for lines are used. If required, additional information is given for COGO arc calculations.

Diagrams Line Calculation

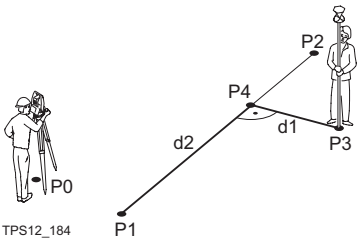
Base Point



TPS12_184

Known
P0 Instrument station
P1 **<Start Point:>**
P2 **<End Point:>**
P3 **<Offset Point:>**
Unknown
P4 Base point
d1 **<Offset-XX:>**
d2 **<ΔLine-XX:>**

Offset Point



TPS12_184

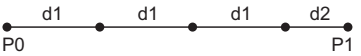
Known
P0 Instrument station
P1 **<Start Point:>**
P2 **<End Point:>**
d1 **<Offset-XX:>**
d2 **<ΔLine-XX:>**
Unknown
P3 **<Offset Point:>**
P4 Base point

Segmentation

GPS12_144

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.



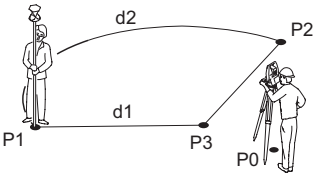
GPS12_145

Line divided by
<Method: Segment Length>

P0 **<Start Point:>**
P1 **<End Point:>**
d1 **<Seg Length:>**
d2 Remaining segment

Diagrams
Arc Calculation

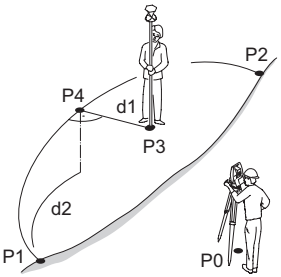
Arc Center



TPS12_217

Known
P0 Instrument station
P1 **<Start Point:>**
P2 **<End Point:>**
Unknown
P3 Arc center
d1 **<Arc Radius:>**
d2 **<Arc Length:>**

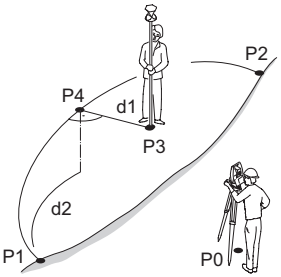
Base Point



TPS12_186

Known
P0 Instrument station
P1 **<Start Point:>**
P2 **<End Point:>**
P3 **<Offset Point:>**
Unknown
P4 Base point
d1 **<ΔOffset-XX:>**
d2 **<ΔArcDist-XX:>**

Offset Point



TPS12_186

Known
P0 Instrument station
P1 **<Start Point:>**
P2 **<End Point:>**
d1 **<ΔOffset-XX:>**
d2 **<ΔArcDist-XX:>**
Unknown
P3 **<Offset Point:>**
P4 Base point

Access

Refer to "2.2 Accessing COGO" to access **COGO Line Calculations Input**.

COGO
Line Calculations
Input,
Input page

- The setting for **<Task:>** and **<Method:>** in this screen determines the availability of the subsequent fields.
- The softkeys are identical to those available for traverse COGO calculations. Refer to "2.5 COGO Calculation - Traverse Method" for information on the softkeys.

Description of fields

Field	Option	Description
<Task:>	Choicelist	The type of line/arc COGO calculation.
<Method:>		The method by which the line will be defined.

Field	Option	Description
	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 Tgnts/Radius	Defines the arc using two tangents and a radius of the arc.
	2 Tgnts/Arc Lngt	Defines the arc using two tangents and the length of the arc.
	2 Tgnts/Chrd Lngt	Defines the arc using two tangents and the chord of the arc.
<Start Point:>	Choicelist	The start point of the line.
<Second Point:>	Choicelist	The second point of the arc.
<End Point:>	Choicelist	The end point of the line. Available for **<Method: 2 Points>**.
<Point 1:>	Choicelist	A point on the first tangent. Available for **<Method: 2 Tgnts/Radius>**, **<Method: 2 Tgnts/Arc Lngt>** and **<Method: 2 Tgnts/Chrd Lngt>**.
<PI Point:>	Choicelist	The point of intersection of the two tangents. Available for **<Method: 2 Tgnts/Radius>**, **<Method: 2 Tgnts/Arc Lngt>** and **<Method: 2 Tgnts/Chrd Lngt>**.
<Point 2:>	Choicelist	A point on the second tangent. Available for **<Method: 2 Tgnts/Radius>**, **<Method: 2 Tgnts/Arc Lngt>** and **<Method: 2 Tgnts/Chrd Lngt>**.
<Azimuth:>	User input	The azimuth of the line. Available **<Method: Pt/Brg/Dist>**.
<HDist-XX:>	User input	The horizontal distance from the start point to the end point of the line. Available for **<Method: Pt/Brg/Dist>**.
<Radius:>	User input	The radius of the arc. Available for **<Method: 2 Points/Radius>**.
<Arc Length:>	User input	The length of the arc. Available for **<Method: 2 Tgnts/Arc Lngt>**.
<Chord Length:>	User input	The length of the chord. Available for **<Method: 2 Tgnts/Chrd Lngt>**.
<Offset Point:>	Choicelist	The offset point. Available for **<Task: Calc Base Point>**.
<ΔLine-XX:>	User input	Horizontal distance from start point to base point. Available for **<Task: Calc Offset Point>**.

Field	Option	Description
<ΔArcDist-XX:>	User input	Horizontal distance along the arc from start point to base point. Available for **<Task: Calc Offset Point>**.
<Offset-XX:>	User input	Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for **<Task: Calc Offset Point>**.
<ΔOffset-XX:>	User input	Offset from base point to offset point. Positive to the right and negative to the left of the arc. Available for **<Task: Calc Offset Point>**.

Next step

IF	THEN
<Task: Calc Arc Center>, **<Task: Calc Base Point>** or **<Task: Calc Offset Point>**	**CALC (F1)** calculates the result. Refer to paragraph "COGO XX Results, Result page".
<Task: Segmentation>	**CALC (F1)** accesses **COGO Define Segmentation**. Refer to paragraph "COGO Define Segmentation".

COGO XX Results, Result page

- The calculated coordinates are displayed.
- The softkeys are identical to those available for traverse COGO calculations. Refer to "2.5 COGO Calculation - Traverse Method" for information on the softkeys.

Description of fields

Field	Option	Description
<Point ID:>	User input	The identifier for the COGO point. The configured point ID template is used. The ID can be changed: • To start a new sequence of point ID's overtype the point ID. • For an individual point ID independent of the ID template **SHIFT INDIV (F5)**. **SHIFT RUN (F5)** changes back to the next free ID from the configured ID template.
<Ortho Ht:> or **<Local Ell Ht:>**	User input	---- is displayed when entering the **Result** page. A height value to be stored with the calculated point can be typed in.
<Offset Point:>	Output	Point ID of offset point. Available for **<Task: Calc Base Point>**.

Field	Option	Description
<ΔLine-XX:>	Output	Horizontal distance from start point to base point. Available for **<Task: Calc Base Point>**.
<ΔArcDist-XX:>	Output	Horizontal distance along the arc from start point to base point. Available for **<Task: Calc Base Point>**.
<ΔOffset-XX:>	Output	Offset from base point to offset point. Positive to the right and negative to the left of the line. Available for **<Task: Calc Base Point>**.
<Line Length:>	Output	Length of line from start point to end point. Available for **<Task: Calc Offset Point>**.
<Line Brng:>	Output	Bearing of line from start point to end point. Available for **<Task: Calc Offset Point>**.
<Arc Radius:>	Output	Computed radius of arc. Available for **<Task: Calc Arc Center>** and **<Task: Calc Offset Point>**.
<Arc Length:>	Output	Computed length of arc. Available for **<Task: Calc Arc Center>** and **<Task: Calc Offset Point>**.
<Offs Pt Brng:>	Output	Bearing of offset point from base point to offset point. Available for **<Task: Calc Offset Point>**.

Next step

PAGE (F6) changes to the **Code** page.

COGO XX Results, Code page

The setting for **<Thematc Codes:>** in **CONFIGURE Coding & Linework** determines the availability of the fields and softkeys. They are identical to those of thematical coding with/without codelist. Refer to the TPS1200 Technical Reference Manual for information on coding.

Next step

PAGE (F6) changes to the **Plot** page.

COGO Define Segmentation

Description of fields

Field	Option	Description
<Method:>		How the line is to be divided. Refer to paragraph "Diagrams Line Calculation".
	Delta Angle	To divide the arc by an angular value.
<Line Length:>	Output	Calculated line length between the selected **<Start Point:>** and **<End Point:>**.

Field	Option	Description
<Arc Length:>	Output	Computed length of arc.
<No. of Segs:>	User input or output	The number of segments for the line.
<Seg Length:>	User input or output	The calculated length of each segment or the required segment length.
<Last Seg Lgth:>	Output	Available for **<Method: Segment Length>**. The length of the remaining segment.
<Delta Angle:>	User input	The angular value by which new points will be defined on the arc.
<Start PtID:>	User input	The point ID to be assigned to the first new point on the line.
<PtID Inc:>	User input	**<Start PtID:>** is incremented numerically for the second, third, etc. point on the line.

Next step
CALC (F1) to access **COGO Segmentation Results**.

COGO Segmentation Results

The coordinates of the new points are calculated. The heights are computed along the line assuming a linear slope between **<Start Point:>** and **<End Point:>**.

Field	Option	Description
<Number of Segments:>	Output	Describes the number of resulting segments for the line including the remaining segment, if it applies.
<Last Segment Lgth:>	Output	Available for **<Method: Segment Length>**. The length of the remaining segment.

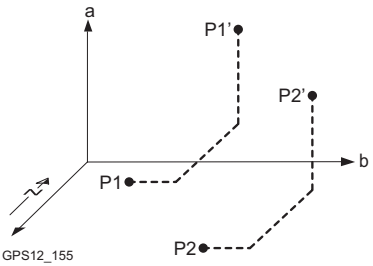
Next step
PAGE (F6) changes to the **Plot** page.

2.8 COGO Calculation - Shift, Rotate & Scale (Manual) Method

Description

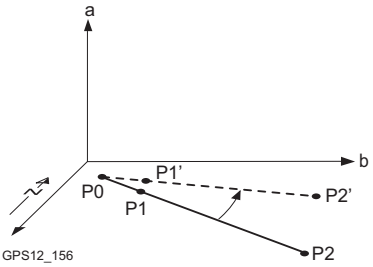
The COGO calculation shift, rotate & scale (manual) applies shifts and/or rotation and/or scale to one or several known points. The values for shifts and/or rotation and/or scale are typed in manually.

Diagrams



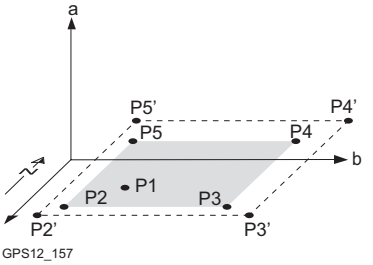
Shift

a	Height
b	Easting
P1-P2	Known point
P1'-P2'	Shifted point



Rotation

a	Height
b	Easting
P0	**<Rotation Pt:>**
P1-P2	Known point
P1'-P2'	Rotated point



Scale

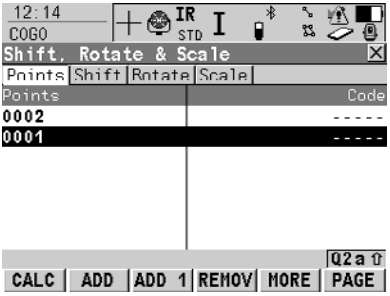
a	Height
b	Easting
P1	**<Rotation Pt:>**, can be held fixed, all other points are then scaled from here
P2-P5	Known point
P2'-P5'	Scaled point

Access

Refer to "2.2 Accessing COGO" to access **COGO Shift, Rotate & Scale**.

COGO Shift, Rotate & Scale, Points page

Listed are points which have been selected for shifting, rotating and/or scaling.



CALC (F1)
To perform the shift, rotation and scale calculation and to continue with the subsequent screen. Calculated COGO points are not yet stored.

ADD (F2)
To add several points from the active job to the list. Selected sort and filter settings apply.

ADD 1 (F3)
To add one point from the active job to the list. Selected sort and filter settings apply.

REMOV (F4)
To remove the highlighted point from the list. The point itself is not deleted.

MORE (F5)
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.

SHIFT REM A (F4)
To remove all points from the list. The points itself are not deleted.

SHIFT RANGE (F5)
To define a range of points from the active job to be added to the list.

Next step
PAGE (F1) accesses **COGO Shift, Rotate & Scale**, **Shift** page.

COGO Shift, Rotate & Scale, Shift page

- The setting for **<Method:>** in this screen determines the availability of the subsequent fields.
- The softkeys are identical to those available for traverse COGO calculations. Refer to "2.5 COGO Calculation - Traverse Method" for information on the softkeys.

Description of fields

Field	Option	Description
<Method:>	Choicelist	The method by which the shift in Δ Easting, Δ Northing and Δ Height will be determined.
<From:>	Choicelist	Available for **<Method: Use 2 Points>**. The point ID of the first known point for calculating the shift.

Field	Option	Description
<To:>	Choicelist	Available for **<Method: Use 2 Points>**. The point ID of the second known point for calculating the shift.
<Azimuth:>	User input	Available for **<Method: Enter Bng,Dst,Ht>**. The azimuth defines the direction of the shift.
<HDist-XX:>	User input	Available for **<Method: Enter Bng,Dst,Ht>**. The amount of shift from the original point to the calculated COGO points.
<Δ Easting:>	User input or output	The amount of shift in East direction.
<Δ Northing:>	User input or output	The amount of shift in North direction.
<Δ Height:>	User input or output	The amount of shift in height.

Next step
PAGE (F6) accesses **COGO Shift, Rotate & Scale**, **Rotate** page.

COGO Shift, Rotate & Scale, Rotate page

- The softkeys are identical to those available for traverse COGO calculations.
- Refer to "2.5 COGO Calculation - Traverse Method" for information on the softkeys.

Description of fields

Field	Option	Description
<Method:>	Choicelist	The method by which the rotation angle will be determined.
<Rotation Pt:>	Choicelist	The point around which all points will be rotated.
<Existing Az:>	User input	Available for **<Method: Computed>**. A known direction before rotating.
<New Azimuth:>	User input	Available for **<Method: Computed>**. A known direction after rotating.
<Rotation:>	User input or output	The amount by which the points will be rotated.

Next step
PAGE (F6) accesses **COGO Shift, Rotate & Scale**, **Scale** page.

COGO Shift, Rotate & Scale, Scale page

The softkeys are identical to those available for traverse COGO calculations. Refer to "2.5 COGO Calculation - Traverse Method" for information on the softkeys.

Description of fields

Field	Option	Description
<Method:>	Choicelist	The method by which the scale factor will be determined.
<Existing Dist:>	User input	Available for **<Method: Computed>**. A known distance before scaling. This value is used for calculating the scale factor.
<New Dist:>	User input	Available for **<Method: Computed>**. A known distance after scaling. This value is used for calculating the scale factor.
<Scale:>	User input or output	The scale factor used in the calculation.
<Scale From Pt:>	**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 Pt:>** selected on the **Rotation** page. The coordinates of **<Rotation Pt:>** will not change.

Next step

CALC (F1) performs the shift, rotation and scale calculation and accesses **COGO Shift, Rotate & Scale Store**.

COGO Shift, Rotate & Scale Store, General page

Description of fields

Field	Option	Description
<Pts Selected:>	Output	The number of selected points having been shifted, rotated and/or scaled.
<Store Job:>	Choicelist	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 additional identifiers for the point ID's of the calculated COGO points.
<Identifier:>	User input	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 **<Identifier:>** in front of the original point ID's.

Field	Option	Description
	Suffix	Adds the setting for **<Identifier:>** at the end of the original point ID's.

Next step
STORE (F1) accesses **COGO Shift, Rotate & Scale Results**, **Result** page.

COGO Shift, Rotate & Scale Results Result page

Description of fields

Field	Option	Description
<No. of New Pts:>	Output	Number of new points created.
<No. of Skipped Pts>	Output	Number of points which were skipped either due to not being able to convert coordinates or points with identical point ID's already existed in **<Store Job:>**.

Next step
CONT (F1) returns to **COGO Shift, Rotate & Scale**.

2.9 COGO Calculation - Shift, Rotate & Scale (Match Pts) Method

Description

The COGO calculation shift, rotate & scale (match pts) 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 tranformation.

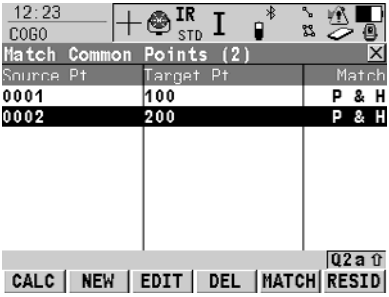
The number of pairs of points matched determines whether the shift, rotation and scale values are computed.

Access

Refer to "2.2 Accessing COGO" to access **COGO Match Common Points (n)**.

COGO Match Common Points (n)

This screen provides a list of points chosen from the active job. The points are used for the determination of the 2D Helmert transformation. Unless there is no pair of matching points in the list all softkeys are available.



CALC (F1)
To confirm the selections, compute the transformation and continue with the subsequent screen.

NEW (F2)
To match a new pair of points. This pair is added to the list. A new point can be manually occupied. Refer to paragraph "Match points step-by-step".

EDIT (F3)
To edit the highlighted pair of matched points.

DEL (F4)
To delete the highlighted pair of matched points from the list.

MATCH (F5)
To change the type of match for a highlighted pair of matched points.

RESID (F6)
To display a list of the matched points used in the transformation calculation and their associated residuals.

SHIFT PARAM (F5)
To define the parameters to be used in the 2D transformation. Refer to paragraph "Fix parameters".

Description of columns

Column	Description
Source Pt	The point ID of the points of origin for the calculation of the shifts and/or rotation and/or scale.
Target Pt	The point ID of the target points for the calculation of the shifts and/or rotation and/or scale.

Column	Description
Match	The type of match to be made between the points. This information is used in the transformation calculation. **P**osition **& H**eight, **P**osition **only**, **H**eight **only** or **None**. **None** removes matched common points from the transformation calculation but does not delete them from the list. This can be used to help improve residuals.

Next step

CALC (F1). The calculated shift, rotation and scale values are displayed in **COGO Shift, Rotate & Scale**. They cannot be edited. The remaining functionality of the calculation is very similar to COGO calculation shift, rotate & scale (manual). Refer to "2.8 COGO Calculation - Shift, Rotate & Scale (Manual) Method".

Match points step-by-step

Matching new points and editing matched points is very similar.

Step	Description
1.	Refer to "2.2 Accessing COGO" to access **COGO Match Common Points**.
2.	**NEW (F2)** or **EDIT (F3)**
3.	**COGO Choose Matching Points** or **COGO Edit Matching Points** **<Source Pt:>** A point of origin for the calculation of the shifts and/or rotation and/or scale. **<Target Pt:>** 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 in **<Source Pt:>** and **<Target Pt:>**. **Pos**ition **& Height**, **Pos**ition **Only**, **Height Only** or **None**. Select the points to be matched.
☞	**SURVY (F5)**. To manually occupy a point and store it in the active job.
4.	**CONT (F1)** returns to **COGO Match Common Points (n)** and adds a new pair of matched points to the matched points list.

Fix parameters

The values for fixing the shifts, the rotation and the scale are displayed.

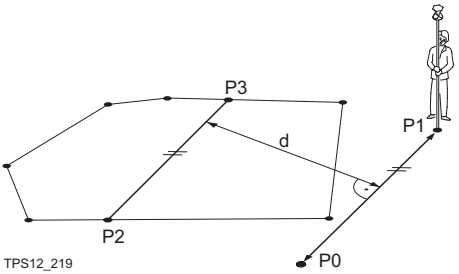
Next step

IF	AND	THEN
a field displays -----	the parameter needs to be fixed to a value	highlight the field. Enter the value of the parameter. **FIX (F4)**.
a field displays a value	the parameter needs to be calculated	highlight the field. **ADJST (F4)**.
all parameters are configured	-	**CONT (F1)** to return to **COGO Match Common Points (n)**.

2.10 COGO Calculation - Area Division

Diagrams

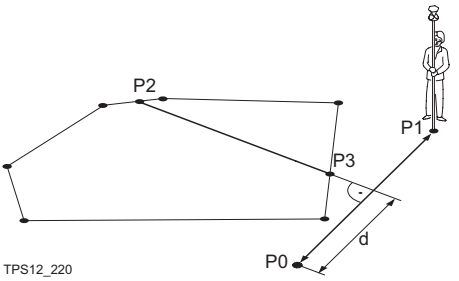
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Parallel Line**	**By Distance**
2.	**By Percentage**	**Parallel Line**	-
3.	**By Area**	**Parallel Line**	-



TPS12_219

P0 **<Point A:>** of defined line
P1 **<Point B:>** of defined line
P2 First new COGO point
P3 Second new COGO point
d **<HDist-XX:>**

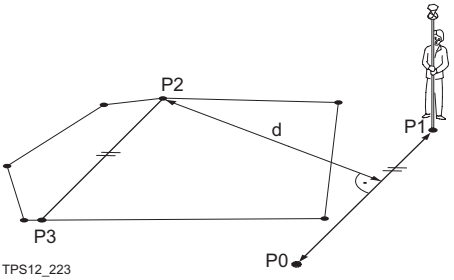
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Perpendic Line**	**By Distance**
2.	**By Percentage**	**Perpendic Line**	-
3.	**By Area**	**Perpendic Line**	-



TPS12_220

P0 **<Point A:>** of defined line
P1 **<Point B:>** of defined line
P2 First new COGO point
P3 Second new COGO point
d **<HDist-XX:>**

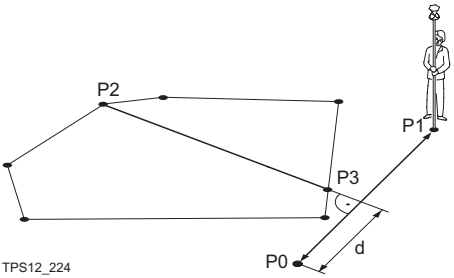
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Parallel Line**	**Through Point**



TPS12_223

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 **<HDist-XX:>**

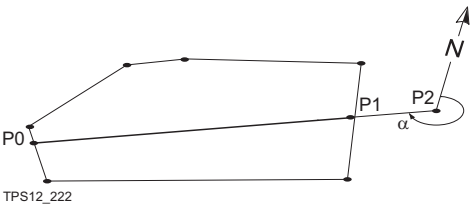
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Perpendic Line**	**Through Point**



TPS12_224

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 **<HDist-XX:>**

Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Percentage**	**Swing Line**	-
2.	**By Area**	**Swing Line**	-



TPS12_222

P0 First new COGO point
P1 Second new COGO point
P2 **<Rotation Pnt:>**
α **<Azimuth:>**

Access Refer to "2.2 Accessing COGO" to access **COGO Choose Area to be Divided**.

COGO
Choose Area to be Divided

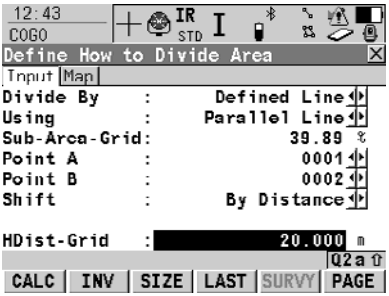
Description of fields

Field	Option	Description
<Area to Use:>	**Select Existing**	To use an area from the **<Job:>** selected in **COGO COGO Begin**. 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.
<Area ID:>	Choicelist or user input	To select the area to be divided or to enter a name for the new area.
<No. of Points:>	Output	Number of points forming the area.
<Area:>	Output	The size of the selected area.
<Perimeter:>	Output	The perimeter of the area.

Next step

IF	THEN
<Area to Use: Select Existing>	**CONT (F1)** accesses **COGO Define How to Divide Area**. Refer to paragraph "COGO Define How to Divide Area, Input page".
<Area to Use: Survey New Area>	**CONT (F1)** accesses **COGO Survey: Job Name**. Points to be added to the new area can be surveyed. **COGO Survey: Job Name** • To stop surveying the area and to store the area: **DONE (F4)** and then **STORE (F1)**. • To return to **COGO Choose Area to be Divided**: **ESC**.

COGO
Define How to Divide Area, Input page



CALC (F1)
To perform the area division and to continue with the subsequent screen. Calculated COGO points are not yet stored.

INV (F2)
To calculate the value for the distance from two existing points. Available if **<HDist-XX:>** is highlighted.

SIZE (F3) and **PERC (F3)**
To display the size and the percentage of the sub-area.

LAST (F4)
To select the value for the distance from previous COGO inverse calculations. Available if **<HDist-XX:>** is highlighted.

SURVY (F5)
To manually occupy a point for the COGO calculation. Available if **<Point A:>**, **<Point B:>**, **<Rotation Pnt:>** or **<Through Point:>** is highlighted.

SHIFT CONF (F2)
To configure the COGO application program.

Description of fields

Field	Option	Description
<Divide By:>	Choicelist	This field defines how the size of the sub area is defined.
<Using:>	**Parallel Line**	The border will be parallel to a line defined by **<Point A:>** and **<Point B:>**.
	Perpendic Line	The border will be perpendicular to a line defined by **<Point A:>** and **<Point B:>**.
	Swing Line	The border will be a line rotated around **<Rotation Pnt:>** by **<Azimuth:>**.
<Sub-Area-XX:>	User input	For **<Divide By: Percentage>** and **<Divide By: Area>**. The size of the sub area must be typed either in % or in m^2. 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 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 Pnt:>** and the **<Azimuth:>**. The sub area is always to the left of the new dividing line.
	Output	For **<Divide By: Defined Line>**. The size of the sub area is calculated and displayed.
<Point A:>	Choicelist	The first point of the line which is used as the reference for a new parallel or perpendicular border.

Field	Option	Description
<Point B:>	Choicelist	The second point of the line which is used as the reference for a new parallel or perpendicular border.
<Shift:>		Available for **<Divide By: Defined Line>**.
	By Distance	The new border will run in a certain distance from the line defined by **<Point A:>** and **<Point B:>**.
	Through Point	The new border will run through a point defined in **<Through Point:>**.
<Through Point:>	Choicelist	Available for **<Shift: Through Point>**. The point through which the new border will run.
<Rotation Pnt:>	Choicelist	Available for **<Using: Swing Line>**. The point around which the new border will rotate by **<Azimuth:>**.
<Azimuth:>	Output	Available for **<Using: Swing Line>**. The angle of the new border from **<Rotation Pnt:>** to the new COGO point.
<HDist-XX:>	User input or output	The distance from the line defined by **<Point A:>** and **<Point B:>** to the new border.

Next step

CALC (F1) performs the area division and accesses **COGO Results of Area Division**.

COGO Results of Area Division, Result page

Description of fields

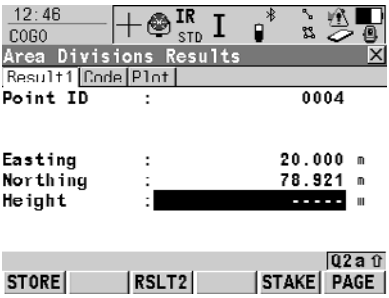
Field	Option	Description
<Area Ratio:>	Output	The ratio of the size of the two sub areas in percent.
<Area 1-XX:>	Output	The size of the first sub area in m^2.
<Area 2-XX:>	Output	The size of the second sub area in m^2.

Next step

CONT (F1) accesses **COGO Area Division Results**.

COGO Area Division Results, ResultX page

The coordinates of the intersection points of the new border with the original area are displayed.



STORE (F1)
To store the two results and to return to **COGO Choose Area to be Divided** once both points are stored.

COORD (F2)
To view other coordinate types.

RSLT1 (F3) or **RSLT2 (F3)**
To view the first and second result.

STAKE (F5)
To access the Stakeout application program and stake out the calculated COGO point.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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 step

STORE (F1) stores the results and accesses **COGO Choose Area to be Divided**. For **<Write Logfile: Yes>** in **COGO Configuration**, **Logfile** page the result is written to the logfile.

3 Determine Coordinate System - General

3.1 Overview

Description

- GPS measured points are always stored based on the global geocentric datum known as WGS 1984. Using GPS measured points with the TPS1200 requires 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 needs to 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 program allows:
  - the parameters of a new transformation to be determined.
  - the parameters of an existing transformation to be recomputed.

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 datums 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 geoidal model program may 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 may 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.

- 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, because neither the orientation of the local reference frame nor any scale factor within the local datum can be taken into account.

Coordinate system determination methods

Two different methods for determining a coordinate system are available:

Coordinate system determination method	Characteristic	Description
Normal	Number of control points needed	One or more control points for both the WGS 1984 and the local datum.

Coordinate system determination method	Characteristic	Description
	Transformation to use	Onestep, Twostep or Classic 3D, depending on number of control points and available information.
One point localisation	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.

3.2 Configuring Det Coord System

3.2.1 Configuring Det Coord System - Normal

Description

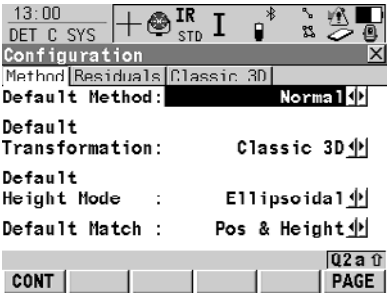
The configuration of **DET C SYS**, normal method, allows options to be set which are used as the default options within the Determine Coordinate System application program when using the normal method. These settings are stored within the active configuration set.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Determine Coordinate System** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **DET C SYS Configuration**. Select **<Default Method: Normal>**.

DET C SYS Configuration, Method page

The explanations for the softkeys given below are valid for all pages, unless otherwise stated.



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

FIX (F4) or **ADJST (F4)**
Available for **Classic 3D** page unless **<Transf Model:>** is highlighted. To define which parameters are computed or fixed in the Classic 3D transformation.

Description of fields

Field	Option	Description
<Default Method:>	**Normal** or **One Pt Localistn**	Method used to determine the coordinate system.
<Default Transformation:>	**Onestep**, **Twostep** or **Classic 3D**	The default transformation to be used when determining the coordinate system.
<Default Height Mode:>	**Orthometric** or **Ellipsoidal**	The default height type to be used when determining the coordinate system.
<Default Match:>	**Pos & Height**, **Pos Only**, **Height Only** or **<None>**	Options available depend on the choice made for **<Default Transformation:>**. Point parameters to be matched between points in both datums.

Next step

PAGE (F6) changes to the **Residuals** page.

DET C SYS Configuration, Residuals page

Description of fields

Field	Option	Description
<Easting:>	User input	The limit above which Easting residuals will be flagged as possible outliers.
<Northing:>	User input	The limit above which Northing residuals will be flagged as possible outliers.
<Height:>	User input	The limit above which Height residuals will be flagged as possible outliers.
<Default Residual Distbtn:>	**None**, **1/Distance^{XX}** or **Multiquadratic**	The method by which the residuals of the control points will be distributed throughout the transformation area.

Next step

PAGE (F6) changes to the **Classic 3D** page.

DET C SYS Configuration, Classic 3D page

The settings on this page define the parameters to be used in a Classic 3D transformation.

IF the value for a field is	THEN the value for this parameter will be
-----	calculated.
any number	fixed to that value.

Next step

CONT (F1) returns to **DET C SYS Determine Coord System Begin**.

3.2.2 Configuring Det Coord System - One Point Localisation

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Determine Coordinate System** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **DET C SYS Configuration**. Select **<Default Method: One Pt Localistn>**.

DET C SYS Configuration, Method page

The softkeys are identical to those available for **<Default Method: Normal>**. Refer to "3.2.1 Configuring Det Coord System - Normal" for information on softkeys.

Description of fields

Field	Option	Description
<Default Method:>	**Normal** or **One Pt Localistn**	Method used to determine the coordinate system.
<Default Transformation:>	**Onestep**, **Twostep** or **Classic 3D**	The default transformation to be used when determining the coordinate system.
<Default Height Mode:>	**Orthometric** or **Ellipsoidal**	The default height mode to be used when determining the coordinate system.

Next step
PAGE (F6) changes to the **Onestep** page.

DET C SYS Configuration, Onestep page

Description of fields

Field	Option	Description
<Default Rotation:>	**Use WGS84 North**	Rotate to North as defined by WGS 1984.
	User Entered	Rotation can be manually typed in.
	Convergnce Angle	Angle between grid North and geodetic North at a certain point.
	Two WGS84 Points	Rotation defined by two points on the WGS 1984 datum.
<Default Height SF:>	**User Entered**	Height scale factor can be manually typed in.
	Known WGS84 Pt	Height scale factor defined by a known point on the WGS 1984 datum.
	Known WGS84 Ht	Height scale factor defined by the known height of a point on the WGS 1984 datum.

Next step
PAGE (F6) changes to the **Twostep** page.

DET C SYS Configuration, Twostep page

Some fields are identical to those on the **Onestep** page. Additional fields are explained here.

Description of fields

Field	Option	Description
<Default Scale:>	**User Entered** **Compute CSF**	Scale factor can be manually typed in Compute the combined grid and height scale factor.
<Deflt Grid SF:>	**User Entered** or **Known Local Pt**	Available for **<Default Scale: Compute CFS>**. Default method for computing the grid scale factor of the known point.

Next step
PAGE (F6) changes to the **Classic 3D** page.

DET C SYS Configuration, Classic 3D page

Description of fields

Field	Option	Description
<Default Local Height:>	**Use WGS84 Pt Ht** or **Use Local Pt Ht**	Source of height information to use.

Next step
CONT (F1) returns to **DET C SYS Determine Coord System Begin**.

4 Determine Coordinate System - Normal

4.1 Determining a New/Updating a Coordinate System

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Determine Coordinate System** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **DET C SYS Configuration**. Select **<Default Method: Normal>**.

☞ If a coordinate system was chosen to be edited in **DET C SYS Determine Coord System Begin**, pressing **CONT (F1)** accesses **DET C SYS Step 3: Match Points (n)**.

DET C SYS Step 1: Choose Transform Type

Description of fields

Field	Option	Description
<Transfrm Name:>	User input	A unique name for the transformation. If a coordinate system is being updated then its name is displayed.
<Transfrm Type:>	**Onestep**, **Twostep** or **Classic 3D** Output	Available when determining a new coordinate system. Available when updating a coordinate system. The transformation type shown is the same as the transformation used in the existing system.
<Height Mode:>	**Orthometric** or **Ellipsoidal** Output	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
CONT (F1) continues to **DET C SYS Step 2: Choose Parameters**.

DET C SYS Step 2: Choose Parameters

This screen contains different fields, depending on what transformation type was chosen in **DET C SYS Step 1: Choose Transform Type**.

Description of fields

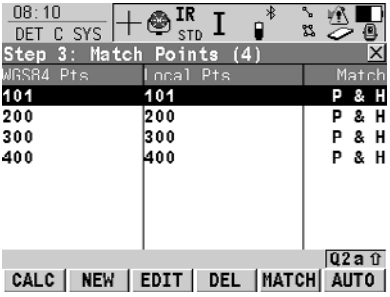
Field	Option	Description
<Geoid Model:>	Choicelist	The geoid model to be used in the transformation. Geoid models from **MANAGE Geoid Models** can be selected.
<Pre Transform:>	Choicelist	The pre-transformation to use for the preliminary 3D transformation.
<Ellipsoid:>	Choicelist Output	The ellipsoid to use in the transformation. The ellipsoid being used by a hard wired projection when selected in **<Projection:>**.
<Projection:>	Choicelist	The projection to use in the transformation.
<CSCS Model:>	Choicelist	The CSCS model to use in the transformation. All CSCS models from **MANAGE CSCS Models** can be selected.

Next step

CONT (F1) continues to **DET C SYS Step 3: Match Points (n)**.

DET C SYS Step 3: Match Points (n)

This screen provides a list of points chosen from **<WGS84 Pts Job:>** and **<Local Pts Job:>**. The number of control points matched between both jobs is indicated in the title, for example **DET C SYS Step 3: Match Points (4)**. Unless there is no pair of matching points in the list all softkeys are available.



CALC (F1)
To confirm the selections, compute the transformation and continue with the subsequent screen.

NEW (F2)
To match a new pair of points. This pair is added to the list. A new point can be measured.

EDIT (F3)
To edit the highlighted pair of matched points.

DEL (F4)
To delete the highlighted pair of matched points from the list.

MATCH (F5)
To change the type of match for a highlighted pair of matched points.

AUTO (F6)
To scan both jobs for points that have the same point ID. Points with matching point ID's are added to the list.

SHIFT PARAM (F5)
To configure Classic 3D transformation parameters. Available for **<Transfrm Type: Classic 3D>** in **DET C SYS Step 1: Choose Transform Type**.

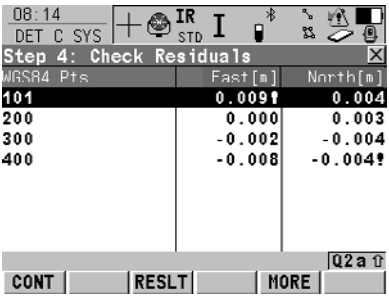
Description of columns

Column	Description
WGS84 Pts	The point ID of the points chosen from **<WGS84 Pts Job:>**.
Local Pts	The point ID of the points chosen from **<Local Pts Job:>**.
Match	The type of match to be made between the points. This information is used in the transformation calculation. **P**osition **& H**eight, **P**osition **only**, **H**eight **only** or **None**. • For **<Transfrm Type: Onestep>** or **<Transfrm Type: Twostep>** possible options are **P & H**, **P only**, **H only** or **None**. • For **<Transfrm Type: 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 can be used to try and improve the residuals that are obtained when calculating the transformation.

Next step
CALC (F1) computes the transformation and continues to **DET C SYS Step 4: Check Residuals**.

DET C SYS Step 4: Check Residuals

Displays a list of the matched points used in the transformation calculation and their associated residuals.



CONT (F1)
To accept the residuals and to continue with the subsequent screen.

RESLT (F3)
To view results of the transformation.

MORE (F5)
To display information about height residuals.

Description of columns

Column	Description
WGS84 Pts	The point ID of the points chosen from **<WGS84 Pts Job:>**.
East, **North** and **Height**	The Easting, Northing and Height residuals. If positions or heights were not used in the transformation calculation then ----- will be displayed.
?	Indicates residuals that exceed the residual limit defined in **DET C SYS Configuration**, **Residuals** page.
!	Indicates the largest residual in **East**, **North** and **Height**.

Next step

IF the residuals are	THEN
unacceptable	**ESC** returns to **DET C SYS Step 3: Match Points (n)**. Matched points can be edited, deleted or temporarily removed from the list and the transformation recalculated.
acceptable	**CONT (F1)** continues to **DET C SYS Step 5: Store Coord System**.

DET C SYS Step 5: Store Coord System, Summary page

Description of fields

Field	Option	Description
<Name:>	User input	The name of the coordinate system can be changed.
<Transfrm Type:>	Output	The type of transformation used, as defined in **DET C SYS Step 1: Choose Transform Type**.
<Matched Pts:>	Output	Number of matched points, as defined in **DET C SYS Step 3: Match Points (n)**.
<Easting:>, **<Northing:>** and **<Height:>**	Output	Largest Easting residual from the transformation calculation.

Next step

PAGE (F6) changes to the **Coord System** page.

DET C SYS Step 5: Store Coord System, Coord System page

Description of fields common to all transformations

Field	Option	Description
<Residuals:>	**None, 1/Distance^{XX}** or **Multiquadratic**	The method by which the residuals of the control points will be distributed throughout the transformation area.

Refer to paragraph "DET C SYS Step 2: Choose Parameters" for details of all other fields.

Next step

STORE (F1) stores the coordinate system to the DB-X and attaches it to the **<WGS84 Pts Job:>** selected in **DET C SYS Determine Coord System Begin**, replacing any coordinate system attached to this job. **<WGS84 Pts Job:>** becomes the active job.

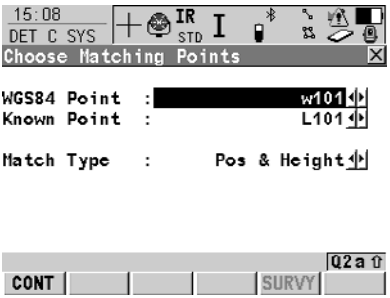
4.2 Selecting/Editing a New Pair of Matching Points

Access step-by-step

Step	Description
1.	Refer to "4.1 Determining a New/Updating a Coordinate System". Follow the instructions to access **DET C SYS Step 3: Match Points (n)**.
2.	Press **NEW (F2)/EDIT (F3)** to access **DET C SYS Choose Matching Points/DET C SYS Edit Matching Points**.

Editing a pair of matched points is similar to creating a new pair of matching points. For simplicity, the screen is called **DET C SYS XX Matching Points** and differences are clearly outlined.

DET C SYS XX Matching Points



CONT (F1)
To accept the matching points and to continue with the subsequent screen.

SURVY (F5)
To measure a point and store it in the local job.

Description of fields

Field	Option	Description
<WGS84 Point:>		A WGS 1984 control point. All WGS 1984 stored points from **MANAGE Data: Job Name** can be selected.
<Known Point:>		A local control point. All local stored points from **MANAGE Data: Job Name** of any class, except **NONE**, can be selected.
<Match Type:>		The type of match to be made between the points selected in **<WGS84 Point:>** and **<Known Point:>**. The options available depend on **<Transfrm Type:>** in **DET C SYS Step 1: Choose Transform Type**.

Next step

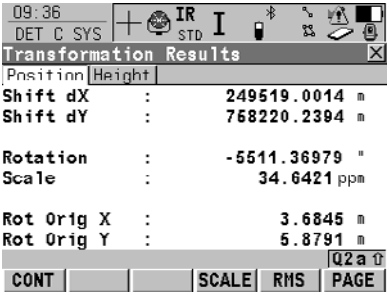
CONT (F1) returns to **DET C SYS Step 3: Match Points (n)** and adds a new line of matched points to the matched points list.

4.3 Transformation Results

Access step-by-step

Step	Description
1.	Refer to "4.1 Determining a New/Updating a Coordinate System". Follow the instructions to access **DET C SYS Step 4: Check Residuals**.
2.	Press **RESLT (F3)** to access **DET C SYS Transformation Results**.

DET C SYS Transformation Results, Position page; DET C SYS Transformation Results, Parameters page



CONT (F1)
To return to **DET C SYS Step 4: Check Residuals**.

SCALE (F4) or **PPM (F4)**
Available on the **Position** page. To switch between **<Scale:>** displaying the true scale and displaying the ppm.

RMS (F5) or **PARAM (F5)**
To switch between the root mean square values of the parameters and the actual parameter values. The name of the screen changes to **DET C SYS Transformation Results rms** when displaying rms values.

Description of fields

Field	Option	Description
<Shift dX:>	Output	Shift in X direction.
<Shift dY:>	Output	Shift in Y direction.
<Rotation:>	Output	Rotation of transformation.
<Rotations X:>, **<Rotations Y:>** or **<Rotation Z:>**	Output	Rotation around the X, Y or Z axis.
<Scale:>	Output	Scale factor used in transformation. Either true scale or ppm.
<Rot Orig X:>	Output	Position in the X direction of the origin of rotation.
<Rot Orig Y:>	Output	Position in the Y direction of the origin of rotation.

Next step

IF	THEN
<Transfrm Type: Onestep> or **<Transfrm Type: Twostep>**	**PAGE (F6)** changes to the **Height** page.
<Transfrm Type: Classic 3D>	**PAGE (F6)** changes to the **Rotn Origin** page.

DET C SYS Transformation Results, Height page

Description of fields

Field	Option	Description
<Slope in X:>	Output	Tilt of the transformation in the X direction.
<Slope in Y:>	Output	Tilt of the transformation in the Y direction.
<Height Shift:>	Output	Shift in height between WGS 1984 datum and local datum.

Next step
CONT (F1) returns to **DET C SYS Step 4: Check Residuals**.

DET C SYS Transformation Results, Rotn Origin page

Description of fields

Field	Option	Description
<Transf Model:>	Output	Classic 3D transformation model used for the transformation as defined in **DET C SYS Configuration, Classic 3D** page.
<Rot Orig X:>, **<Rot Orig Y:>** and **<Rot Orig Z:>**	Output	Available for **<Transf Model: Molodensky-Bad>**. Position in the X, Y and Z direction of the origin of rotation.

Next step
CONT (F1) returns to **DET C SYS Step 4: Check Residuals**.

5 Determine Coordinate System - One Point Localisation

5.1 Accessing Det Coord System - One Point Localisation

<Azimuth:> is used throughout this chapter. This should always be considered to also mean **<Bearing:>**.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Determine Coordinate System** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **DET C SYS Configuration**. Select **<Default Method: One Pt Localistn>**.
4.	Press **CONT (F1)** to access **DET C SYS Step 1: Choose Transform Type**.

DET C SYS Step 1: Choose Transform Type

Description of fields

Field	Option	Description
<Transfrm Name:>	User input	A unique name for the coordinate system. The name may be up to 16 characters in length and may include spaces.
<Transfrm Type:>	**Onestep**, **Twostep** or **Classic 3D**	The type of transformation to be used when determining a coordinate system.
<Height Mode:>	**Orthometric** or **Ellipsoidal**	The height mode to be used in the determination of a coordinate system

Next step

IF	THEN
<Transfrm Type: Onestep> or **<Transfrm Type: Twostep>**	**CONT (F1)** to access **DET C SYS Step 2: Choose Parameters**. Refer to "5.2 Det Coord System - Onestep/Twostep Transformation".
<Transfrm Type: Classic 3D>	**CONT (F1)** to access **DET C SYS Step 2: Choose Parameters**. Refer to "5.3 Det Coord System - Classic 3D Transformation".

5.2 Det Coord System - Onestep/Twostep Transformation

5.2.1 Determining a New/Coordinate System

Access

Refer to "5.1 Accessing Det Coord System - One Point Localisation" to access **DET C SYS Step 2: Choose Parameters**.

DET C SYS Step 2: Choose Parameters

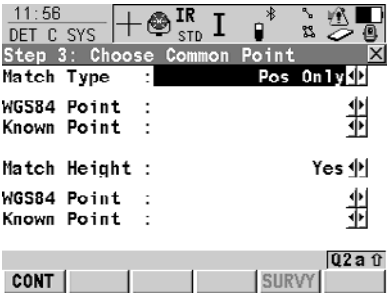
Description of fields

Field	Option	Description
<Pre Transform:>	Choicelist	Available for **<Transfrm Type: Twostep>**. The pretransformation to be used for the preliminary 3D transformation.
<Ellipsoid:>	Choicelist	Available for **<Transfrm Type: Twostep>**. The ellipsoid to be used in the transformation.
	Output	The ellipsoid being used by a hard wired projection when selected in **<Projection:>**.
<Projection:>	Choicelist	Available for **<Transfrm Type: Twostep>**. The projection to be used in the transformation.
<Geoid Model:>	Choicelist	The geoid model to be used in the transformation.

Next step

CONT (F1) continues to **DET C SYS Step 3: Choose Common Point**.

DET C SYS Step 3: Choose Common Point



CONT (F1)
To confirm the selections and to continue with the subsequent screen.

SURVY (F5)
To measure a point and store it in **<Local Pts Job:>**.

Description of fields

Field	Option	Description
<Match Type:>	**Pos & Height**	Position and height are taken from the same pair of matching points.
	Pos Only	Position is taken from one pair of matching points. The height can be taken from another pair of matching points.

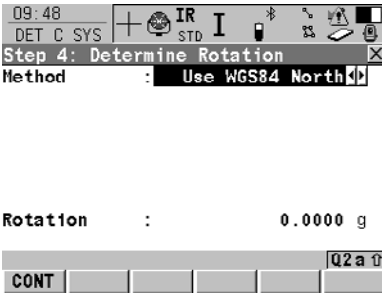
Field	Option	Description
<WGS84 Point:>	Choicelist	The point ID of the control point chosen from **<WGS84 Pts Job:>**.
<Known Point:>	Choicelist	The point ID of the control point chosen from **<Local Pts Job:>**.
<Match Height:>	**Yes** or **No**	Available for **<Match Type: Pos Only>**. Activates the determination of the vertical shift from a separate pair of matching points.

Next step

CONT (F1) continues to **DET C SYS Step 4: Determine Rotation**.

DET C SYS Step 4: Determine Rotation

This screen contains different fields, depending on the **<Method:>** selected. The explanations for the softkeys given below are valid as indicated.



CONT (F1)
To confirm the selections and to continue with the subsequent screen.

INV (F2)
Available for **<Method: Two WGS84 Points>** and **<Method: User Entered>**. To compute an azimuth between two local points.

SURVY (F5)
To manually occupy a point and store it in **<WGS84 Pts Job:>**. Available when certain fields are highlighted.

Description of common fields

Field	Option	Description
<Method:>	**Use WGS84 North**, **User Entered, Convergnce Angle** or **Two WGS84 Points**	Method by which the rotation angle for the transformation is determined.

For <Method: Use WGS84 North>

Description of fields

Field	Option	Description
<Rotation:>	Output	Transformation will be rotated to North as defined by the WGS 1984 datum. North is 0.00000°.

For <Method: User Entered>

Description of fields

Field	Option	Description
<Rotation:>	User input	Allows the orientation of the transformation to be manually typed in or calculated in **DET C SYS Compute Required Azimuth**.

For <Method: Convergnce Angle>

Description of fields

Field	Option	Description
<Coord System:>	Choicelist	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.
<WGS84 Point:>	Choicelist	WGS 1984 point of which the convergence angle will be calculated.
<Rotation:>	Output	The rotation of the transformation calculated as 0.00000^{o} minus the computed convergence angle. The field is updated as **<Coord System:>** and **<WGS84 Point:>** are changed.

For <Method: Two WGS84 Points>

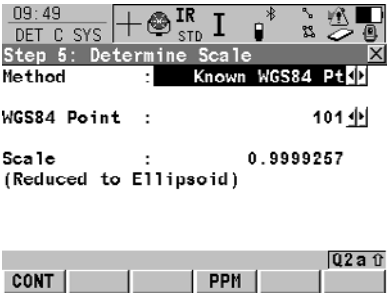
Description of fields

Field	Option	Description
<Point 1:>	Choicelist	First point to use for computation of **<Azimuth:>**.
<Point 2:>	Choicelist	Second point to use for computation of **<Azimuth:>**.
<Azimuth:>	Output	Computed azimuth between **<Point 1:>** and **<Point 2:>**.
<Reqd Azimuth:>	User input	The required grid azimuth, computed between two local points.
<Rotation:>	Output	The rotation of the transformation calculated as **<Reqd Azimuth>** minus **<Azimuth>**. The field is updated as **<Point 1:>**, **<Point 2:>** and **<Reqd Azimuth:>** are changed.

Next step
CONT (F1) continues to **DET C SYS Step 5: Determine Scale**.

DET C SYS Step 5: Determine Scale

This screen contains different fields, depending on the **<Method:>** selected. The explanations for the softkeys given below are valid as indicated. 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 **DET C SYS Step 3: Choose Common Point** and h is the height of this point above the WGS 1984 ellipsoid for **<Transfrm Type: Onestep>** or the local ellipsoid for **<Transfrm Type: Twostep>**.



CONT (F1)
To confirm the selections and to continue with the subsequent screen.

GRID (F2)
To compute the grid scale factor. Available for **<Transfrm Type: Twostep>** where **<Method: Compute CSF>**.

HIGHT (F3)
To compute the height scale factor. Available for **<Method: Compute CSF>**.

SCALE (F4) or **PPM (F4)**
To switch between **<Scale:>** displaying the true scale and displaying the ppm.

SURVY (F5)
To measured a point and store it in **<Local Pts Job:>**.

For <Transfrm Type: Onestep>

Description of common fields

Field	Option	Description
<Method:>	**User Entered**, **Known WGS84 Pt** or **Known WGS84 Ht**	Method of determining the scale factor of the transformation.

For <Transfrm Type: Onestep> and <Method: User Entered>

Description of fields

Field	Option	Description
<Scale:>	User input	Allows the scale factor to be typed in manually.

For <Transfrm Type: Onestep> and <Method: Known WGS84 Pt>

Description of fields

Field	Option	Description
<WGS84 Point:>	Choicelist	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.
<Scale:>	Output	The calculated scale factor.

For <Transfrm Type: Onestep> and <Method: Known WGS84 Ht>

Description of fields

Field	Option	Description
<Known Height:>	User input	The WGS 1984 height of a point can be typed in. The scale factor is calculated using this height.
<Scale:>	Output	The calculated scale factor.

For <Transfrm Type: Twostep>

Description of fields

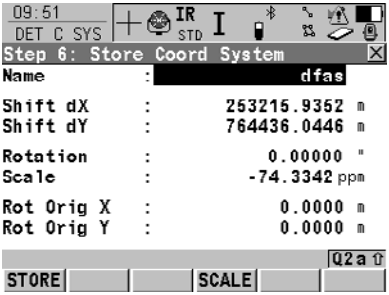
Field	Option	Description
<Method:>	**User Entered** or **Compute CSF**	The default method for determining the **C**ombined **S**cale **F**actor to be used in the transformation process.
<Grid SF:>	Output	Available for **<Method: Compute CSF>**. The grid scale factor as computed in **DET C SYS Compute Grid Scale Factor**.
<Height SF:>	Output	Available for **<Method: Compute CSF>**. The height scale factor as computed in **DET C SYS Compute Height Scale Factor**.
<Combined SF:>	User input Output	Available for **<Method: User Entered>**. The scale factor can be typed in. Available for **<Method: Compute CSF>**. The product of the grid scale factor and the height scale factor.

Next step

CONT (F1) continues to **DET C SYS Step 6: Store Coord System**.

DET C SYS Step 6: Store Coord System

The shifts in X and Y direction, the rotation, the scale factor of the transformation and the position of the origin of rotation is displayed.



STORE (F1)

To store the coordinate system to the DB-X, attach the system to **<WGS84 Pts Job:>** that was selected in **DET C SYS Determine Coord System Begin** and return to **TPS1200 Main Menu**.

SCALE (F4) or **PPM (F4)**

To switch between **<Scale:>** displaying the true scale and displaying the ppm.

Next step

STORE (F1) stores the coordinate system and returns to **TPS1200 Main Menu**.

5.2.2 Computing the Grid Scale Factor for Twostep Transformation

Access step-by-step

Step	Description
1.	Refer to "5.1 Accessing Det Coord System - One Point Localisation" to access **DET C SYS Step 1: Choose Transform Type**.
2.	Select **<Transfrm Type: Twostep>**.
3.	Continue to **DET C SYS Step 5: Determine Scale**.
4.	Select **<Method: Compute CSF>**.
5.	Press **GRID (F2)** to access **DET C SYS Compute Grid Scale Factor**.

DET C SYS Compute Grid Scale Factor

Description of fields

Field	Option	Description
<Method:>	**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.
<Local Point:>	Choicelist	Available for **<Method: Known Local Pt>**. The point ID of the point chosen from **<Local Pts Job:>** from which the grid scale factor is computed using the projection selected in **DET C SYS Step 2: Choose Parameters**.
<Grid SF:>	User input	Available for **<Method: User Entered>**. To type in the grid scale factor.
	Output	Available for **<Method: Known Local Pt>**. The computed grid scale factor.

Next step

CONT (F1) returns to **DET C SYS Step 5: Determine Scale**.

5.2.3 Computing the Height Scale Factor for Twostep Transformation

Access step-by-step

Step	Description
1.	Refer to "5.1 Accessing Det Coord System - One Point Localisation" to access **DET C SYS Step 1: Choose Transform Type**.
2.	Select **<Transfrm Type: Twostep>**.
3.	Continue to **DET C SYS Step 5: Determine Scale**.
4.	Select **<Method: Compute CSF>**.
5.	Press **HIGHT (F3)** to access **DET C SYS Compute Height Scale Factor**.

DET C SYS Compute Height Scale Factor

Description of fields

Field	Option	Description
<Method:>	**User Entered**	Height scale factor can be manually typed in.
	Known Local Pt	Height scale factor is computed using the height of a known local point.
	Known Local Ht	Height scale factor is computed using the known height of a local point.
<Known Point:>	Choicelist	Available for **<Method: Known Local Pt>**. The point ID of the point chosen from **<Local Pts Job:>** from which the height scale factor is computed.
<Known Height:>	User input	Available for **<Method: Known Local Ht>**. A known local height.
<Height SF:>	User input	Available for **<Method: User Entered>**. To type in the height scale factor.
	Output	Available for **<Method: Known Local Pt>** and **<Method: Known Local Ht>**. The computed height scale factor.

Next step

CONT (F1) returns to **DET C SYS Step 5: Determine Scale**.

5.3 Det Coord System - Classic 3D Transformation

Access

Refer to "5.1 Accessing Det Coord System - One Point Localisation" to access **DET C SYS Step 1: Choose Transform Type**.

DET C SYS Step 2: Choose Parameters

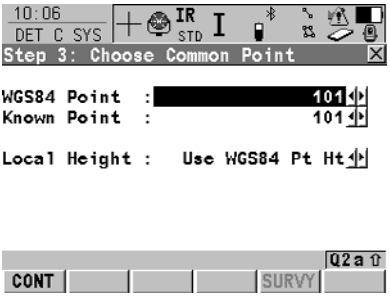
Description of fields

Refer to "5.2 Det Coord System - Onestep/Twostep Transformation" paragraph "DET C SYS Step 2: Choose Parameters" for information about the fields available.

Next step

CONT (F1) continues to **DET C SYS Step 3: Choose Common Point**.

DET C SYS Step 3: Choose Common Point



CONT (F1)
To confirm the selections and to continue with the subsequent screen.

SURVY (F5)
To measure a point and store it in **<Local Pts Job:>**.

Description of fields

Field	Option	Description
<WGS84 Point:>	Choicelist	The point ID of the control point chosen from **<WGS84 Pts Job:>**.
<Known Point:>	Choicelist	The point ID of the control point chosen from **<Local Pts Job:>**.
<Local Height:>	**Use WGS84 Pt Ht** or **Use Local Pt Ht**	The source of the height information to use in the transformation.

Next step

CONT (F1) continues to **DET C SYS Step 4: Store Coord System**.

DET C SYS Step 4: Store Coord System

The shifts in the X, Y and Z directions are displayed.

Next step

STORE (F1) stores the coordinate system and returns to **TPS1200 Main Menu**.

5.4 Computing Required Azimuth

Available for **<Method: Two WGS84 Points>** and **<Method: User Entered>** in **DET C SYS Step 4: Determine Rotation**.

Description

Allows two local points to be chosen from **<Local Pts Job:>** selected in **DET C SYS Determine Coord System Begin** between which the required azimuth will be computed. This azimuth is then used with an azimuth computed between two WGS 1984 points chosen from **<WGS84 Pts Job:>** selected in **DET C SYS Determine Coord System Begin**, to calculate the rotation of the transformation.
The computed required azimuth appears in the **<Reqd Azimuth:>** field for <Method: Two WGS84 Points> and the <Rotation:> field for <Method: User Entered> in **DET C SYS Step 4: Determine Rotation**.

Access step-by-step

Step	Description
1.	Refer to "5.1 Accessing Det Coord System - One Point Localisation" to access **DET C SYS Step 1: Choose Transform Type**.
2.	Select **<Transfrm Type: Onestep>** or **<Transfrm Type: Twostep>**.
3.	Continue to **DET C SYS Step 4: Determine Rotation**.
4.	Select **<Method: Two WGS84 Points>** or **<Method: User Entered>**.
5.	Press **INV (F2)** to access **DET C SYS Compute Required Azimuth**.

DET C SYS Compute Required Azimuth

Description of fields

Field	Option	Description
<From:>	Choicelist	The point ID of the first known point for the azimuth calculation.
<To:>	Choicelist	The point ID of the second known point for the azimuth calculation.

Next step

CONT (F1) to calculate the required azimuth and return to **DET C SYS Step 4: Determine Rotation**.

6 GPS Survey

6.1 Overview

Description

GPS Survey is an application program which is used with SmartStation. The main purpose of this application program is to enable measurement of points in GPS mode without having to run through the Setup application program.

Access

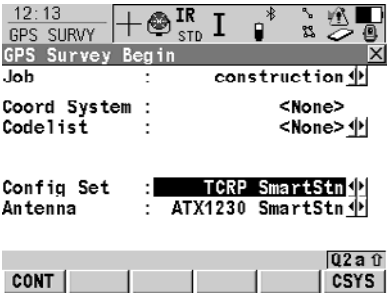
Select **Main Menu: Programs...\GPS Survey**.

Point properties

The properties of GPS Survey points are:

Type	Property	Property
Class	**MEAS**	**NAV**
Sub class	**GPS Fixed, GPS Code only**	**GPS** Code only
Source	**GPS Survey**	**GPS Survey**
Instrument source	**GPS**	**GPS**

GPS SURVEY
GPS Survey Begin



CONT (F1)
To accept changes and access the subsequent screen. The chosen settings become active.

CSYS (F6)
To select a different coordinate system.

Description of fields

Field	Option	Description
<Job:>	Choicelist	The active job. All jobs from **Main Menu: Manage...\Jobs** can be selected.
<Coord System:>	Output	The coordinate system currently attached to the selected **<Job:>**.
<Codelist:>	Choicelist	No codes are stored in the selected **<Job:>**. All codelists from **Main Menu: Manage...\Codelists** can be selected.

Field	Option	Description
	Output	Codes have already been stored in the selected **<Job:>**. If codes had been copied from a System RAM codelist, then the name of the codelist is displayed. If codes have not been copied from a System RAM codelist but typed in manually, then the name of the active job is displayed.
<Config Set:>	Choicelist	The active configuration set. All configuration sets from **Main Menu: Manage...\Configuration Sets** can be selected.
<Antenna:>	Choicelist	Opening the choicelist accesses **MANAGE Antennas**. The default antenna is SmartAntenna.

Next step

CONT (F1) accepts the changes and accesses **GPS SURVEY GPS Survey**.

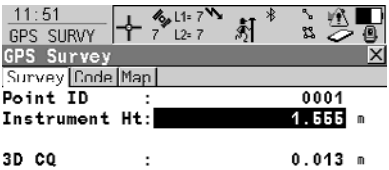
GPS SURVEY GPS Survey, Survey page

Overview

Important feaures about this screen:

- Upon entering this screen SmartStation switches into GPS mode.
- The display mask for this screen is fixed and is not configurable.
- SmartAntenna is automatically turned on upon entry to the screen.
- Some of the screen icons change from TPS specific to GPS specific.
- The GPS real-time radio link is automatically activated, if configured.
- The occupation/storing behaviour is dependent on the configuration settings.

Diagram



Refer to "Description of softkeys" for details on the softkeys and their functionality.

Description of softkeys

Key	Description
OCUPY (F1)	To start logging of static observations. The position mode icon changes to the static icon. **(F1)** changes to **STOP**.

Key	Description
STOP (F1)	To end logging of static observations when enough data is collected. When **<Auto STOP: Yes>** in **CONFIGURE Point Occupation Settings**, logging of static observations ends automatically as defined by the stop criteria. The position mode icon changes to the moving icon. **(F1)** changes to **STORE**.
STORE (F1)	To store the measured point. When **<Auto STORE: Yes>** in **CONFIGURE Point Occupation Settings**, the measured point is stored automatically. **(F1)** changes to **OCUPY**. 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.
SHIFT AVGE (F2)	To check the residuals for the averaged position. Available for **<Averaging Mode: Average>** and for more than one measured coordinate triplet recorded for the same point.
SHIFT ABS (F2)	To check the absolute difference between measurements. Available for **<Averaging Mode: Absolute Diffs>** and for more than one measured coordinate triplet recorded for the same point.
SHIFT CONEC (F3) and **SHIFT DISCO (F3)**	To dial the number of the reference station configured in the active configuration set and to hang up immediately after the survey is completed. Available for GPS real-time devices of type digital cellular phone or modem. Available for **<Auto CONEC: No>** in **CONFIGURE GSM Connection**.
SHIFT INIT (F4)	To select an initialisation method and to force a new initialisation. Available for configuration sets allowing phase fixed solutions.
SHIFT INDIV (F5) and **SHIFT RUN (F5)**	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:>	User input	The identifier for manually occupied points. The configured point ID template is used. The ID can be changed: To start a new sequence of point ID's overtype the point ID. For an individual point ID independent of the ID template **SHIFT INDIV (F5)**. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.

Field	Option	Description
<Instrument Ht:>	User input	Current instrument height. SmartAntenna offset is automatically added but not displayed.
<3D CQ:>	Output	The current 3D coordinate quality of the computed position.
<Time at Point:>	Output	The time from when the point is occupied until point occupation is stopped.
<RTK Positions:>	Output	The number of GPS real-time positions recorded over the period of point occupation.

Next step
PAGE (F6) changes to the **Code** page.

GPS SURVEY GPS Survey, Code page

The setting for **<Thematc Codes:>** in **CONFIGURE Coding Settings** determines the availability of the fields and softkeys.

Next step
PAGE (F6) changes to the **Map** page.

GPS SURVEY GPS Survey, Map page

The **Map** page provides an interactive display of the data.

Next step
PAGE (F6) changes to the first page on this screen.

6.2 Management of Antennas

6.2.1 Overview

Description

- Leica Geosystems antennas are predefined as default and can be selected from a list.
- Additional antennas can be defined.
- Default antennas contain an elevation dependent correction model.
- New antenna correction models can be set up and transferred to the instrument using LGO.

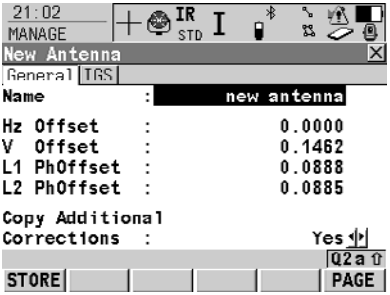
6.2.2 Creating a New Antenna/Editing an Antenna

Access step-by-step

Step	Description
1.	Refer to "6.1 Overview" to access **MANAGE Antennas**.
2.	In **MANAGE Antennas** highlight an antenna. When creating a new antenna, highlight the antenna with offset characteristics similar to those required by the new antenna.
3.	Press **NEW (F2)/EDIT (F3)** to access **MANAGE New Antenna**/**MANAGE Edit Antenna**.

Editing antennas is similar to creating a new antenna. All fields can be edited except those of Leica default antennas. For simplicity, the screens are called **MANAGE XX Antenna**.

MANAGE XX Antenna, General page



STORE (F1)
To store the new antenna and to return to **MANAGE Antennas**.

Description of fields

Field	Option	Description
<Name:>	User input	A unique name for the new antenna.
<Hz Offset:>	User input	Horizontal offset of measurement reference point.
<V Offset:>	User input	Vertical offset of measurement reference point.
<L1 PhOffset:>	User input	Offset of L1 phase centre.
<L2 PhOffset:>	User input	Offset of L2 phase centre.
<Copy Additional Corrections:>	**Yes** or **No**	Allows additional corrections to be copied from the antenna which was highlighted when **MANAGE New Antenna** was accessed.

Next step
PAGE (F6) changes to the **IGS** page.

MANAGE New Antenna, IGS page

The combination of values typed in on this page provides a unique standardised ID for the antenna being used.

Description of fields

Field	Option	Description
<IGS Name:>	User input	The **I**nternational **G**PS **S**ervice name of the antenna.
<Serial Number:>	User input	The serial number of the antenna.
<Set Up Number:>	User input	The set up number of the antenna. This identifies the version number of the current calibration.

Next step

STORE (F1) stores the antenna and returns to **MANAGE Antennas**.

7 Hidden Point

7.1 Overview

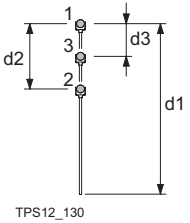
Description

Hidden points cannot be measured directly by TPS. This is because they are not directly visible.

- A hidden point can be calculated from measurements to prisms mounted on a hidden point rod with a known spacing and a known length of the hidden point rod. The hidden point rod may 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 reflectors. Refer to "7.2 Configuring Hidden Point" for information on configuring the hidden point rod.
- If three reflectors are used the average will be calculated.

Hidden point rod

The reflectors on the hidden point rod are also called auxiliary points after they have been measured.



1 Reflector 1
2 Reflector 2
3 Reflector 3
d1 Rod length
d2 Distance from reflector 1 to reflector 2
d3 Distance from reflector 1 to reflector 3

Hidden point tasks

The Hidden Point application program can be used for the following tasks:

- The hidden point program may be used to obtain accurate three dimensional coordinates for a point that is currently blocked from direct measurement by an obstruction between the point and the instrument.
- Determination of flow line locations and elevations in manholes, without measuring from the rim of the manhole to the flow line and estimating corrections for nonverticality of the measuring tape and eccentricity from the measurement on the rim to the horizontal location of 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 remodeling 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.

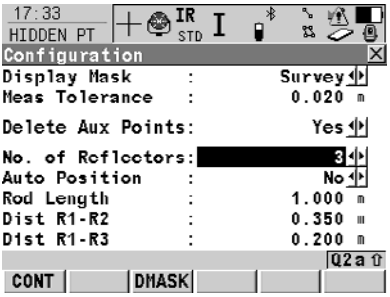
☞ TPS Hidden Point application program does not generate a logfile.

7.2 Configuring Hidden Point

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Hidden Point** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **HIDDEN PT Configuration**.

HIDDEN PT Configuration



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DMASK (F3)
To edit the display mask currently being displayed in this field. Accesses **CONFIGURE Define Display Mask n**. Available for **<Display Mask:>** being highlighted.

SHIFT ABOUT (F6)
To display information about the program name, the version number, the date of the version, the copyright and the article number.

Description of fields

Field	Option	Description
<Display Mask:>	Choicelist	The user defined display mask to be shown in **HIDDEN PT Measure Reflector n**. All display masks of the active configuration set defined in **CONFIGURE Display Settings** can be selected.
<Meas Tolerance:>	User input	Limit of the difference between input and measured spacing of the reflectors. For three reflectors 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 reflector 1, reflector 2 and reflector 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.

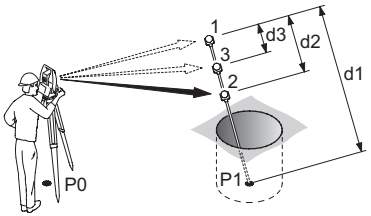
Field	Option	Description
<No. of Refectors:>	**2** or **3**	Two or three reflectors are used on the rod.
<Auto Position:>	**Yes** or **No**	Available for **<No. of Reflectors: 3>**. The third reflector is aimed at automatically.
<Rod Length:>	User input	Total length of hidden point rod.
<Dist R1-R2:>	User input	Spacing between the centres of reflector 1 and reflector 2.
<Dist R1-R3:>	User input	Available for **<No. of Reflectors: 3>**. Spacing between the centres of reflector 1 and reflector 3. Reflector 3 is situated between reflector 1 and reflector 2.

Next step

CONT (F1) returns to the screen from where this screen was accessed from.

7.3 Measuring Hidden Points

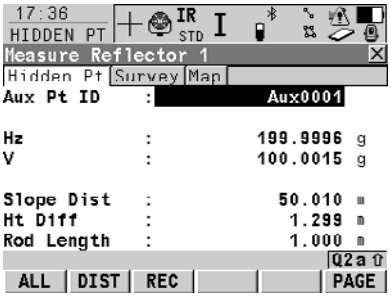
Diagram



TPS12_127

d1 Rod length
d2 Distance from reflector 1 to reflector 2
d3 Distance from reflector 1 to reflector 3

Measuring hidden point step-by-step

Step	Description
1.	Press **PROG**.
2.	Highlight **Hidden Point**.
3.	Press **CONT (F1)** to access **HIDDEN PT Hidden Point Begin**.
4.	Press **CONF (F2)** to access **HIDDEN PT Configuration**.
5.	Select **<No. of Reflectors: 3>**. Enter the values for **<Rod Length:>**, **<Dist R1-R2:>**, **<Dist R1-R3:>**.
6.	Press **CONT (F1)** to access **HIDDEN PT Hidden Point Begin**.
7.	**HIDDEN PT Hidden Point Begin**. **CONT (F1)** to access **HIDDEN PT Measure Reflector 1**.
8.	**HIDDEN PT Measure Reflector 1, Hidden Pt** page.  **<Aux Pt ID:>** The point ID of the auxiliary point, the reflector on the hidden point rod. The Auxiliary Points ID template is used. The horizontal angle, vertical angle, slope distance and height difference to reflector 1, the auxiliary point are displayed. **<Rod Length:>** 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 2 prisms and R1-R3 for 3 prisms into account.
☞	**PAGE (F6)** changes to the **Map** page.
☞	**SHIFT INDIV (F5)** for an individual point ID independent of the ID template. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.

Step	Description
9.	**ALL (F1)** measures reflector 1 and accesses **HIDDEN PT Measure Reflector 2**.
10.	Repeat step 9. for reflector 2 and for reflector 3. After the last reflector of the hidden point rod is measured, **HIDDEN PT Hidden Point Result, Results** page is accessed.
11.	**HIDDEN PT Hidden Point Result, Result** page. **<Point ID:>** The name of the hidden point. The configured point ID template is used. **<Hz:>**, **<V:>** and **<Slope Dist:>** The calculated horizontal and vertical angle and slope distance to the computed hidden point. ----- is displayed for unavailable information. **<Ht Diff:>** The calculated height difference from instrument to computed hidden point. ----- is displayed for unavailable information. **<Easting:>**, **<Northing:>** and **<Ortho Ht:>** The calculated coordinates of the computed hidden point. ----- is displayed for unavailable information.
☞	**NEXT (F5)** to store the hidden point and to access **HIDDEN PT Measure Reflector 1**.
☞	**SHIFT INDIV (F5)** for an individual point ID independent of the ID template. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.
12.	**PAGE (F6)** to change to **Code** page.
13.	**HIDDEN PT Hidden Point Result, Code** page. **<Point Code:>** The thematical code. All codes of the job can be selected. **<Atttribute n:>** The attributes for the thematical code. The behaviour of the fields depend on their definition in the codelist. Type in a code if required.
14.	**PAGE (F6)** to change to **Plot** page.
15.	**HIDDEN PT Hidden Point Result, Plot** page. Measured distances are indicated by solid arrows.
16.	**STORE (F1)** to store the hidden point.

Test or prove hidden points step-by-step

Step	Description
1.	Set up and orient the instrument in an open area.
2.	Repeat steps 1. to 5. from paragraph "Measuring hidden point step-by-step".
3.	Configure the hidden point rod.
4.	Position the tip of the hidden point rod on a mark that is directly visible from the instrument location.

Step	Description
5.	Repeat steps 6. to 16. from paragraph "Measuring hidden point step-by-step". Make sure the hidden point rod does not move between measurements.
6.	**PROG** to access **TPS1200 Programs**.
7.	**TPS1200 Programs**. **Stakeout** to access **STAKEOUT Stakeout Begin**.
☞	Make sure **<Auto Position: 3D>** is selected in **STAKEOUT Configuration, General** page.
8.	**STAKEOUT Stakeout Begin**. **CONT (F1)** to access **STAKEOUT XX Stakeout, Stake** page.
9.	**STAKEOUT XX Stakeout**, **Stake** page. Select the hidden point.
☞	Motorised instruments position to the hidden point.

8 Reference Line

8.1 Overview

Description

The Reference Line application program can be used to set out or measure points relative to a reference line or a reference arc.

Tasks

The Reference Line application program can be used for the following tasks:

- Measuring to a line/arc where the position of a target point can be calculated from its position relative to the defined reference line/arc.
- Staking to a line/arc where 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.

Point types

Heights and positions are always taken into account. Points must have full coordinate triplets.

Terms

Reference point: The term "reference point" is 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. Refer to paragraph "Defining a reference line" and the diagrams for further explanation.

Target point: The design point.

- For measuring to a reference line, this is 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 is the point to be staked.

Measured point: The current position.

Defining a reference line

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

Defining a reference arc

A reference arc can be defined in the following ways:

- Two known points and a radius
- Three known points

Defining chainage

The chainage of the start point of a reference line/arc can be defined.

☞ **<Azimuth:>** is used throughout this chapter. This can also mean **<Bearing:>**.

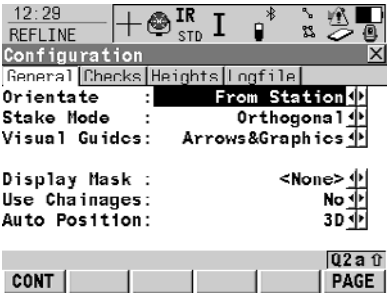
8.2 Configuring Reference Line

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **REFLINE Configuration**.

The General page

This screen consists of four pages. The fields available on the **General** page and the **Checks** page are very similar to those in **STAKEOUT Configuration**. Refer to "1.2 Configuration of a Logfile" for information on the fields on these pages. The explanations for the softkeys given below are valid as indicated.



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DMASK (F3)
To edit the display mask currently being displayed. Available when **<Display Mask:>** is highlighted on **General** page.

SHIFT ABOUT (F5)
To display information about the application program name, the version number, the date of the version, the copyright and the article number.

Description of fields

Field	Option	Description
<Orientate:>		The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Reference Line application program are based on this selection.
	To Line/Arc	The direction of the orientation is parallel to the reference line or the reference arc.
	To Station	The direction of the orientation is from the measured point to the instrument station.
	From Station	The direction of the orientation is from the instrument station to the measured point.

Field	Option	Description
	To 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.
<Stake Mode:>		The method of staking out.
	Polar	Available for **<Orientate: From Station>** or **<Orientate: To Station>**. The horizontal distance and angle between the current position and the point to be staked, the height difference as defined in **REFLINE Configuration**, the height of the point to be staked and the check distances are displayed.
	Orthogonal	The distances along and perpendicular to the orientation line between the current position and the point to be staked, the height difference as defined in **REFLINE Configuration**, the height of the point to be staked and the check distances are displayed.
<Visual Guides:>		Selects the visual guides displayed while staking points to lead to the point to be staked out.
	Off	Available unless **<Orientate: To Arrow>**. No symbols or graphics are displayed.
	Arrows	Available unless **<Orientate: To Arrow>**. Arrows are displayed. The arrows show the direction of the difference in distance between the current position and the point to be staked parallel and perpendicular to the reference object.
	Graphics	A graphical display shows the instrument station, the current position and the point to be staked.
	Arrows & Graphics	Arrows and graphics are displayed.
<Display Mask:>	Choicelist	The user defined display mask to be shown in **REFLINE XX Points**. All display masks of the active configuration set defined in **CONFIGURE Display Settings** can be selected.
<Use Chainages:>	**Yes** or **No**	Activates the use of chainages within the reference line application program.

Field	Option	Description
<Chain Format:>	Choicelist	Available for **<Use Chainages: Yes>**. Selects display format for all chainage information fields.
<Auto Position:>	**2D**	Instrument positions horizontally to the point to be staked out.
	3D	Instrument positions horizontally and vertically to the point to be staked out.
	Off	Instrument does not position to the point to be staked out.

Next step
PAGE (F6) changes to the **Checks** page.

The Checks page

Description of fields

Field	Option	Description
<Pos Check:>	**Yes** or **No**	Allows a check to be made on the horizontal coordinate difference between the staked point and the point to be staked. If the defined **<Pos Limit:>** is exceeded, the stakeout can be repeated, skipped or stored.
<Pos Limit:>	User input	Available for **<Pos Check: Yes>**. Sets the maximum horizontal coordinate difference which is accepted in the position check.
<Height Check:>	**Yes** or **No**	Allows a check to be made on the vertical difference between the staked point and the point to be staked. If the defined **<Height Limit:>** is exceeded, the stakeout can be repeated, skipped or stored.
<Height Limit:>	User input	Available for **<Height Check: Yes>**. Sets the maximum vertical difference accepted in the height check.
<Beep near Pt:>	**Yes** or **No**	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 **<Dist from Pt:>**.
<Dist from Pt:>	User input	Available for **<Beep near Pt: Yes>**. The horizontal radial distance from the current position to the point to be staked when a beep should be heard.

Next step
PAGE (F6) changes to the **Heights** page.

The Heights page

Description of fields

Field	Option	Description
<Heights:>		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.
	Use Ref Line	Available unless **<Orientate: To Line/Arc>**. Heights are computed along the reference line/arc.
	Use Start Point	Heights are computed relative to the height of the starting point. When using a reference arc, this option is automatically applied.
	Use DTM Model	The stake out height is computed from the DTM being used.
<Edit Height:>	**No**	The height of the current position is displayed while staking out. The value cannot be changed.
	Yes	The height of the point to be staked is displayed while staking out. The value can be changed.

Next step
PAGE (F6) changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".

8.3 Starting Reference Line

8.3.1 Manually Entering a Reference Line/Arc

Description

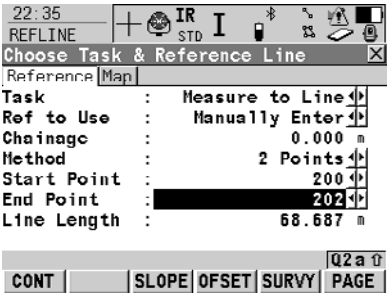
- A reference line/arc can be defined by manually entering known parameters.
- The line/arc is only temporary and is not stored when the program is quit/closed.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
4.	Select **<Ref to Use: Manually Enter>**.

The Reference page

The explanations for the softkeys given below are valid as indicated. The fields available depend on the options chosen for **<Task:>** and **<Method:>** on this screen.



CONT (F1)
To accept changes and continue with the subsequent screen.

SLOPE (F3)
To set a slope from a defined reference line/arc. Cut/Fill values can then be displayed to the slope when measurements are taken along the reference line/arc.

OFSET (F4)
To set horizontal and vertical offsets, shifts and rotations on the defined reference line or to set horizontal and vertical offsets on a defined reference arc.

SURVY (F5)
Available for **<Ref to Use: Manually Enter>** when a point field is highlighted. To measure a point.

SHIFT CONF (F2)
To configure the reference line/arc.

Description of fields

Field	Option	Description
<Task:>	Choicelist	Defines the task to be performed.
<Ref To Use:>		
<Chainage:>	User input	Available for **<Use Chainages: Yes>** in **REFLINE Configuration**, **General** page. Defines the chainage of the start point of the reference line/arc.

Field	Option	Description
<Method:>	Choicelist	The method by which the reference line/arc will be defined. Depending on the chosen **<Task:>** various options are available.
<Start Point:>	Choicelist	The start point of the reference line/arc.
<Second Point:>	Choicelist	Available for **<Method: 3 Points>**. The second point of the reference arc.
<End Point:>	Choicelist	Available for **<Method: 2 Points>**, **<Method: 3 Points>** and **<Method: 2 Points/Radius>**. The end point of the reference line/arc.
<Line Length:>	Output	Available for **<Ref to Use: Manually Enter>** with **<Method: 2 Points>**. The horizontal grid distance between **<Start Point:>** and **<End Point:>** of the line. ----- is displayed if the distance cannot be calculated.
<Azimuth:>	User input	Available for **<Method: Pt/Brg/Dst/Grade>** and **<Method: Pt/Brg/Dst/ΔHt>**. The azimuth of the reference line.
<Horiz Dist:>	User input	Available for **<Method: Pt/Brg/Dst/Grade>** and **<Method: Pt/Brg/Dst/ΔHt>**. The horizontal distance from the start point to the end point of the reference line.
<Grade:>	User input	Available for **<Method: Pt/Brg/Dst/Grade>**. The gradient of the line from the start point to the end point of the reference line.
<ΔHeight:>	User input	Available for **<Method: Pt/Brg/Dst/ΔHt>**. The difference in height from the start point to the end point of the reference line.
<Radius:>	User input	Available for **<Method: 2 Points/Radius>**. The radius of the reference arc.
<Arc Dist:>	Output	The horizontal grid distance along the arc between **<Start Point:>** and **<End Point:>** of the arc. ----- is displayed if the distance cannot be calculated.

Next step

PAGE (F6) changes to the **Map** page.

The Map page

The **Map** page provides an interactive display of the data.

Next step

IF	THEN
<Task: Measure to XX>	• **CONT (F1)** accepts the changes and accesses **REFLINE Measure Points**. • Refer to "8.4 Measuring to a Reference Line/Arc".
<Task: Stake to XX>	• **CONT (F1)** accepts the changes and accesses **REFLINE Enter Offset Values**. • Refer to "8.5 Staking to a Reference Line/Arc".
<Task: Gridstake XX>	• **CONT (F1)** accepts the changes and accesses **REFLINE Define Grid**. • Refer to "8.6 Gridstaking to a Reference Line/Arc".

8.3.2 Selecting an Existing Reference Line/Arc

Description

Reference lines/arcs can be created, edited, stored, deleted in the **<Control Job:>**.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
4.	Select **<Ref to Use: Select from Job>**.

The Reference page

The explanations for the softkeys and the fields are as for manually entering a reference line. The **<Method:>** field is not available and all line definition fields are outputs, all other differences are described below. Refer to "8.3.1 Manually Entering a Reference Line/Arc" for information. The fields shown depend on the options chosen for **<Task:>** and **<Method:>** in **REFLINE New Reference XX**.

Description of fields

Field	Option	Description
<Ref Line:>	Choicelist	Available for **<Task: XX Line>**. The reference line to be used.
<Ref Arc:>	Choicelist	Available for **<Task: XX Arc>**. The reference arc to be used.
<Arc Dist:>	Output	Available for **<Task: XX Arc>**.

Next step

PAGE (F6) changes to the **Map** page.

The Map page

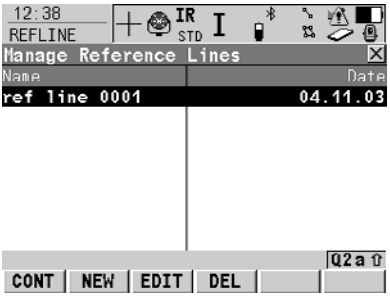
The **Map** page provides an interactive display of the data. The reference line/arc can be viewed but not defined using this page.

Next step

IF	THEN
the desired reference line/arc needs to be created, edited or selected	• Highlight **<Ref Line:>** or **<Ref Arc:>** and press **ENTER** to access **REFLINE Manage Reference XX**. • Refer to paragraph "Managing reference lines".
the desired reference line/arc has been selected	• For **<Task: Measure to XX>** **CONT (F1)** to access **REFLINE Measure Points**, **Ref XX** page. • Refer to "8.4 Measuring to a Reference Line/Arc".

IF	THEN
	• For **<Task: Stake to XX>** **CONT (F1)** to access **REFLINE Enter Offset Values**. • Refer to "8.5 Staking to a Reference Line/Arc". • For **<Task: Gridstake XX>** **CONT (F1)** to access **REFLINE Define Grid**. • Refer to "8.6 Gridstaking to a Reference Line/Arc".
offsets are to be defined	• **OFSET (F4)** to access **REFLINE Define Offsets**.

Managing reference lines



CONT (F1)
To select the highlighted reference line/arc and to return to the screen from where this screen was accessed.

NEW (F2)
To create a reference line/arc.

EDIT (F3)
To edit a reference line/arc.

DEL (F4)
To delete a reference line/arc.

Description of columns

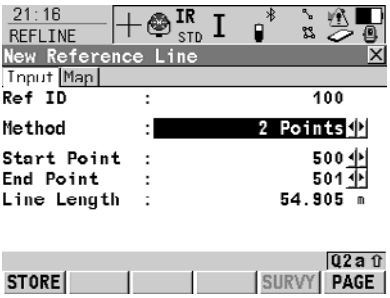
Column	Description
Name	Names of all reference lines/arcs available in the active job.
Date	Date that the reference line/arc was created.

Next step

IF a reference line/arc	THEN
is to be selected	• Highlight the desired reference line/arc. **CONT (F1)** closes the screen and returns to **REFLINE Choose Task & Reference Line**.
is to be created/edited	• **NEW (F2)**/**EDIT (F3)** to access **REFLINE New Reference XX**/**REFLINE Edit Reference XX**. • Refer to paragraph "Creating a new reference line". • Editing a reference line/arc is similar to creating a new reference line/arc. For simplicity, only **REFLINE New Reference XX** is described below and the differences are clearly outlined.

Creating a new reference line

The Input page



STORE (F1)
To store changes and return to **REFLINE Manage Reference XX**.

SURVY (F5)
To measure a known point. Available when **<Start Point:>, <Second Point:>** or **<End Point:>** is highlighted.

Description of fields

Field	Option	Description
<Ref ID:>	User input	The ID of the new reference line/arc.

The other fields available depend on the option chosen for **<Task:>** in **REFLINE Choose Task & Reference Line, Reference** page and **<Method:>** on this screen. When editing a reference line/arc all line definition fields are outputs. Refer to "8.3.1 Manually Entering a Reference Line/Arc" for descriptions.

Next step
PAGE (F6) changes to the **Map** page.

The Map page
The **Map** page provides an interactive display of the data. When editing a reference line/arc this page is a **Plot** page and the reference line/arc can be viewed but not defined using this page.

Next step
STORE (F1) stores the changes and returns to **REFLINE Manage Reference XX**.

8.3.3 Defining the Offsets related to a Reference Line/Arc

Description

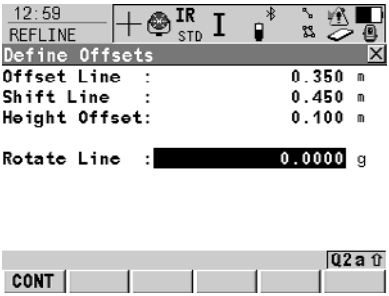
A reference line can be offset, shifted and rotated, a reference arc can be offset.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
4.	Press **OFSET (F4)** to access **REFLINE Define Offsets**.

Defining the offsets

This screen contains different fields depending on the options chosen for **<Heights:>** in **REFLINE Configuration**, **Heights** page, and **<Task:>** in **REFLINE Choose Task & Reference Line**, **Reference** page.



CONT (F1)
To confirm the selections and to return to the previous screen.

SHIFT CONF (F2)
To configure the reference line/arc.

Description of fields

Field	Option	Description
<Offset Line:> or **<Offset Arc:>**	User input	Distance to horizontally offset reference line/arc to the left or right. When an offset is applied to an arc the radius of the arc changes.
<Shift Line:>	User input	Distance to horizontally shift reference line forward or back. Available for **<Task: XX Line>** unless **<Heights: Use Ref Line>** in **REFLINE Configuration, Heights** page.
<Height Offset:>	User input	The vertical offset of the reference line/arc. Available for **<Heights: Use Start Point>** and **<Heights: Use Ref Line>**.
<DTM Offset:>	User input	The vertical offset of the DTM model. Available for **<Heights: Use DTM Model>**.

Field	Option	Description
<Rotate Line:>	User input	Angle by which to rotate the reference line. Available for **<Task: XX Line>** unless **<Heights: Use Ref Line>** in **REFLINE Configuration, Heights** page.

Next step

CONT (F1) closes the screen and returns to **REFLINE Choose Task & Reference Line**.

8.3.4 Defining the Slope related to a Reference Line/Arc

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.

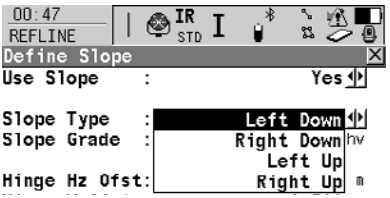
Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
4.	Press **SLOPE (F3)** to access **REFLINE Define Slope**.

Step 1) activating the slope method

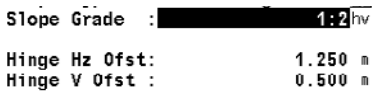
Step	Description
1.	Ensure that **<Use Slope: Yes>** is selected.

Step 2) defining the slope parameters

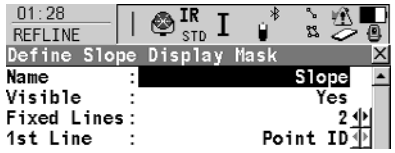
Step	Description
1.	**Defining the slope type**. Defining a slope type of **<Slope Type: Left Down>** creates a downward plane extending to the left of the defined reference line/arc. Defining a slope type of **<Slope Type: Right Down>** creates a downward plane extending to the right of the defined reference line/arc. Defining a slope type of **<Slope Type: Left Up>** creates an upward plane extending to the left of the defined reference line/arc. Defining a slope type of **<Slope Type: Right Up>** creates an upward plane extending to the right of the defined reference line/arc. 
2.	**Defining the slope grade**.

Step	Description
	The inclination of the slope is defined by the slope grade. The units for slope grade are defined in the Configure /Units & Formats screen.

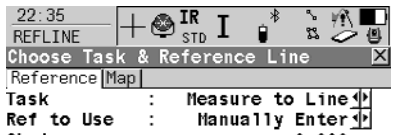
Step 3) defining any necessary offsets

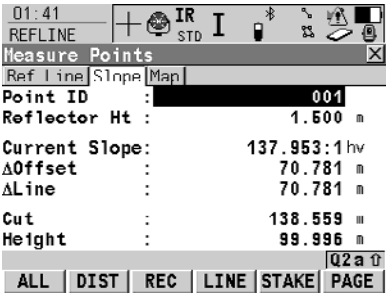
Step	Description
1.	The slope is always defined as starting from a 'hinge line'. The hinge line can be horizontally and/or vertically offset from the reference line/arc. The direction of the reference line/arc is always from the starting point. The offsets are always relative to the direction of the reference line/arc. When Hz Offset=0 and V Offset=0, then the hinge line is the reference line/arc. 

Step 4) defining the display mask

Step	Description
1.	Press **DMASK (F3)** in the Define Slope screen to access the display mask settings This display mask is available when using the slope method. It is user configurable and describes the current reflector position in relation to the defined slope and defined reference line/arc. 

Step 4) measuring the points

Step	Description
1.	Press **CONT (F1)** to close the Define Slope screen.
2.	Choose the appropriate Task and choose the relevant reference line/arc. 
3.	Press **CONT (F1)** to access the Measure Points screen, move to the Slope page.

Step	Description
	

Description of all fields from the Slope Display Mask

Field	Description
<Chainage:>	Displays the current chainage.
<Current Slope:>	Displays the current slope of the reflector position to the hinge.
<Design Slope:>	Displays the slope grade as defined by the user.
<East:>	Displays the East coordinate of the current reflector position.
<Height:>	Displays the Height value of the current reflector position.
<North:>	Displays the North coordinate of the current reflector position.
<Point ID:>	To enter the point ID.
<Reflector Ht:>	To enter the reflector height.
<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 reflector 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.
<ΔHeight Hinge:>	Displays the delta height from the current position to the hinge.
<ΔHeight Line:>	Displays the delta height from the current position to the line/arc.
<ΔLine/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.
<ΔLine/Arc-End:>	Displays the horizontal distance from the end point of the line/arc to the base point of the measured point, along the line/arc.

Field	Description
<ΔOffset:>	Displays the perpendicular offset from the line/arc to measured point.
<ΔOffset Hinge:>	Displays the perpendicular offset from the hinge to measured point.

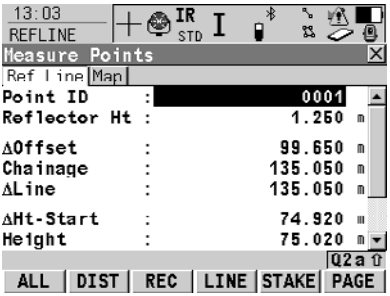
8.4 Measuring to a Reference Line/Arc

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
	Select **<Task: Measure to XX>**.
4.	Press **CONT (F1)** to access **REFLINE Measure Points**.

The Ref Line page

The fields available depend on the options chosen for **<Task:>** in **REFLINE Choose Task & Reference Line, Reference** page and **<Heights:>** and **<Edit Height:>** in **REFLINE Configuration, Heights** page.



ALL (F1)
To measure and record the current position.

DIST (F2)
To measure and display distances. The difference between the current position and the point being staked is displayed.

REC (F3)
To record displayed values.

LINE (F4)
To define/select a reference line/arc.

STAKE (F5)
To define reference line offsets to be staked out in relation to the reference line.

SHIFT CONF (F2)
To configure a reference line/arc.

SHIFT AVGE (F2)
To check an exceeding of the threshold settings for the differences for the position and height components between the averaged point and the point being stored.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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:>	User input	The point ID of the point to be measured.
<Reflector Ht:>	User input	An individual reflector height can by typed in.
<ΔOffset:>	Output	Perpendicular offset from the reference line/arc calculated from the reference point to the measured point.
<Check Dist 1:>	Output	Horizontal distance from start point to measured point.
<Check Dist 2:>	Output	Horizontal distance from end point to measured point.
<ΔLine:>	Output	Horizontal distance along the reference line from the start point to the reference point.
<ΔLine-End:>	Output	Horizontal distance along the reference line from the end point to the reference point.
<ΔArc:>	Output	Horizontal distance along the reference arc from the start point to the reference point.
<ΔArc-End:>	Output	Horizontal distance along the reference arc from the reference point to the end point.
<ΔHt-Start:>	Output	Height difference between the start point and the measured point.
<Height:>	Output	Height of measured point.
<ΔHt-Line:>	Output	Height difference between the reference point and the measured point.
<ΔPerp Dist:>	Output	Slope distance between the reference point and the measured point.
<ΔSpatial Dist:>	Output	Slope distance between the start point and the reference point.
<ΔHt-DTM:>	Output	Height difference between the measured point and the DTM.
<Design Ht:>	User input	Allows input of the design height of the target point.
<ΔHt-Design:>	Output	Height difference between the **<Design Ht:>** and the height of the measured point.

Next step

PAGE (F6) changes to the **Map** page.

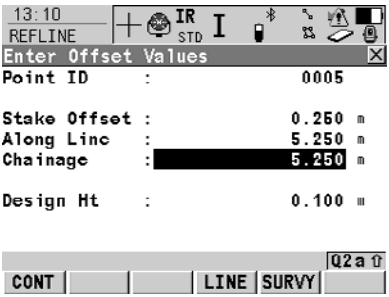
8.5 Staking to a Reference Line/Arc

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
	Select **<Task: Stake to XX>**.
4.	Press **CONT (F1)** to access **REFLINE Enter Offset Values**.

Entering the offset values

The screen contains different fields depending on the options chosen for **<Heights:>** and **<Edit Height:>** in **REFLINE Configuration**, **Heights** page and **<Task:>** in **REFLINE Choose Task & Reference Line**, **Reference** page. The explanations for the softkeys given below are valid in all cases.



CONT (F1)
To confirm the selections and to continue with the subsequent screen.

LINE (F4)
To define/select a reference line/arc.

SURVY (F5)
To measure a point relative to the reference line/arc.

SHIFT CONF (F2)
To configure the reference line/arc.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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:>	User input	The point ID of the target point to be staked.
<Stake Offset:>	User input	The offset from the reference point to the target point.
<Along Line:>	User input	Available for **<Task: Stake to Line>**. Horizontal distance from the start point to the reference point along the reference line.
<Along Arc:>	User input	Available for **<Task: Stake to Arc>**. Horizontal distance from the start point to the reference point along the reference arc.

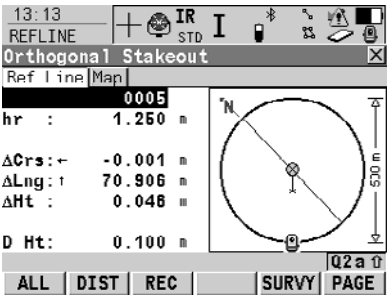
Field	Option	Description
<Chainage:>	User input	Chainage along the line/arc. This is the chainage of the start of the reference line/arc plus **<Along Line:>**/**<Along Arc:>**.
<Height Offset:>	User input	Available for **<Edit Height: No>** unless **<Heights: Use DTM Model>** in **REFLINE Configuration**. The height offset of the target point is calculated as the height of the start/reference point plus **<Height Offset:>**.
<Design Ht:>	User input	Available for **<Edit Height: Yes> in REFLINE Configuration, Heights** page. The suggested design height of the target point is the height of the start/reference point.

Next step

CONT (F1) to accept changes and continue to **REFLINE XX Stakeout, Ref XX** page.

The Ref Line page

This screen contains different fields depending on the options chosen for **<Stake Mode:>** in **REFLINE Configuration, General** page. The majority of the softkeys are identical to those available for measuring to a reference line/arc. Refer to "8.4 Measuring to a Reference Line/Arc" for information on the softkeys.



SURVY (F5)
To measure a point relative to the reference line/arc.

SHIFT POSIT (F4)
Positions the telescope on the point to be staked out.

Description of fields

Field	Option	Description
<Point ID:>	User input	The point ID of the target point to be staked.
<Reflector Ht:> or **<hr:>**	User input	The default reflector height as defined in the active configuration set is suggested.
<Height:> or **<Ht:>**	Output	Available for **<Edit Height: No>** in **REFLINE Configuration**, **Heights** page.

Field	Option	Description
<Design Ht:> or **<D Ht:>**	User input	Available for **<Edit Height: Yes>** in **REFLINE Configuration**, **Heights** page.

Next step
PAGE (F6) changes to the **Map** page.

8.6 Gridstaking to a Reference Line/Arc

Access step-by-step

Step	Description
1.	Press **PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Line** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFLINE Choose Task & Reference Line**. Select **Reference** page.
	Select **<Task: Gridstake to XX>**.
4.	Press **CONT (F1)** to access **REFLINE Define Grid**.

Defining the grid

The softkeys are identical to those available for staking to a reference line/arc. Refer to "8.5 Staking to a Reference Line/Arc" for information on the softkeys.

Description of fields

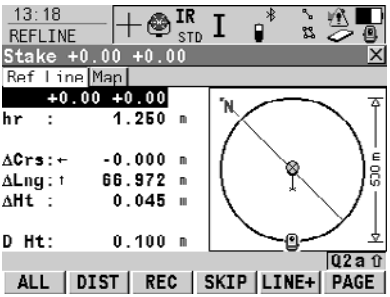
Field	Option	Description
<Begin Grid at:>	User input	Distance along the reference line/arc from the start point to the first target point to be staked.
<Chainage:>	User input	Chainage of the first target point to be staked along the line/arc. This is the chainage of the start of the reference line/arc plus **<Begin Grid At:>**.
<Increment by:>	User input	Spacing between points on the grid line.
<Line Offsets:>	User input	Spacing between grid lines.
<Next Line:>	**Start at Begin**	Each new grid line is started at the same end as where the previous grid line started.
	Current Grid Pt	Each new grid line is started at the same end as where the previous grid line finished.
<Point ID:>	**Grid ID**	Point ID is shown as the position of the grid being staked.
	Pt ID Template	The point ID template as defined in the active configuration set is used for grid point ID's.

Next step

CONT (F1) accepts the changes and continues to **REFLINE Stake +yyy.yy +xxx.xx**, **Ref XX** page.

The Ref Line page

The title of this screen indicates the position of the grid being staked where +yyy.yy is the station position along the grid line and +xxx.xx is the grid line offset.
The functionality of this screen is very similar to **REFLINE XX Stakeout, Ref XX** page. Differences between the two screens are outlined below. Refer to "8.5 Staking to a Reference Line/Arc" for all other key and field explanations.



SKIP (F4)
To skip the currently displayed station and increment to the next station.

LINE (F5)
To start staking the next grid line. The position of the first point on the new line is determined by the option selected for **<Next Line:>.**

Description of fields

Field	Option	Description
<Point ID:>	User input	The point ID is based on the selection for **<Point ID:>** in **REFLINE Define Grid**. If a different point ID is typed in, the next point ID will still be shown as the next automatically computed point ID.
<Height:> or **<Ht:>**	Output	Available for **<Edit Height: No>** in **REFLINE Configuration**, **Heights** page.
<Design Ht:> or **<D Ht:>**	User input	Available for **<Edit Height: Yes>** in **REFLINE Configuration**, **Heights** page. To type in the design height. If a design height has been entered and **SKIP (F4)** or **LINE (F5)** is used the true grid height for the next point is shown as the suggested height.

Next step
PAGE (F6) changes to the **Map** page.

9 Reference Plane & Face Scan

9.1 Overview

Description

- The Reference Plane & Face Scan application program can be used to measure points relative to a reference plane.
- A reference plane can also be scanned via Face Scan.

Reference plane tasks

The Reference Plane & Face Scan application program 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.
- Scanning a defined area.

☞ Planes can only be computed with grid coordinates.

Defining a reference plane

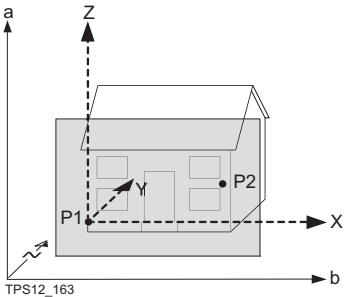
Reference planes are created using a right hand system. For two points defining a plane a vertical plane is used. A reference plane is defined with the X axis and the Z axis of the plane. The Y axis of the plane defines the positive direction of the Y axis. A reference plane can be defined in the following ways.

- vertical
- tilted

Vertical plane

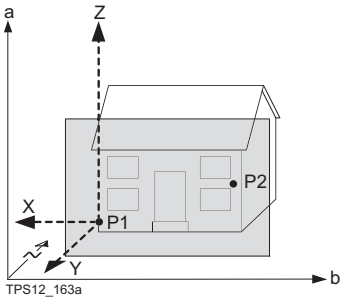
The axis of the vertical reference plane are:

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.



TPS12_163

a Height
b Easting
N Northing
P1 Origin of plane
P2 Point of plane
X X axis of plane



TPS12_163a

a Height
b Easting
N Northing
P1 Origin of plane
P2 Point of plane
X X axis of plane

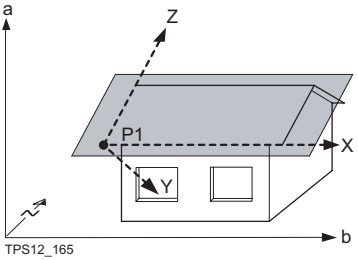
Y Y axis of plane
Z Z axis of plane

Y Y axis of plane
Z Z axis of plane

Tilted plane

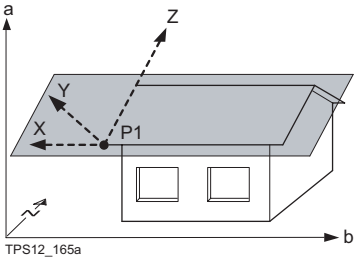
Any number of points define the plane, perimeter to be scanned is defined by a bottom left-topright window. The axis of the tilted reference plane are:

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.



TPS12_165

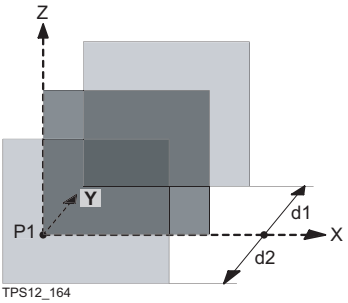
a Height
b Easting
N Northing
P1 Origin of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane



TPS12_165a

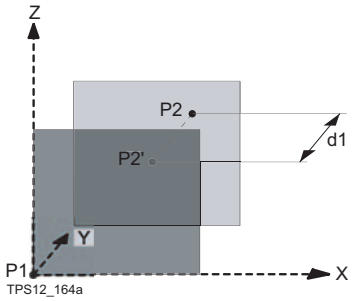
a Height
b Easting
N Northing
P1 Origin of plane
X X axis of plane
Y Y axis of plane
Z Z axis of plane

Offset of the plane



TPS12_164

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



TPS12_164a

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

With four or more points a least squares adjustment is calculated resulting in a best fit plane.

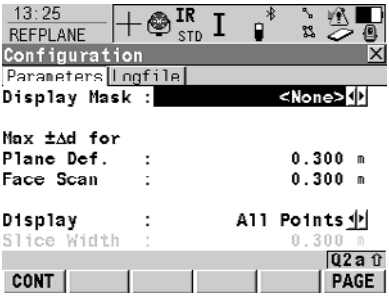
Origin	The origin of the reference plane can be defined to be in the plane coordinates or in the instrument coordinates.
Positive direction of plane	The positive direction of the plane is defined by the direction of the Y axis. The direction can be changed by selecting a point which defines the negative direction of the Y axis.

9.2 Configuring Reference Plane

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Plane** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **REFPLANE Configuration**.

REFPLANE Configuration, Parameters page



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DMASK (F3)
To edit the display mask currently being displayed. Available when **<Display Mask:>** is highlighted on **Parameters** page.

SHIFT ABOUT (F5)
To display information about the application program name, the version number, the date of the version, the copyright and the article number.

Description of fields

Field	Option	Description
<Display Mask:>	Choicelist	The user defined display mask is shown in **REFPLANE Measure Points to Plane**.
<Max ±Δd for Plane Def.:>	User input	The maximum perpendicular deviation of a point from the calculated plane.
<Plane Def.:>	User input	The maximum perpendicular deviation of a point from the calculated plane.
<Face Scan:>	User input	The maximum perpendicular deviation of a measured point in face scan from defined plane. Scanned points outside the defined limit are not stored.
<Display:>		This parameter defines the points displayed in the Plot and Map pages of the Reference Plane application program in the plan view.
	All Points	Displays all points.
	Points in Slice	Displays points within the defined **<Slice Width:>**.

Field	Option	Description
<Slice Width:>	User input	Available for **<Display: Points in Slice>**. This distance is applied to both sides of the plane. If lines and areas are to be displayed in a particular Map page, then parts of lines and areas falling within the defined slice are also displayed.

Next step
PAGE (F6) changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".

9.3 Managing Reference Planes

Description

Overview

- A reference plane is used to measure points relative to the plane or to scan the plane.

Measure to plane

- **<Task: Measure To Plane>** in **REFPLANE Choose Task & Reference Plane**.
- Reference planes can be created, edited, stored and deleted in the active job.
- The reference planes can be recalled for later use.
- The plane can be shifted through a point or a defined offset.

Scan a plane

- **<Task: Scan>** in **REFPLANE Choose Task & Reference Plane**.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Plane** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFPLANE Reference Plane Begin**.
4.	Press **CONT (F1)** to access **REFPLANE Choose Task & Reference Plane.**

REFPLANE Choose Task & Reference Plane

Description of fields

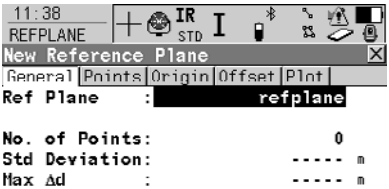
Field	Option	Description
<Task:>	**Measure to Plane**	The coordinates of measured points are calculated relative to the reference plane.
<Plane to Use:>	**Create New Plane** **Select From Job**	Defines a new reference plane. Reference plane is selected in **<Ref Plane:>**.
<Ref Plane:>	Choicelist	Available for **<Plane to Use: Select From Job>**. The reference plane to be used.
<No. of Points:>	Output	Available for **<Plane to Use: Select From Job>**. Number of points used for plane definition for the plane shown in the **<Ref Plane:>**.
<Std Deviation:>	Output	Standard deviation of used points for plane definition. ----- is displayed for less than four points.
<Max Δd:>	Output	Maximum distance between a point and the calculated plane. ----- is displayed for less than four points.
<Offset:>	Output	The offset method used as defined in **REFPLANE XX Reference Plane, Offset** page.

Field	Option	Description
<Origin:>	Output	The origin method used as defined in **REFPLANE XX Reference Plane, Origin** page.

Next step

IF	THEN
a new plane is to be created	• **CONT (F1)** accesses **REFPLANE New Reference Plane, General** page. • Refer to paragraph " REFPLANE New Reference Plane, General page".
a plane is to be edited	• **<Plane to Use: Select From Job>**. Highlight **<Ref Plane:>**. **ENTER** to access **REFPLANE Manage Reference Planes**. **EDIT (F3)** to access **REFPLANE Edit Reference Plane**, **General** page. • Refer to "REFPLANE New Reference Plane, General page". • Editing a reference plane is similar to creating a new reference plane. For simplicity, only **REFPLANE New Reference Plane** is explained.
points are to be measured to a plane	• **CONT (F1)** accessses **REFPLANE Measure Points to Plane, Reference** page. • Refer to "9.4 Measuring Points to a Reference Plane".
a plane is to be scanned	• **CONT (F1)** accesses **REFPLANE Define Scanning Parameters**. • Refer to "9.5 Scanning a Plane".

REFPLANE New Reference Plane, General page



STORE (F1)
To compute and store the reference plane.

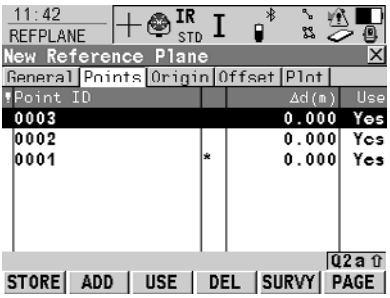
Description of fields

Field	Option	Description
<Ref Plane:>	User input	The ID of the new reference plane.
<No. of Points:>	Output	Number of points used for plane definition.

Field	Option	Description
<Std Deviation:>	Output	Standard deviation of used points for plane definition. ----- is displayed unless more than four points are used to define the plane.
<Max Δd:>	Output	Maximum distance between measured point and defined plane. ----- is displayed unless more than four points are used to define the plane.

Next step
PAGE (F6) changes to **REFPLANE New Reference Plane**, **Points** page.

REFPLANE New Reference Plane, Points page



STORE (F1)
To compute and store the reference plane.

ADD (F2)
To add points from **REFPLANE Data: Job Name** to define the reference plane.

USE (F3)
To change between **Yes** and **No** for the highlighted point.

DEL (F4)
To remove the highlighted point from the list.

SURVY (F5)
To measure a point to be used for the plane.

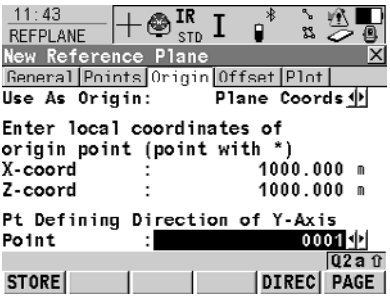
SHIFT ORIGIN (F4)
To use the highlighted point as the origin of the plane.

Description of columns

Column	Description
Δd(m)	Displays the perpendicular distance of the point from the definition of the plane.
*	Shown to the right of the point for a point which will be used as origin of the plane.
!	Shown to the left of the point if the point is outside maximum distance between a point and the calculated plane as defined in **REFPLANE Configuration**, **Parameters** page.

Next step
PAGE (F6) changes to **REFPLANE New Reference Plane**, **Origin** page.

REFPLANE New Reference Plane, Origin page



STORE (F1)
To compute and store the reference plane.

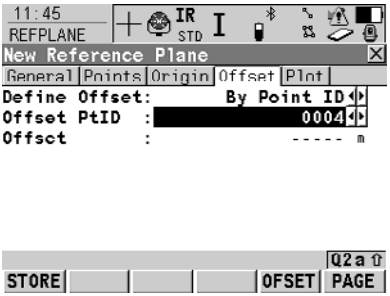
DIREC (F5)
Available for **<Point:>** being highlighted. To access **REFPLANE Survey: XX**. Measure a point to define the positive plane direction.

Description of fields

Field	Option	Description
<Use As Origin:>	**Plane Coords**	Point results are additionally stored with X, Y, Z coordinates based on the local plane coordinate system.
	Instrumnt Coords	Points on the plane are transformed into the national coordinate system.
<X-coord:> or **<Z-coord:>**	User input	Available for **<Use As Origin: Plane Coords>**. Enter local X or Z coordinate of origin. The origin is defined as the projection of the measured point onto the calculated plane.
<Point:>	Choicelist	Defines the positive direction of the Y axis.

Next step
PAGE (F6) changes to **REFPLANE New Reference Plane**, **Offset** page.

REFPLANE New Reference Plane, Offset page



STORE (F1)
To compute and store the reference plane.

OFSET (F5)
Available for **<Offset PtID:>** being highlighted. Measure a point to define the offset point.

Description of fields

Field	Option	Description
<Define Offset:>	Choicelist	An offset can be defined by a point or a distance. The defined plane is shifted along the Y axis by the offset.
<Offset PtID:>	Choicelist	Available for **<Define Offset: By Point ID>**. Point ID of offset point.
<Offset:>	User input or output	Distance by which to offset the plane along the Y axis.

Next step
PAGE (F6) changes to **REFPLANE New Reference Plane**, **Plot** page.

REFPLANE New Reference Plane, Plot page

Points displayed depend on the settings in **REFPLANE Configuration**, **Parameters** page. Points defining the plane are displayed in black, the other points are displayed in grey.

Softkey	Description
SHIFT FACE (F1)	To access the face view of the plane.
SHIFT PLAN (F1)	To access the plan view of the plane.

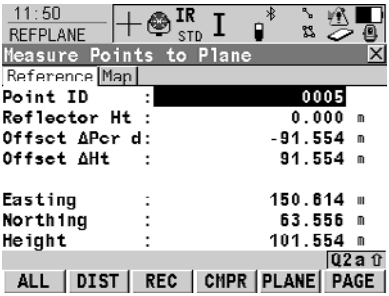
Next step
STORE (F1) to compute and store the reference plane.

9.4 Measuring Points to a Reference Plane

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Plane** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **REFPLANE Choose Task & Reference Plane**.
4.	Select a reference plane.
5.	Press **CONT (F1)** to access **REFPLANE Measure Points to Plane**. Select **Reference** page.

REFPLANE Measure Points to Plane, Reference page



ALL (F1)
To measure and store distances and angles.

DIST (F2)
To measure and display distances.

REC (F3)
To record data.

CMPR (F4)
To calculate offsets to previously measured points.

PLANE (F5)
To edit the selected reference plane.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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
<Offset ÄPer d:>	Output	The perpendicular distance between current position and adjusted plane.
<Offset ΔHt:>	Output	The vertical distance between current position and adjusted plane.

Next step
PAGE (F6) changes to **REFPLANE Measure Points to Plane**, **Map** page.

REFPLANE Measure Points to Plane, Map page

Softkey	Description
SHIFT FACE (F1)	To access the face view of the plane.
SHIFT PLAN (F1)	To access the plan view of the plane.

Next step

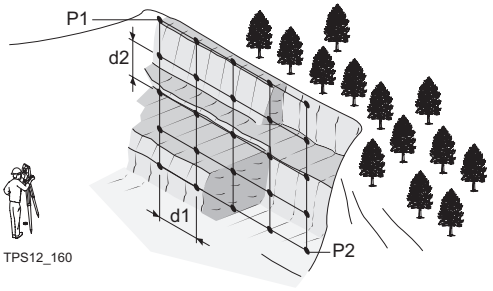
PAGE (F6) changes to another page on this screen.

9.5 Scanning a 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 interval values for vertical and horizontal grid are defined by the user. Face scan can be run on motorised instruments with the option "reflectorless EDM" only.

Diagram



Known

P1 First corner of plane
P2 Second corner of plane
d1 **<Horizontal:>** grid spacing
d2 **<Up Slope:>** grid spacing

Unknown

Grid point coordinates

Scan a new plane step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Reference Plane** and press **CONT (F1)**.
☞	Press **CONF (F2)** to access **REFPLANE Configuration**.
3.	Press **CONT (F1)** to access **REFPLANE Choose Task & Reference Plane**.
4.	Select **<Task: Scan>**. Select **<Plane to Use: Create New Plane>**.
5.	Press **CONT (F1)** to access **REFPLANE New Reference Plane**
6.	Define new reference plane. Refer to paragraph " REFPLANE New Reference Plane, General page".
7.	Press **STORE (F1)** to store the new reference plane.
8.	Define the first and second corner of the area to be scanned.
9.	**REFPLANE Define Scanning Parameters** For tilted and vertical planes: **<Horizontal:>** Horizontal grid distance. **<Up Slope:>** Up slope grid distance. **<Start Pt ID:>** Name of the first point ID. **<Pt ID Inc:>** The incrementation used for **<Start Pt ID:>**. No point ID template used.

Step	Description
	• For **<Start Pt ID: RMS>** and **<Pt ID Inc: 10>** the points are **<Point ID: RMS>**, **<Point ID: RMS10>**, **<Point ID: RMS20>**, ..., **<Point ID: RMS100>**, ... • For **<Start Pt ID: 100>** and **<Pt ID Inc: 10>** the points are **<Point ID: 100>**, **<Point ID: 110>**, ..., **<Point ID: 200>**, **<Point ID: 210>**, ... • For **<Start Pt ID: abcdefghijklmn89>** and **<Pt ID Inc: 10>** the points are **<Point ID: abcdefghijklmn99>**, point ID incrementing fails. **<Scan Area:>** Size of the area to be scanned. **<Estimated Pts:>** Estimated number of points to be scanned.
10.	**START (F1)** to access **REFPLANE Scanning Status, Scanning** page.
☞	**PAUSE (F3)** to pause the scanning of points. **SCAN (F3)** to continue scanning.
☞	**STOP (F1)** to stop the scanning of points.
11.	**REFPLANE Scanning Status, Scanning** page. Status of the scanning is displayed when under process. **<Pts Scanned:>** Number of points being scanned. **<Pts Remaining:>** Number of points remaining to be scanned. **<Pts Rejected:>** Number of skipped points. **<% Completed:>** Percentage of points scanned. **<Time Left:>** Estimated time remaining until scan is finished. **<Point ID:>** Point ID of last stored point.
12.	**PAGE (F6)** to access **REFPLANE Scanning Status, Plot** page.
13.	**REFPLANE Scanning Status, Plot** page. Points currently scanned are displayed in black, previously measured points, lines and areas are dispayed in grey.
☞	**SHIFT FACE (F1)** to access the face view of the plane. **SHIFT PLAN (F1)** to access the plan view of the plane.
14.	**CONT (F1)** to access **REFPLANE Choose Task & Reference Plane**.

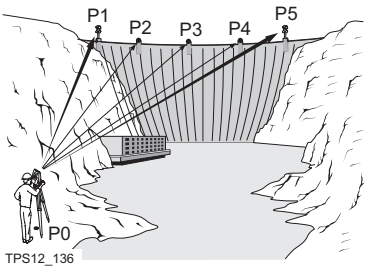
10 Sets of Angles

10.1 Overview

Description

- Sets of Angles:
  - This program (which can include Monitoring as an option) is used to measure multiple sets of directions and distances (optional) to pre-defined target points in one or two faces.
  - The mean direction and mean distance (optional) to each target point, within a set is calculated. The residual for each direction and distance (optional) within a set is also calculated.
  - The reduced average direction and average distance (optional) to each target point, for all active sets is calculated.
- 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-P5 pre-defined points - E,N,Height (optional)
Unknown:
Mean direction and mean distance to each point, within a set
Residual for each direction and distance, within a set
Reduced average direction and average distance to each point, for all active sets
Measure at least:
Two points and Two sets

ATR - automatic target recognition

ATR search and ATR measurements can be performed to a reflector. After the first measurement to each point is done, the measurements to the other points are automated.

Station setup and station orientation

A station set up and station orientation is required before starting the Sets of Angles program, if oriented grid coordinates are to be recorded.

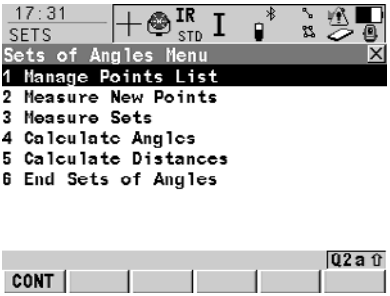
10.2 Sets of Angles

10.2.1 Accessing Sets of Angles

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Sets of Angles** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **SETS Sets of Angles Menu** The menu lists all options to select/measure/calculate sets. Highlight the desired option.
4.	Press **CONT (F1)**.

SETS Sets of Angles Menu



CONT (F1)
To select the highlighted option and to continue with the next screen.

SHIFT CONF (F2)
To configure the program.

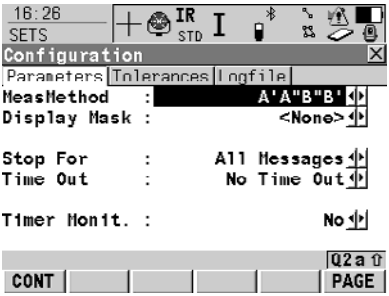
10.2.2 Configuring Sets of Angles

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Sets of Angles** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **SETS Configuration**.

SETS Configuration, Parameters page

The explanations for the softkeys given below are valid for all pages, unless otherwise stated.



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DEFLT (F5)
Available for default configuration sets. To recall the default settings.

Description of fields

Field	Option	Description
<MeasMethod:>	**$A^{I}A^{II}B^{II}B^{I}$**	Points are measured in face **I** and face **II**. point A **I** - point A **II** - point B **II** - point B **I** ...
	$A^{I}A^{II}B^{I}B^{II}$	Points are measured in face **I** and face **II**. point A **I** - point A **II** - point B **I** - point B **II** ...
	$A^{I}B^{I}A^{II}B^{II}$	Points are measured in face **I** and face **II**. point A **I** - point B **I**... point A **II** - point B **II** ...
	$A^{I}B^{I}B^{II}A^{II}$	Points are measured in face **I** and face **II**. point A **I** - point B **I** .. point B **II** - point A **II** ..
	$A^{I}B^{I}C^{I}D^{I}$	Points are only measured in face **I**. point A **I** - point B **I** - point C **I** - point D **I** ...
<Display Mask:>	Choicelist	The user defined display mask to be shown in **SETS Select Points - Survey**.
<Stop For:>	Choicelist	To define what action is taken when a message dialog appears during a measurement set.
	All Messages	All message dialogs are displayed as per normal and are closed as defined by the settings in **<Time Out:>**.

Field	Option	Description
	Tol Exceed Only	Only the message dialog relating to the exceeding of tolerances is displayed and is closed as defined by the settings in **<Time Out:>**.
	Never	• No message dialogs are displayed except for specific warnings. • Specific warnings which affect the instrument and it's ability to continue with the monitoring process will be displayed and will remain on the screen. These include the over-heating of the instrument, low battery levels, unavailable space on the CompactFlash card.
<Time Out:>		To define the time delay for the automatic closing of message dialogs during a measurement set. This choicelist is not available when **<Stop For: Never>**.
	No Time Out	There is no automatic closure of message dialogs. When a message dialog appears, it is only closed by pressing **YES (F4)**.
	1 sec to **60 sec**	All message dialogs are automatically closed as defined by these individual time settings.
<Timer Monit.:>		This input field is only available when Monitoring is registered through the licence key.
	Yes	Automatic monitoring of target points is activated.
	No	Automatic monitoring of target points is not activated. The Sets of Angles application will apply.

Next step
PAGE (F6) changes to the **Tolerances** page.

SETS Configuration, Tolerances page

Description of fields

Field	Option	Description
<Use Tolerances:>	**Yes** or **No**	The entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements.
<Hz Tolerance:>, **<V Tolerance:>** or **<Dist Tolerance:>**	User input	Tolerance for horizontal, vertical directions and distances.

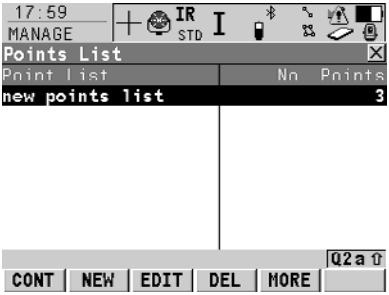
Next step
PAGE (F6) changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".

10.2.3 Managing the Points List

Access

Highlight **Manage Points List** in **SETS Sets of Angles Menu** and **CONT (F1)**.

MANAGE Points List



CONT (F1)
To return to the Sets of Angles Menu.

NEW (F2)
To create a new points list.

EDIT (F3)
To edit an existing points list.

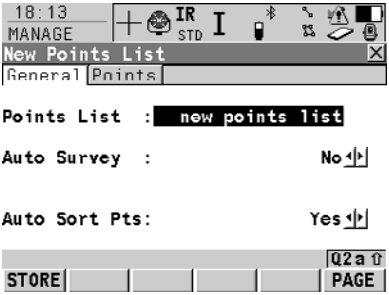
DEL (F4)
To delete an existing points list.

MORE (F5)
To display additional information.

SHIFT HOME (F2)
To move the focus to the top of all the lists.

SHIFT END (F3)
To move the focus to the end of all the lists.

MANAGE New Points List General page

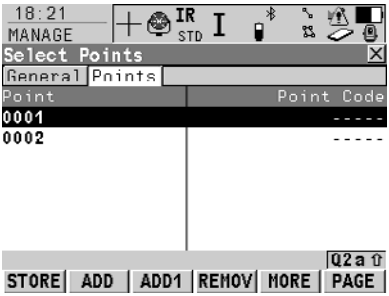


STORE (F1)
To store the new points list.

Description of fields

Field	Option	Description
<Points List:>	User input	The name of the points list.
<Auto Survey:>	**Yes** or **No**	To automatically survey the target points (the instrument will automatically turn and measure the target point). For instruments with ATR.
<Auto Sort Pts:>	**Yes** or **No**	To automatically sort the target points (the instrument will work in a clockwise direction and find the shortest path to move between the target points).

MANAGE
Select Points
Points page



STORE (F1)
To store the points to the list.

ADD (F2)
To add points from the fixpoint job to the list.

ADD 1 (F3)
To add one point from the fixpoint job to the list.

REMOV (F4)
To remove the highlighted point from the list. The point itself is not deleted.

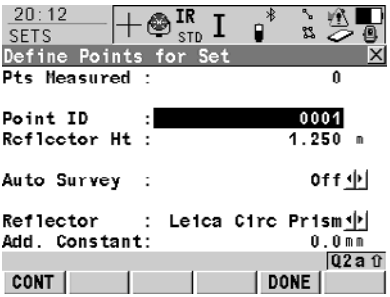
MORE (F5)
To display additional information.

10.2.4 Measuring the New Points

Access

Highlight **Measure New Points in SETS Sets of Angles Menu** and **CONT (F1)**.

SETS Define Points for Set



CONT (F1)
To measure the entered point.

DONE (F5)
To finish selection of points.

SHIFT GETPT (F4)
To select points stored in the database.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
To change between entering an individual point ID different to the defined ID template and the running point ID according to the ID template.

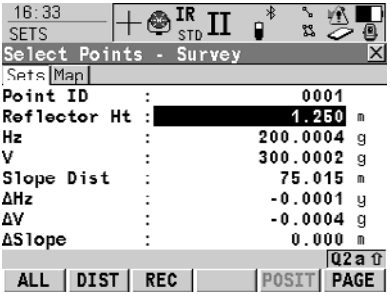
Description of fields

Field	Option	Description
<Auto Survey:>	**On** or **Off**	For instruments with ATR and **<Auto Survey: On>** ATR search and ATR measurements are done to specified targets in additional sets.

Next step

CONT (F1) accesses **SETS Select Points - Survey**.

SETS Select Points - Survey, Sets page



ALL (F1)
To measure and store angles and distance.

DIST (F2)
To measure a distance.

REC (F3)
To store data.

POSIT (F5)
To position the instrument to the selected target point.

Description of fields

The fields are the same as in **SETS Set XX of XX, Pt XX of XX**.

Next step

ALL (F1) measures, stores and returns to **SETS Define Points for Set**.

☞ If **<Auto Survey: On>**, instruments with ATR automatically measure the selected points in the second face of the first set.

10.2.5 Measuring the Sets

Access

Highlight **Measure Sets** in **SETS Sets of Angles Menu** and **CONT (F1)**.

SETS
Measure Sets

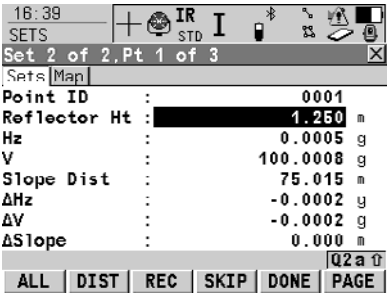
Description of fields

Field	Option	Description
<No. of Sets:>	User input	The number of sets to be measured with the selected points.
<No. of Pts:>	Output	The number of target points.

Next step
CONT (F1) measures further sets of the defined points.

SETS
Set XX of XX, Pt XX of XX,
Sets page

The functionality of this screen is very similar to **SETS Select Points - Survey, Sets** page. Differences between the two screens are outlined below. Refer to "10.2.4 Measuring the New Points" for information on all other softkeys and fields.



SKIP (F4)
To skip measuring the displayed point and continue with the next point.

DONE (F5)
To end the sets of angles measurements.

SHIFT POSIT (F5)
To position the instrument to the selected target point.

Description of fields

Field	Option	Description
<Δ Hz:>, **<Δ V:>** and **<Δ Slope:>**	Output	Difference between the current horizontal/vertical angle or distance and the horizontal/vertical angle or distance to this target when selected.

Next step
ALL (F1) measures further sets of the selected points.

☞ Motorised instruments point automatically in the direction of the targets. Instruments with ATR and **<Auto Survey: On>** measure the targets automatically.

☞ For the calculation two entire sets must be measured. Horizontal and vertical angles and distances can be calculated individually.

10.2.6 Calculating Angles and Distances in Two Faces

Description

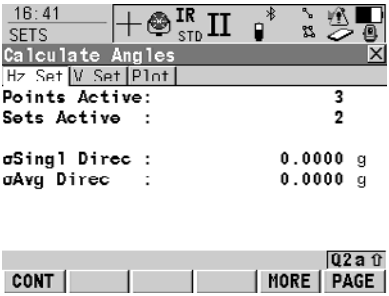
For two and more sets measured with angles and distances in two faces calculations can be done for angles and distances. For sets measured in one face the results can be viewed no calculations are done. Refer to "10.2.8 Viewing Angle and Distance Results in One Face" for more information.

Access

Highlight **Calculate Angles** in **SETS Sets of Angles Menu** and **CONT (F1)**.

SETS Calculate XX, XX Set page

The softkeys are the same for vertical angles, horizontal angles and for distances.



CONT (F1)
To access **SETS Sets of Angles Menu**.

MORE (F5)
To view results of calculation.

Description of fields

Field	Option	Description
<Points Active:> and **<Sets Active:>**	Output	Number of active points/sets which are set to **On** in the **Use** column and used for calculation.
<σSingl Direc:> or **<σSingl Dist:>**	Output	Standard deviation of a single horizontal/vertical direction or single distance.
<σAvg Direc:> or **<σAvg Dist:>**	Output	Standard deviation of the average horizontal/vertical direction or average distance.

Next step

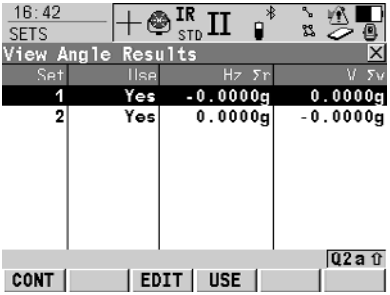
MORE (F5) accesses **SETS View XX Results**.

10.2.7 Viewing Angle and Distance Results in Two Faces

Access

Press **MORE (F5)** in **SETS Calculate Angles or SETS Calculate Distances**.

SETS
View XX Results



CONT (F1)
To access **SETS Calculate XX**.

EDIT (F3)
To view residuals in the highlighted set.

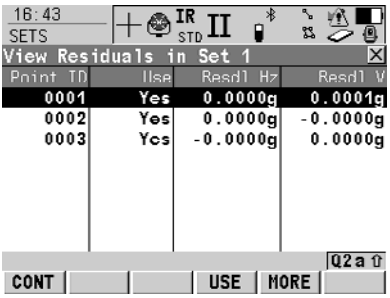
USE (F4)
To set **Yes** or **No** in the **Use** column for the highlighted set.

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 Σr in Hz of the selected set. Σr is the sum of the difference between the reduced average direction and each sets directions. For sets not used for calculation ----- is shown.
V Σr	Shows the calculated Σr in V of the selected set. Σr is the sum of the difference between the average V angles and each sets V angles. For sets not used for calculation ----- is shown.

Next step
CONT (F1) accesses **SETS Calculate XX**.

SETS
View Residuals in Set XX



CONT (F1)
To access **SETS View XX Results**.

USE (F4)
To set **Yes** or **No** in the **Use** column for the highlighted point.

MORE (F5)
To view additional information.

Description of columns when calculating angles

Column	Description
Point ID	Point ID of the measured points in the order they were defined and measured in **SETS Measure New Points** truncated to six digits from the right.
Use	• For **Yes**: The point is used for calculations in all sets. • For **No**: The point is not used for calculations in all sets.
Resdl Hz	Residual in the Hz value of the point within the single set.
Resdl V	Residual in the V value of the 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	Point ID of the measured points in the order they were defined and measured in **SETS Measure New Points** truncated to six digits from the right.
Use	• For **Yes**: The point is used for calculations in all sets. • For **No**: The point is not used for calculations in all sets.
Resdl SD	Residual in the distance value of the point within the single set.
Avg SD	Average distance value of the point in all active sets.
Mean SD	Mean distance value of the point within the single set.

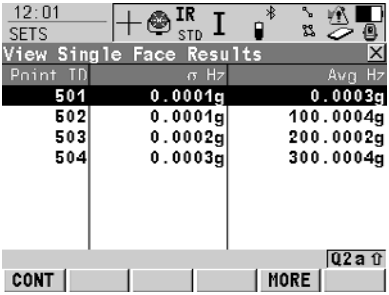
Next step
CONT (F1) accesses **SETS View XX Results**.

10.2.8 Viewing Angle and Distance Results in One Face

Access

Highlight **Calculate XX** in **SETS Sets of Angles Menu** and press **CONT (F1)**.

SETS
View Single Face Results



CONT (F1)
To access **SETS Sets of Angles Menu**.

MORE (F5)
To view additional columns.

Description of columns

Column	Description
Point ID	Point ID of the measured points in the order they were defined and measured in **SETS Measure New Points** truncated to six digits from the right.
σ Hz, **σ V** and **σ Dist**	Standard deviation of all Hz, V readings or distance measurements to the current point.
Mean Hz, **Mean V** and **Mean SD**	Mean value of all Hz, V readings or distance measurements to the current point.

Next step
CONT (F1) accesses **SETS Sets of Angles Menu**

10.3 Monitoring

Description

- Monitoring is a module integrated within the Sets of Angles application program.
- 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 dialogs during measurement sets is also enabled.

Important aspects

- For monitoring, instruments must be motorised.

Access

- Monitoring is licence protected and is only activated through a licence key. The licence key can be entered manually or loaded from the CompactFlash card.
- Refer to "10.2.1 Accessing Sets of Angles" for details on accessing Monitoring.

Monitoring preparation

- This step-by-step desciption is an example on preparing a set for monitoring.
- Refer to "10.2 Sets of Angles" for a complete description of the Sets of Angles program.

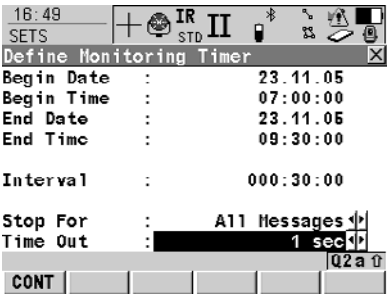
Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Sets of Angles** and press **CONT (F1)**.
3.	Set station coordinates and station orientation - **SETUP (F3)**.
4.	Configure Sets of Angles for monitoring - **CONF (F2)**. For the **Parameters** page: **<MeasMethod: $A^{I}B^{I}B^{II}A^{II}$>** (for example purposes only). **<Display Mask: None>** (for example purposes only). **<Stop For: All Messages>** (for example purposes only). **<Time Out: 10 secs>** (for example purposes only). **<Timer Monit.: Yes>** (this option must be selected for monitoring). This will enable the access to the **SETS Define Monitoring Timer** screen.
5.	Press **CONT (F1)** to access the **SETS Sets of Angles Menu** screen.
6.	Select **Measure New Points**.
7.	Press **CONT (F1)** to access the **SETS Define Points for Set** screen
8.	Enter details of the target point as required. For each target point, ensure that **<Auto Survey: On>** is set. This will enable the automated measurement and recording of the target point in the other face and the automated measurement and recording of all target points during monitoring.
9.	Press **CONT (F1)** to access the **SETS Select Points - Survey** screen.
10.	Measure and record the measurement to the target point as required.
11.	Continue with steps 7/8/9 until all target points for the first measurement set have been measured and recorded.

Step	Description
12.	Press **DONE (F5)** to complete the selection of the target points for the first measurement set in one face and to begin the measurement of the target points in the other face. On completion the **SETS Sets of Angles Menu** screen will be accessed.
13.	Select **Measure Sets**.
14.	Press **CONT (F1)** to access the **SETS Define Monitoring Timer** screen. Refer to "SETS Define Monitoring Timer" for information about the screen.

SETS Define Monitoring Timer

Decription

This screen enables the entry of dates, times, intervals and the handling of message dialogs during a measurement set. When all required information is entered press **CONT (F1)** to begin the monitoring process.



CONT (F1)
To begin the monitoring process.

Description of fields

- The format of all date and time input fields is defined in **CONFIGURE Units and Formats**.
- The format of the interval input field is hh:mm:ss.

Field	Option	Description
<Begin Date:>	User Input	Start date for monitoring.
<Begin Time:>	User Input	Start time for monitoring.
<End Date:>	User Input	End date for monitoring.
<End Time:>	User Input	End time for monitoring.
<Interval:>	User Input	The time between the start of each scheduled measurement set.
<Stop For:>	Choicelist	• To define what action is taken when a message dialog appears during a measurement set. • The setting for this input field has already been defined in the configuration. Here, it can be changed if required, before starting the monitoring process.

Field	Option	Description
<Time Out:>	Choicelist	• To define the time delay for the automatic closing of message dialogs during a measurement set. This choicelist is not available when **<Stop For: Never>**. • The setting for this input field has already been defined in the configuration. Here, it can be changed if required, before starting the monitoring process.

Monitoring interval

Description

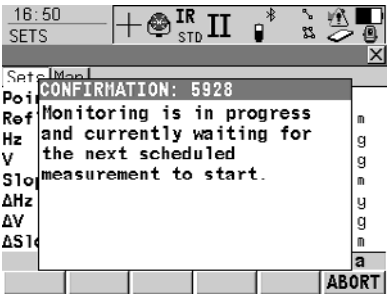
- The times and dates entered define the time frame for the monitoring.
- The time interval defines the starting time for each measurement set which is from **<Begin Time:>** to the next **<Begin Time:>**.

Example

- Data - 3 target points; 4 measure sets; Begin Date: 20.04.2002; Begin Time: 14:00:00; End Date 23.04.2002; End Time 14:00:00; Interval 30 min
- 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 20.04.2002. At 14:10:00 the first measurement set is complete. The instrument will wait until 14:30:00 for the next scheduled measurement set.

Monitoring in progress

This screen displays a notice that monitoring is in progress.



ABORT (F6)
To stop the monitoring process and return to the **SETS Sets of Angles Menu** screen.

Calculations

Refer to "10.2 Sets of Angles" for information about calculations and the viewing of results.

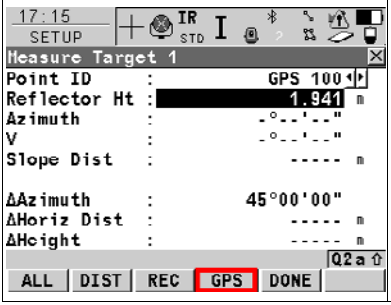
11 Setup

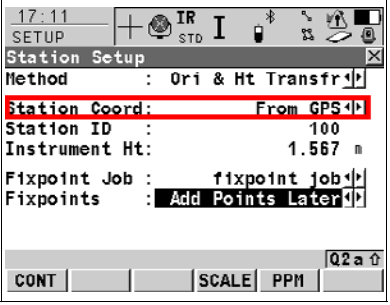
11.1 Overview

Description

Setup
The Setup program is used when setting up a TPS station, to determine the TPS station coordinates (with TPS and/or GPS measurements) and setting the TPS orientation.

Setup with GPS, using SmartPole	Setup with GPS, using SmartStation
SmartPole enables target points to to be determined from GPS measurements, which can then be used as control points for the TPS station setup.	SmartStation enables TPS station coordinates (position and height) to be determined from GPS measurements.



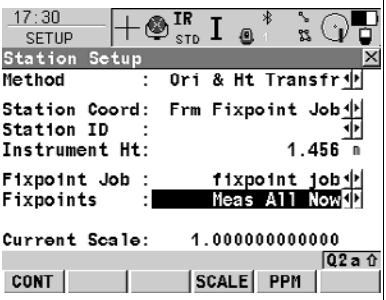
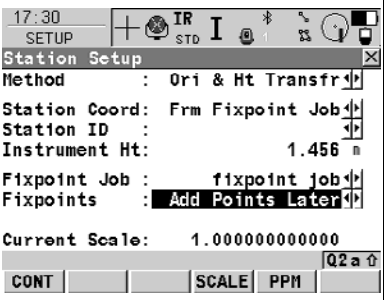


Setup methods

Setup Method	"Standard" setup type	"On-the-Fly" setup type	Methods for TPS1200	Methods for SmartPole	Methods for SmartStation
Set Azimuth	✓		✓		✓
Known Backsight Point	✓		✓	✓	✓
Orientation & Height Transfer	✓	✓	✓	✓	✓
Resection	✓	✓	✓	✓	
Resection Helmert	✓	✓	✓	✓	
Local Resection	✓		✓		

- Each method requires different input data and a different number of target points

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 allows the user to measure setup points and survey points as they work or "on the fly". The TPS station coordinates and TPS orientation do not have to be set before measuring survey points. This can be done at anytime during the survey.
Fixpoints=Meas All Now must be set.	Fixpoints=Add Points Later must be set.
	
	This setup can only be used when measuring survey points. When staking out points, the TPS station coordinates and TPS orientation must first be set.

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 an "On-the-Fly" setup, the setup points can be measured together with the survey points. It is not necessary to complete the setup before measuring survey points. In this state, this type of setup is regarded as an incomplete setup.

An incomplete setup can be accessed in the following ways:	
1.	When pressing **SETUP (F3)** in the Begin screen of a program (other than Setup), a message is displayed to notify that the setup is incomplete. It is then possible to: a) start Setup and continue to measure additional fixpoints, **OK (F4)** b) start Setup and create a new station setup, or **NEW (F2)** c) leave Setup and continue with the existing program **ABORT (F6)**
2.	When pressing **CONT (F1)** in the Begin screen of any program, a message is displayed to notify that the setup is incomplete. It is then possible to: a) continue with the existing program*, or **CONT (F1)** b) start Setup and create a new station setup, or **NEW (F3)** c) start Setup and continue to measure additional fixpoints. **SETUP (F6)**
3.	Assign the function **FUNC Continue Open Setup** to the User Menu or Hot Key

* The Setup Reminder screen (if it has been set) is not displayed in this instance. In the Survey program, Setup can be accessed by **SETUP (F5)**.

Point properties

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	**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	**GPS Fixed** / **GPS Code only**	**GPS Code only**
Source	**Setup (setup method)**	**Setup (setup method)**
Instrument	**GPS**	**GPS**

11.2 Configuring Setup

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Setup** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **SETUP Configuration**.

SETUP Configuration, General page

Description of fields

Field	Option	Description
<Setup Reminder:>	Choicelist	Current instrument setup details can be displayed to remind the user to either keep the current instrument setup or to create a new instrument setup. Refer to "11.5 Setup Reminder" for details.
	Yes	Whenever **CONT (F1)** is pressed in a **Begin** screen, the current setup information is displayed.
	No	Whenever **CONT (F1)** is pressed in a **Begin** screen, the current setup information is not displayed and the program continues as normal.
<Two Faces:>	**Yes** or **No**	Defines if the instrument measures the second face automatically after storing the first or not.
<Use Scale:>	**Yes** or **No**	The appearance of the **SETUP Results XX** screen differs with this setting. The ppm value may be set in the system as the geometric ppm value or not.
<Auto Position:>	**2D**, **3D** or **Off**	Instrument positions horizontally, horizontally and vertically or not at all to the point.
<Display AR:>	Choicelist	To set the direction to the backsight point to zero.
	Yes	Sets **<AR: 0.0000>** towards the backsight point. If set in the current display mask, **<AR:>** displays the horizontal angle difference between the backsight point and the measured point. This has no effect on the set orientation.

Field	Option	Description
	No	Does not set a value for **<AR:>**. If the display mask is configured to display **<AR:>** in the Survey application program, the value is identical to the azimuth. If **<Set Angle Right: Yes>** and more than one backsight point is used, the behaviour is as for **<Set Angle Right: No>**.
<Antenna:>	Choicelist	Applicable when the SmartAntenna is connected. Opening the choicelist accesses **MANAGE Antennas**. Refer to "6.2 Management of Antennas" for further information on antennas. The default antenna is the SmartAntenna.

Next step

PAGE (F6) changes to the **Parameters** page.

SETUP Configuration, Parameters page

Description of fields

Field	Option	Description
When Method=Resections, Ori & Ht Transfer, the following fields apply:		
<Hz Acc Ori:>	User input	For Resection or Orientation and Height Transfer. The standard deviation limit of the orientation.
<Pos Acc Target:>	User input	For Resection or Orientation and Height Transfer. The position accuracy of the target point.
<Ht Acc Target:>	User input	For Resection or Orientation and Height Transfer. The height accuracy of the target point.
When Method=Local Resection, the following fields apply:		
<Define:>	Choicelist	For Local Resection. To define the positive North or positive East axis.
	Northing Axis	The second point measured defines the direction of the positive North axis.
	Easting Axis	The second point measured defines the direction of the positive East axis.
When Method=Resection Helmert, the following fields apply:		
<Weighting:>	**1/Distance** or **1/Distance^2**	To change the distance weighting that is used in the calculation of the station height in the resection.

Next step
PAGE (F6) changes to **Checks** page.

SETUP
Configuration
Checks page

Description of fields

Field	Option	Description
When Method=Known BS Point, the following fields apply:		
<Pos Check:>	**Yes** or **No**	Allows a check to be made on the horizontal coordinate difference between the existing and the measured known backsight point.
<Pos Limit:>	User input	Available for **<Pos Check: Yes>**. Sets the maximum horizontal coordinate difference accepted in the position check.
<Height Check:>	**Yes** or **No**	Allows a check to be made on the vertical difference between the existing and the measured known backsight point.
<Height Limit:>	User input	Available for **<Height Check: Yes>**. Sets the maximum vertical difference accepted in the height check.

Next step
PAGE (F6) changes to **Logfile** page.
Refer to "1.2 Configuration of a Logfile".

11.3 Setup with SmartStation

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Setup** and press **CONT (F1)**.
3.	**CONT (F1)** to access the **SETUP Station Setup**.
4.	**SETUP Station Setup Begin**. Check the settings and ensure that a coordinate system other than <None> or WGS84 is selected and attached to the active job.
5.	**CONT (F1)** to access the **SETUP Station Setup** screen.

6.	**SETUP Station Setup**.
	• Choose one of the following setup methods:
	  • **<Method: Set Azimuth>** or
	  • **<Method: Known BS Point>** or
	  • **<Method: Ori & Ht Transfr>**.
	• These are the only methods applicable for a setup with SmartStation.

7.	**<Station Coord: From GPS>**. Ensure that the SmartAntenna is connected and the interface is set. **<Station ID:>** Enter the instrument station. **<Instrument Ht:>** Enter the height of the instrument station.
8.	**CONT (F1)** to access **SETUP New Station Point**. If a coordinate system has not been selected: • **LOCAL (F5)** to access **SETUP SmartStation One Pt OneStep** to enter local coordinates for the setup point and a name for the local coordinate system. • **CSYS (F6)** to access **SETUP Coordinate Systems** to select an existing coordinate system. In this screen the creating and editing of coordinate systems is also available.
9.	**SETUP New Station Point** **OCUPY (F1)** To start the point occupation. **STOP (F1)** To end the point occupation. **STORE (F1)** To store the point information.

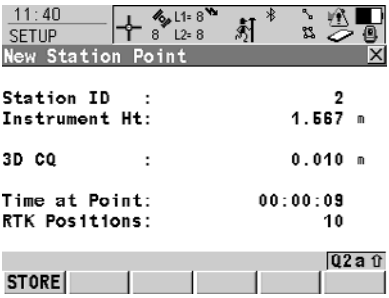
SETUP New Station Point

Overview of the screen

Important feaures about this screen:

- Upon entering this screen SmartStation switches into GPS mode.
- The display mask for this screen is fixed and is not configurable.
- A coordinate system is required and should be attached to the active job.
- SmartAntenna is automatically turned on upon entry to the screen.
- Some of the screen icons change from TPS specific to GPS specific.
- The occupation/storing behaviour is dependent on the configuration settings.

Screen display



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
OCUPY (F1)	To start logging of static observations. The position mode icon changes to the static icon. **(F1)** changes to **STOP**.
STOP (F1)	To end logging of static observations when enough data is collected. When **<Auto STOP: Yes>** in **CONFIGURE Point Occupation Settings**, logging of static observations ends automatically as defined by the stop criteria. The position mode icon changes to the moving icon. **(F1)** changes to **STORE**.
STORE (F1)	To store the measured point. When **<Auto STORE: Yes>** in **CONFIGURE Point Occupation Settings**, the measured point is stored automatically. **(F1)** changes to **OCUPY**. 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.
SHIFT CONEC (F3), SHIFT DISCO (F3)	To dial the number of the reference station configured in the active configuration set and to hang up immediately after the survey is completed. Available for GPS real-time devices of type digital cellular phone or modem. Available for **<Auto CONEC: No>** in **CONFIGURE GSM Connection**.
SHIFT INIT (F4)	To select an initialisation method and to force a new initialisation. Available for configuration sets allowing phase fixed solutions.

Description of fields

Field	Option	Description
<Station ID:>	Output	Station ID as entered in **SETUP Station Setup**.

Field	Option	Description
<Instrument Ht:>	Output	Instrument height as entered in **SETUP Station Setup**. SmartAntenna offset is automatically added but not displayed.
<3D CQ:>	Output	The current 3D coordinate quality of the computed position.
<Time at Point:>	Output	The time from when the point is occupied until point occupation is stopped.
<RTK Positions:>	Output	The number of GPS real-time positions recorded over the period of point occupation.
<Msd PP Obs:>	Output	The number of static observations recorded over the period of point occupation. Available only when the recording of static observations is configured.

11.4 Setup with SmartPole

Access step-by-step

Step	Description
1.	Access **SETUP Station Setup Begin**.
2.	**SETUP** Station Setup Begin Check the settings and ensure that a coordinate system other than <None> or WGS84 is selected and attached to the active job.
3.	**CONT (F1)** to access **SETUP Station Setup**.
4.	**SETUP Station Setup** Choose one of the following setup methods: **<Method: Known BS Point>** or **<Method: Ori & Ht Transfr>**, or **<Method: Resection>** or **<Method: Resection Helmert>**. These are the only methods applicable for a setup with SmartPole.
5.	<Station Coord:> If available, select the source for the instrument station coordinates. **<Station ID:>** Enter/Select the instrument station **<Instrument Ht:>** Enter the height of the instrument station **<Fixpoint Job:>** Select the fixpoint job of the control/target points
6.	<Fixpoints:> If available, select the method for measuring the control/target points. Select **Meas All Now** if a "Standard" setup is required. Select **Add Points Later** if an “On-the-Fly” setup is required.
	Steps 7. and 8. do not relate to **<Method: Known BS Point>**.
7.	**CONT (F1)** to access **SETUP Measure Target 1**.
8.	**SETUP Measure Target 1** Refer to "11.8 Setup Method - Orientation & Height Transfer" for details on fields and keys.
9.	**GPS (F4)** to access **SETUP Survey Survey**.
10.	**SETUP Survey Survey** This is the GPS Survey screen within the Setup program. The target points can be measured with GPS, which can then be used as fixpoints for the station setup. • **OCUPY (F1)** To start the point occupation. • **STOP (F1)** To end the point occupation. • **STORE (F1)** To store the point information.

SETUP Survey Survey

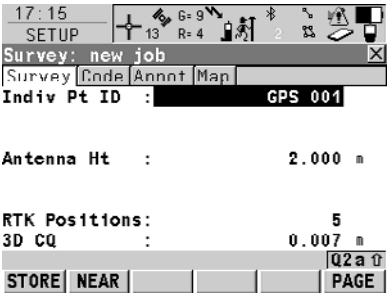
Overview of the screen

Important feaures about this screen:

- Upon entering **SETUP** Survey Survey SmartPole switches into GPS mode.

- The display mask for **SETUP** Survey Survey is configurable.
- A coordinate system is required and should be attached to the active job.
- SmartAntenna is automatically turned on upon entry to the screen.
- Some of the screen icons change from TPS specific to GPS specific.
- The occupation/storing behaviour is dependent on the configuration settings.

Screen display



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
OCUPY (F1)	Refer to "11.3 Setup with SmartStation".
STOP (F1)	Refer to "11.3 Setup with SmartStation".
STORE (F1)	Refer to "11.3 Setup with SmartStation".
NEAR (F2)	To find the nearest reference station with the connected device. Coordinates of these stations must be known.
SHIFT CONEC (F3), **SHIFT DISCO (F3)**	To find the nearest reference station with the connected device. Coordinates of these stations must be known.
SHIFT INIT (F4)	Refer to "11.3 Setup with SmartStation".

Description of fields

Field	Option	Description
<Indiv Pt ID:>	User input	An Individual Pt ID is used by default. This enables the user to give the target point a different point ID.
<Antenna Ht:>	User input	The antenna height.
<RTK Positions:>	Output	The number of GPS real-time positions recorded over the period of point occupation.
<3D CQ:>	Output	The current 3D coordinate quality of the computed position.

Field	Option	Description
<Msd PP Obs:>	Output	The number of static observations recorded over the period of point occupation. Available only when the recording of static observations is configured.

Next steps

- **STORE (F1)** to store the point and then return to SETUP Measure Target. Refer to "11.8 Setup Method - Orientation & Height Transfer" for details on all fields and keys.
  - **ALL (F1)** to measure and store this same point with the TPS station. (The GPS target point which was previously stored, is automatically suggested as the target point to measure with the TPS station. This is then the first target point for the station setup).
  - **GPS (F4)** to measure additional target points with GPS.
  - **DONE (F5)** to temporarily exit the Setup program. (This is applicable when Add Points Later is set. In this state, this type of setup is regarded as an incomplete setup. The setup can be continued and completed at a later time). This key is replaced by CALC (F5) when sufficient data is available.
  - **CALC (F5)** to compute the setup results (This is applicable when at least two target points have been measured and stored).
  - **SET (F1)** to set the TPS station and TPS orientation in the SETUP Results screen. This setup is now complete. It is still possible to add additional points to the setup to improve the setup results. Refer to "11.11 Setup Results - Least Square and Robust Calculation" for details.

11.5 Setup Reminder

Description

- When activated, the setup reminder function displays a screen which enables the user to check the current station setup details before proceeding with the survey. When this screen appears, three options are available to the user:
  - 1. To keep the current station setup and proceed with the survey.
  - 2. To create a new station setup.
  - 3. To check the backsight point.
- The setup reminder function is available to every application program, except:
  - Alignment Tool Kit
  - Determine Coordinate System
  - Setup
  - Traverse

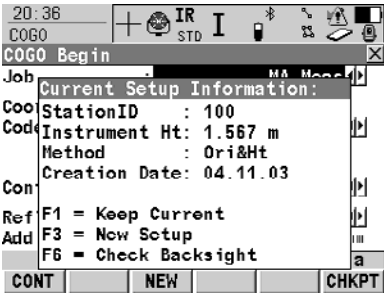
Access

When the setup reminder function is activated (refer to "11.2 Configuring Setup"), the current station setup details are displayed whenever **CONT (F1)** is pressed in a **Begin** screen in an application program.

Setup Reminder screen

Reminder for setup method
- Set Azimuth
- Known BS Point

Reminder for setup method
- Ori & Ht Transfer
- Resection
- Resection Helmert
- Local Resection



Description of softkeys

Softkey	Description
CONT (F1)	To continue with the existing program.
NEW (F3)	To start the Setup program and create a new station setup.
CHKPT (F6)	To open the Check Recorded Pt/Backsight Pt screen.

11.6 Setup Method - Set Azimuth

Requirements

- For TPS1200 the position coordinates of the station point are required. 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 SmartStation the position coordinates of the station are unknown and are determined with GPS real-time. 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

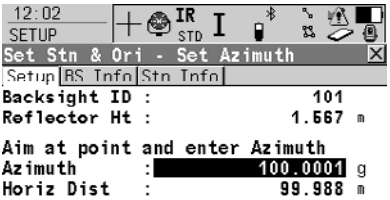
- A station setup using this setup method is always automatically flagged with an 'update later' attribute. Therefore, all angle measurements taken from that station are always automatically updated.

Access step-by-step

Step	Description
1.	Press **PROG** to access the **Programs** menu.
2.	Select and activate **Setup** to move to the first screen.
3.	Press **CONT (F1)** to access **SETUP Station Setup**.
4.	**<Method:>** Ensure that **Set Azimuth** is selected. **<Station Coord:>** Select the source for the station coordinates. **<Station ID:>** Enter/Select the instrument station. **<Instrument Ht:>** Enter the height of the instrument station. **<Fixpoint Job:>** Select the fixpoint job of the control/target points.
5.	The geometric scale correction is displayed. The correction displayed depends upon the options chosen in **CONFIGURE TPS Corrections, GeoPPM** page: if **<Calc Scale: Automatically>**, **<Computd Scale:>** is displayed. if **<Calc Scale: Manually>**, **<Current Scale:>** is displayed.
6.	Press **CONT (F1)** to access **SETUP Set Stn & Ori - Set Azimuth**.

SETUP Set Stn & Ori - Set Azimuth, Setup page

The explanations for the keys given below are valid for the pages as indicated.



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
SET (F1)	To set the station and orientation and exit the Setup application program.
DIST (F2)	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 **SET (F1)**. Checking is **NOT** performed on the distance measurement when setting the Station and the Orientation **SET (F1)**.
Az=0 (F4)	Available on the **Setup** page. To set **<Azimuth: 0>** and running. This value is not set to the system until **SET (F1)** is pressed.
HOLD (F5), **FREE (F5)**	Available on the Setup page and if **<ATR: Off>**. **HOLD (F5)** freezes the current **<Azimuth:>** value, making it possible to set the **<Azimuth:>** value first, turn the instrument to the desired direction and release the <Azimuth:> value using **FREE (F5)**.
SHIFT INDIV (F5), **SHIFT RUN (F5)**	Available on the **Setup** page. To change between entering an individual backsight point ID different to the defined ID template and the running point ID according to the ID template.

Description of fields

Field	Option	Description
<Backsight ID:>	User input	Point ID of the backsight point according to the point ID template.
<Reflector Ht:>	User input	The default reflector height as defined in the active configuration set is suggested.
<Azimuth:>	User input	The current system azimuth value. If a different azimuth is typed in and **ENTER** is pressed or if **Az=0 (F4)** is pressed, this azimuth value is displayed in the field and updated with the telescope movement. The value is not set to the system until **SET (F1)** is pressed.
<Horiz Dist:>	Output	Press **(F2)** to measure a distance to the target point being used to set the azimuth.

Next step
PAGE (F6) changes to **BS Info** page.

SETUP
Set Stn & Ori - Set Azimuth, BS Info page

Description of fields

Field	Option	Description
<Backsight ID:>	Output	Backsight ID as entered in **SETUP Station Setup**.
<Code:>	Choicelist	The code for the backsight point.
<Code Desc:>	Output	A short description of the code.

Next step
PAGE (F6) changes to **Stn Info** page.

SETUP
Set Stn & Ori - Set Azimuth, Stn Info page

Description of fields

Field	Option	Description
<Station ID:>	Output	Station ID as selected in **SETUP Station Setup**.
<Instrument Ht:>	User input	The instrument height.
<Code:>	Choicelist	The code for the station.
<Code Desc:>	Output	A short description of the code.
<Stn Easting:>	Output	The easting coordinate for the setup station.
<Stn Northing:>	Output	The northing coordinate for the setup station.
<Stn Height:>	Output	The height of the setup station.
<Current Scale:>	Output	The geometric scale correction is displayed. The correction displayed depends upon the options chosen in **CONFIGURE TPS Corrections, GeoPPM** page.

Next step
SET (F1) sets the station and sets the orientation.

11.7 Setup Method - Known Backsight Point

Requirements

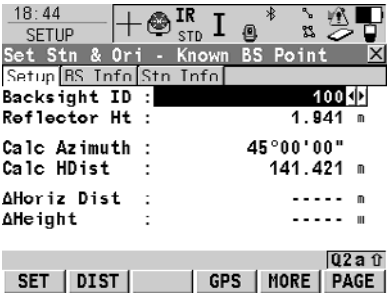
- For TPS1200 the position coordinates of the station point are required. The instrument is set up and oriented to a known backsight target.
- For SmartStation the position coordinates of the station are unknown and are determined with GPS real-time. The instrument is set up and oriented to a known backsight target.

Access step-by-step

Step	Description
1.	Press **PROG** to access the **Programs** menu.
2.	Select and activate **Setup** to move to the first screen.
3.	Press **CONT (F1)** to access **SETUP Station Setup**.
4.	**<Method:>** Ensure that **Known BS Point** is selected. **<Station Coord:>** Select the source for the station coordinates. **<Station ID:>** Enter/Select the instrument station. **<Instrument Ht:>** Enter the height of the instrument station. **<Fixpoint Job:>** Select the fixpoint job of the control/target points.
5.	The geometric scale correction is displayed. The correction displayed depends upon the options chosen in **CONFIGURE TPS Corrections, GeoPPM** page: if **<Calc Scale: Automatically>**, **<Computd Scale:>** is displayed. if **<Calc Scale: Manually>**, **<Current Scale:>** is displayed.
6.	Press **CONT (F1)** to access **SETUP Set Stn & Ori - Known BS Point**.

SETUP Set Stn & Ori - Known BS Point, Setup page

- The functionality of all pages and softkeys is similar to SETUP Set Stn & Ori - Set Azimuth. Differences between the two screens are outlined below.
- Refer to "11.6 Setup Method - Set Azimuth" for information on softkeys/fields.



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
SET (F1)	To set the station and orientation and exit the Setup application program.

Key	Description
DIST (F2)	To measure the distance to the backsight point.
GPS (F4)	Available when using **SmartPole**. To enter the GPS Survey screen (the same screen as for SmartRover) and measure a point with GPS. The antenna height is automatically converted from the reflector height. **STORE (F1)** to store the point and leave the GPS Survey screen. The point is stored to the **<Job:>** and copied to the **<Fixpoint Job:>**, where it can be used as a backsight. **ESC** or **SHIFT QUIT (F6)** to leave the GPS Survey screen.
MORE (F5)	The display changes to the measured values of azimuth, horizontal distance and height. Available on the Setup page.

Description of fields

Field	Option	Description
<Backsight ID:>	Choicelist	Backsight point ID. All 3D and 2D points from **<Fixpoint Job:>** can be selected.
<Reflector Ht:>	User input	The default reflector height as defined in the active configuration set is suggested.
<Calc Azimuth:>	Output	Calculated azimuth from the station to the backsight point.
<Calc HDist:>	Output	Calculated horizontal distance from the station to the backsight point.
<ΔHoriz Dist:> and **<ΔHeight:>**	Output	The difference between the calculated horizontal distance or coordinate height from station to backsight point and the measured distance or height.
<Horiz Dist:> and **<Height:>**	Output	Displayed after a distance was measured with **DIST (F2)** and after **MORE (F5)** was pressed. The measured horizontal distance to or height of the backsight point.

Next step

SET (F1) sets the station and sets the orientation.

11.8 Setup Method - Orientation & Height Transfer

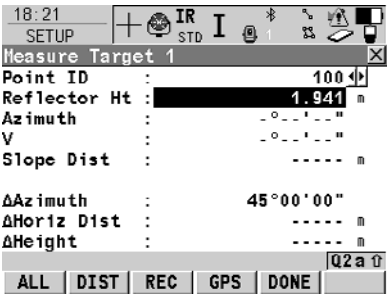
Requirements

- For TPS1200 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 real-time. The instrument is set up and oriented to one or more known backsight targets.
- For TPS1200 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 may be measured. The height of the station point can also be derived from the target points.

Access step-by-step

Step	Description
1.	Press **PROG** to access the **Programs** menu.
2.	Select and activate **Setup** to move to the first screen.
3.	Press **CONT (F1)** to access **SETUP Station Setup**.
4.	**<Method:>** Ensure that **Ori & Ht Transfr** is selected. **<Station Coord:>** Select the source for the station coordinates. **<Station ID:>** Enter/Select the instrument station. **<Instrument Ht:>** Enter the height of the instrument station. **<Fixpoint Job:>** Select the fixpoint job of the control/target points.
5.	**<Fixpoints:>** Select the method for measuring the control/target points. Select **Meas All Now** if a "Standard" setup is required. Select **Add Points Later** if an “On-the-Fly” setup is required.
6.	The geometric scale correction is displayed. The correction displayed depends upon the options chosen in **CONFIGURE TPS Corrections, GeoPPM** page: if **<Calc Scale: Automatically>**, **<Computd Scale:>** is displayed. if **<Calc Scale: Manually>**, **<Current Scale:>** is displayed.
7.	Press **CONT (F1)** to access **SETUP Measure Target 1**.

SETUP Measure Target



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
ALL (F1)	To measure and store distances and angles to the backsight points.
DIST (F2)	To measure and display distances.
REC (F3)	To records displayed values to the current job.
GPS (F4)	Available when using **SmartPole**. To enter the GPS Survey screen (the same screen as for SmartRover) and measure a point with GPS. The antenna height is automatically converted from the reflector height. **STORE (F1)** to store the point and leave the GPS Survey screen. The point is stored to the **<Job:>** and copied to the **<Fixpoint Job:>**, where it can be used as a target for the setup. **ESC** or **SHIFT QUIT (F6)** to leave the GPS Survey screen.
CALC (F5)	Available once sufficient data is available for calculation.
DONE (F5)	Available when Fixpoints=Add Points Later. To temporarily exit the Setup program. The station setup will be incomplete but can be continued and completed at a later time. This softkey is replaced by **CALC (F5)** when sufficient data is available.
SHIFT FIND (F2)	Available once sufficient data is available for calculation. To guide the reflector to the selected target point.
SHIFT POSIT (F4)	Available once sufficient data is available for calculation. To position the instrument to the selected target point.

Description of fields

Field	Option	Description
<Point ID:>	Choicelist	The point ID of the target point to be measured. All points from **<Fixpoint Job:>** can be selected, except class **NONE**.
<Reflector Ht:>	User input	The default reflector height as defined in the active configuration set is suggested.
<Azimuth:> and **<V:>**	Output	The current horizontal or vertical angle.
<Slope Dist:>	Output	The measured slope distance after **DIST (F2)** was pressed.
<ΔAzimuth:> and **<ΔHoriz Dist:>**	Output	Displays the difference between the calculated azimuth or horizontal distance and the measured horizontal angle or horizontal distance.

Field	Option	Description
<ΔHeight:>	Output	The difference between the given and the measured height of the target point.

Next steps

IF	THEN
more target points are to be measured	**ALL (F1)** to measure and store distances and angles, or **REC (F3)** to store the current measurement, or **GPS (F4)** to measure a point with GPS.
the program is to be temporarily exited	**DONE (F5)** to temporarily exit the Setup program. The station setup will be incomplete but can be continued and completed at a later time.
sufficient target points were measured	**CALC (F5)** to calculate the setup.

A maximum of ten target points can be measured and used for the calculation. When the maximum number of points was measured, the **SETUP Results XX** screen is accessed automatically after **ALL (F1)**. In the **SETUP Additional Information** screen measured target points can be deleted and the **SETUP Measure Target XX** screen can be reaccessed to measure new target points.

11.9 Setup Method - Resection/Resection Helmert

Requirements

- For TPS1200 the coordinates of the station point are unknown. The coordinates and orientation are determined by sighting to one or more known target points (maximum of ten target points). Only angles or both angles and distances may be measured.
- For a resection, least squares or robust calculations are used. For a resection Helmert, Helmert calculations are used.

Access step-by-step

Step	Description
1.	Press **PROG** to access the **Programs** menu.
2.	Select and activate **Setup** to move to the first screen.
3.	Press **CONT (F1)** to access **SETUP Station Setup**.
4.	**<Method:>** Select either **Resection** or **Resection Helmert**. **<Station ID:>** Enter the instrument station. **<Instrument Ht:>** Enter the height of the instrument station. **<Fixpoint Job:>** Select the fixpoint job of the control/target points.
5.	**<Fixpoints:>** Select the method for measuring the control/target points. Select **Meas All Now** if a "Standard" setup is required. Select **Add Points Later** if an “On-the-Fly” setup is required.
6.	Press **CONT (F1)** to access **SETUP Measure Target 1**.
7.	SETUP Measure Target
8.	**ALL (F1)** or **REC (F3)** or **GPS (F4)** (to measure a point with GPS).
9.	Refer to "11.8 Setup Method - Orientation & Height Transfer" for details on all fields and keys.

SETUP Measure Target XX

This screen is similar to **SETUP Measure Target XX** for the setup method **<Method: Ori & Ht Transfr>**. Refer to "11.8 Setup Method - Orientation & Height Transfer" for screen information and a description of fields.

11.10 Setup Method - Local Resection

Description

- This setup method is only applicable to TPS1200 and not to SmartStation.
- This method can be used to calculate the two or three-dimensional local coordinates for the instrument station and the orientation of the horizontal circle from distance and angular 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 configuration settings).

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 step-by-step

Step	Description
1.	Press **PROG** to access the **Programs** menu.
2.	Select and activate **Setup** to move to the first screen.
3.	Press **CONT (F1)** to access **SETUP Station Setup**.
4.	**<Method:>** Ensure that **Local Resection** is selected. **<Station ID:>** Enter the instrument station. **<Instrument Ht:>** Enter the height of the instrument station. **<Stn Ht From:>** Select the source for the instrument station height. **<Station Ht:>** Enter the elevation of the instrument station.
5.	Press **CONT (F1)** to access **SETUP Measure Target 1**.

SETUP Measure Target XX

This screen is similar to **SETUP Measure Target XX** for the setup method **<Method: Ori & Ht Transfr>**. Refer to "11.8 Setup Method - Orientation & Height Transfer" for screen information and a description of fields.

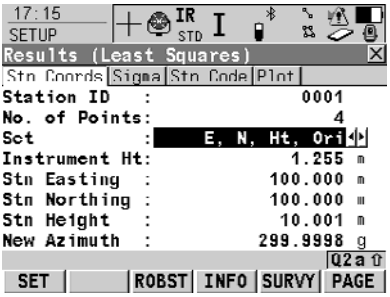
11.11 Setup Results - Least Square and Robust Calculation

Access

Press **CALC (F5)** in the **SETUP Measure Target XX** screen.

SETUP Results XX, Stn Coords page

The explanations for the softkeys given below are valid for the **Stn Coord** and **Sigma** page.



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
SET (F1)	To set data selected in **<Set:>**.
COORD (F2)	To view other coordinate types.
ROBST (F3) or **LSQRS (F3)**	To display the results for the robust or the least squares calculation method.
INFO (F4)	To display additional information.
DONE (F5)	Available when Fixpoints=Add Points Later. To temporarily exit the Setup program. The station setup will be incomplete but can be continued and completed at a later time.
SURVY (F5)	Available when Fixpoints=Meas All Now. To measure more target points.
SHIFT ELL H (F2) or **SHIFT ORTH (F2)**	To change between the ellipsoidal and the orthometric height.
SHIFT 3 PAR (F2) or **SHIFT 4 PAR (F2)**	Switches between a 3 parameter and 4 parameter helmert calculation. The results are immediately updated.
SHIFT OTHER (F5)	Available if two solutions were calculated. Changes between these solutions.

Description of fields

Field	Option	Description
<Station ID:>	User input	Station ID of the current station set up.
<No. of Points:>	Output	Number of points used in calculation.

Field	Option	Description
<Set:>	**E, N, Ht, Ori**, **E, N, Ht** **E, N, Ori** **Ht, Ori**, **Ht** or **Ori**	The selected options are set and stored in the system. All other values are taken from the current system setup.
<Instrument Ht:>	Output	The current instrument height.
<Stn Easting:> and **<Stn Northing:>**	Output	Easting/Northing is displayed either from fixpoint job, system or calculated.
<Stn Height:>	Output	The calculated Height is displayed.
<New Azimuth>	Output	New oriented azimuth with running angle as telescope moves.

Next step
PAGE (F6) changes to the **Sigma** page.

SETUP Results XX, Sigma page

Description of fields

Field	Option	Description
<σEasting:>, **<σNorthing:>**, **<σHeight:>** and **<σHz Orient.:>**	Output	Standard deviation of the calculated station Easting/Northing, Height and orientation.
<Calc Scale:> and **<Calc ppm:>**	Output	Calculated scale factor/ppm from resection or orientation and height transfer.
<Current Scale:>	Output	The current scale calculated from the geometric ppm.

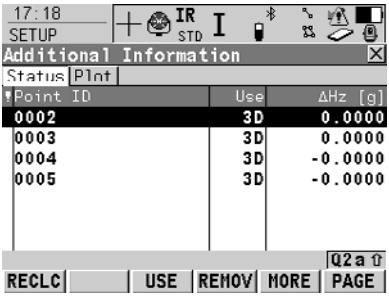
Next step
PAGE (F6) changes to the **Stn Code** page.

SETUP Results XX, Stn Code page

The functionality of the **Stn Code** page is similar to **MANAGE New Point, Code** page. Refer to "TPS1200 System Field Manual" for information on coding.

Next step
INFO (F4) changes to **SETUP Additional Information, Status** page.

SETUP
Additional Information, Status page



Refer to the description of softkeys for details on softkeys and their functionality.

Description of screen softkeys

Key	Description
RECLC (F1)	To recalculate the station data and update all values.
USE (F3)	To decide whether a target point is to be used in the calculation as 3D point, 2D point or not used. Changes the value in the **Use** column.
REMOV (F4)	To delete a point from the list of measured target points and exclude it from the Setup calculation.
MORE (F5)	To view more information.
SHIFT SURVY (F5)	To measure more target points.

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**.
ΔHz, **ΔDist**, **ΔHeight**, **ΔEast**, **ΔNorth**	Can be displayed by pressing **MORE (F5)**. Difference between calculated and measured horizontal angle, distance from station to target points and height for the target points. If a target point does not have coordinates, ----- are displayed. Differences exceeding the defined limit are indicated by a *.

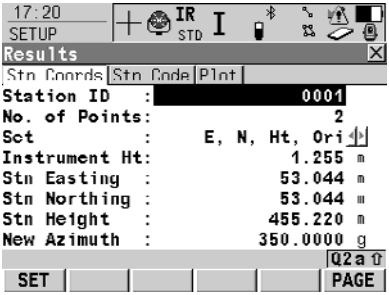
Next steps
RECLC (F1) recalculates the station data.

11.12 Setup Results - Local Resection

Access

Press **ALL (F1)** in the **SETUP Measure Target 2** screen.

SETUP Results, Stn Coords page



SET (F1)
To set data selected in **<Set:>** and to store all setup data and exit the application program.

Description of fields

Field	Option	Description
<Station ID:>	User input	Station ID of the current station set up.
<No. of Points:>	Output	Number of points used in calculation.
<Set:>	Output	The displayed options are set and stored in the system. All other values are taken from the current system setup.
<Instrument Ht:>	Output	The current instrument height.
<Stn Easting:>	Output	The calculated Easting.
<Stn Northing:>	Output	The calculated Northing.
<Stn Height:>	Output	The calculated Height.
<New Azimuth>	Output	New oriented azimuth with running angle as telescope moves.

Next step
PAGE (F6) changes to the **Stn Code** page.

SETUP Results, Stn Code page

The functionality of the **Stn Code** page is similar to **MANAGE New Point, Code** page. Refer to "TPS1200 System Field Manual" for information on coding.

Description of fields

Field	Option	Description
<Point Code:>	Choicelist	The thematical code for the offset point. Available for **<Thematc Codes: With Codelist>**. All point codes from the job codelist can be selected. The attributes are shown as output, input or choicelist fields depending on their definition.

Field	Option	Description
	User input	Available for **<Thematc Codes: Without Codelist>**. 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.
<Code Desc:>	Output	Available for **<Thematc Codes: With Codelist>**. The description of the code.
<Attribute n:>	User input	Available for **<Thematc Codes: Without Codelist>**. Up to eight attribute values are available.

Next step
PAGE (F6) changes to the **Stn Plot** page.

12 Stakeout

12.1 Overview

Description

The Stakeout application program 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 may

- have been uploaded to a job on the instrument using LGO.
- already exist in a job on the instrument.
- have been uploaded from an ASCII file to a job on the instrument using **Main Menu: Convert...\Import ASCII/GSI Data to Job**.
- be typed in.

Stakeout modes

Points can be staked using different modes:

- Polar mode.
- Orthogonal to station mode.
- Orthogonal from station mode.

The points to be staked must exist in a job on the active memory device or can be typed in.

Coordinate system

Points cannot be staked if the active coordinate system is different to that in which the points to be staked are stored. For example, the points to be staked are stored in WGS 1984 and the active coordinate system is **<None>**.

Height source

Heights can be taken into account from

- the vertical component of a coordinate triplet.
- a **D**igital **T**errain **M**odel.

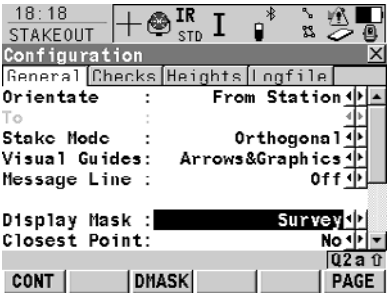
12.2 Configuring Stakeout

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Stakeout** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **STAKEOUT Configuration**.

STAKEOUT Configuration, General page

The explanations for the softkeys given below are valid for all pages, unless otherwise stated.



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DMASK (F3)
Available for **<Display Mask:>** being highlighted on **General** page. To edit the display mask currently being displayed in this field.

Description of fields

Field	Option	Description
<Orientate:>		The reference direction to be used to stakeout points. The stakeout elements and the graphical display shown in the Stakeout application program are based on this selection.
	From Station	The direction of the orientation is from the instrument to the point to be staked.
	To Station	The direction of the orientation is from the point to be staked to the instrument.
	From North	The direction of the orientation is from the North direction to the point to be staked.
	To North	The direction of the orientation is from the point to be staked to the North direction.
	To 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.
	To Last Point	Timewise the last recorded point. If no points are yet staked, **<Orientate: To North>** is used for the first point to be staked.

Field	Option	Description
	To Point (Stake)	A point from **<Stakeout Job:>** selected in **STAKEOUT Stakeout Begin**.
	To Point (Store)	A point from **<Job:>** selected in **STAKEOUT Stakeout Begin**.
	To Line (Stake)	The direction of the orientation is parallel to a reference line from **<Stakeout Job:>** selected in **STAKEOUT Stakeout Begin**. Open the listbox to create, edit or delete a reference line.
	To Line (Store)	The direction of the orientation is parallel to a reference line from **<Job:>** selected in **STAKEOUT Stakeout Begin**. Open the listbox to create, edit or delete a reference line.
<To:>	Choicelist	Available when • **<Orientate: To Point(Stake)>**, • **<Orientate: To Point(Store)>**, • **<Orientate: To Line(Stake)>** and • **<Orientate: To Line(Store)>**. To select the point or line to be used for orientation.
<Stake Mode:>		The method of staking out.
	Polar	The direction from the orientation reference, the horizontal distance and the cut/fill is displayed.
	Orthogonal	The distance forwards to/backwards from the point, the distance right/left to the point and the cut/fill is displayed.
<Visual Guides:>		Arrows and/or a graphical display in **STAKEOUT XX Stakeout**. help finding the point to be staked.
	Off	Neither arrows nor a graphical display are shown.
	Arrows	Upon pressing **DIST (F2)** arrows are shown.
	Graphics	A graphical display is shown.
	Arrows & Graphics	Upon pressing **DIST (F2)** arrows are shown. A graphical display is always shown.
<Message Line:>		For each point which is selected for staking, angle and distance information is momentarily displayed in the message line.

Field	Option	Description
	Off	No information is displayed in the message line.
	Dist From Stn	The delta Hz angle that the instrument should turn to the point and the distance from the instrument to the point is momentarily displayed in the message line.
	Dist Frm Last Pt	The delta Hz angle that the instrument should turn to the point and the distance from the last staked point is momentarily displayed in the message line.
<Display Mask:>	Choicelist	The user defined display mask to be shown in **STAKEOUT XX Stakeout**.
<Closest Point:>		The order of the points suggested for staking out.
	Yes	After staking and storing a point, the next point suggested for staking out is the point closest to the point which was staked.
	No	After staking and storing one point, the next point suggested for staking out is the subsequent one in **<Stakeout Job:>**.
<Auto Position:>	**2D**	Instrument positions horizontally to the point to be staked.
	3D	Instrument positions horizontally and vertically to the point to be staked.
	Off	Instrument does not position to the point to be staked.
<Update Angle:>	**Yes**	Angles are updated with telescope movement after a distance was measured.
	No	Angles and stakeout values are updated after a distance measurement.
<Store Pt ID:>	**Same as Stake Pt**	The manually occupied staked points are stored with the same point ID's as the points to be staked.
	Prefix	Adds the setting for **<Prefix/Suffix:>** in front of the original point ID's.
	Suffix	Adds the setting for **<Prefix/Suffix:>** at the end of the original point ID's.
<Prefix/Suffix:>	User input	Available for **<Store Pt ID: Prefix>** and **<Store Pt ID: Suffix>**. The identifier with up to four characters is added in front of or at the end of the ID of the manually occupied staked point.

Next step
PAGE (F6) changes to the **Checks** page.

STAKEOUT Configuration, Checks page

Description of fields

Field	Option	Description
<Pos Check:>	**Yes** or **No**	Allows a check to be made on the horizontal coordinate difference between the staked point and the point to be staked.
<Pos Limit:>	User input	Available for **<Pos Check: Yes>**. Sets the maximum horizontal coordinate difference accepted in the position check.
<Height Check:>	**Yes** or **No**	Allows a check to be made on the vertical difference between the staked point and the point to be staked.
<Height Limit:>	User input	Available for **<Height Check: Yes>**. Sets the maximum vertical difference accepted in the height check.
<Beep near Pt:>	**Yes** or **No**	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 **<Dist from Pt:>**.
<Dist from Pt:>	User input	Available for **<Beep near Pt: Yes>**. The horizontal radial distance from the current position to the point to be staked when a beep should be heard.

Next step
PAGE (F6) changes to the **Heights** page.

STAKEOUT Configuration, Heights page

Description of fields

Field	Option	Description
<Height Offset:>	User input	Allows a constant height offset to be applied to the height of the points or DTM being staked.
<Edit Height:>	**Yes**	The design height, the height of the point to be staked, is displayed. The value can be changed.
	No	The height of the current position is displayed while staking out. The value cannot be changed.
<Use DTM:>		Available if DTM Stakeout has been activated via a licence key.

Field	Option	Description
	No	No DTM file is used. The positions and heights of points in the selected **<Stakeout Job:>** are staked out.
	DTM only	Activates the stakeout of heights without positions. Heights relative to the selected **<DTM Job:>** are staked out.
	DTM & Stake Job	The positions of points in the selected **<Stakeout Job:>** are staked out. Heights to be staked out are taken from **<DTM Job:>**.

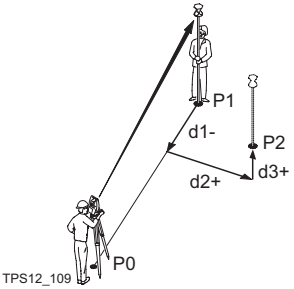
Next step
PAGE (F6) changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".

12.3 Staking Out

Diagrams

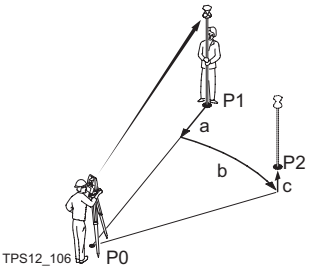
The diagrams show examples for staking out.

Orthogonal mode



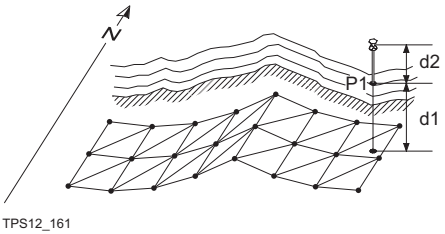
P0	Station
P1	Current position
P2	Point to be staked
d1	**<Go FORWARD:>** ↓ ↑ or **<Go BACK:>** ↑ ↓
d2	**<Go RIGHT:>** → or **<Go LEFT:>** ←
d3	**<CUT:>** or **<FILL:>**

Polar mode



P0	Station
P1	Current position
P2	Point to be staked
a	**<Δ DISTANCE:>**
b	**<Δ HZ:>**
c	**<CUT:>** or **<FILL:>**

DTM Stakeout



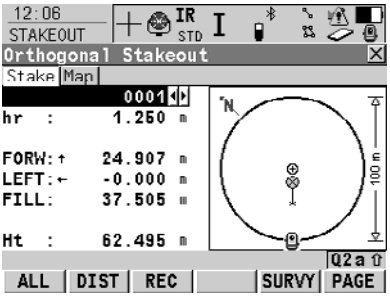
P1	Point to be staked
d1	**<CUT:>** or **<FILL:>**
d2	Reflector height

Access

Refer to "1.1 Starting an Application Program" to access **STAKEOUT XX Stakeout**.

STAKEOUT XX Stakeout, Stake page

The pages shown are those from a typical configuration set. An additional page is available when a user defined display mask is used.



ALL (F1)
To measure a distance and store distance and angles.

DIST (F2)
To measure a distance.

REC (F3)
To store angles and distance. Distance must be measured before.

SURVY (F5)
To access Survey application program to measure points independent from the Stakeout application program. To return to Stakeout application program, press **SHIFT QUIT (F6)** or **ESC**.

SHIFT CONF (F2)
To configure stakeout.

SHIFT MSTAK (F3)
To enter angle and distance values to stake out a point.

SHIFT POSIT (F4)
To position instrument 2D/3D, depending on the **<Auto Position:>** setting.

Description of fields

Field	Option	Description
<Point ID:>	Choicelist	The point ID of the point to be staked.
<Reflector Ht:> or **<hr:>**	User input	The default reflector height as defined in the active configuration set is suggested.
<Height:> or **<Ht:>**	Output	Available for **<Edit Height: No>** in **STAKEOUT Configuration**, **Heights** page. The height of the current position is displayed as orthometric height. 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.

Field	Option	Description
<Design Ht:> or **<D Ht:>**	User input	Available for **<Edit Height: Yes>** in **STAKEOUT Configuration**, **Heights** page. The design height, which is the height of the point to be staked, is displayed as orthometric height. 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 **STAKEOUT Configuration**, **Heights** page is not taken into account.

Next step
PAGE (F6) changes to the **Map** page.

12.4 Stakeout Difference Limit Exceeded

Description

If configured a check is made on the horizontal and/or vertical coordinate distance from the staked point to the point to be staked when storing a staked point.

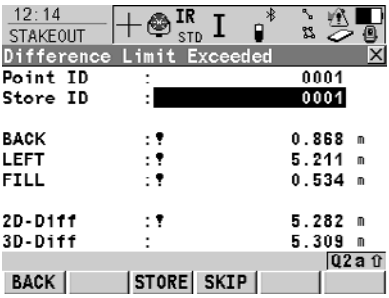
Access

The screen shown below is accessed automatically when the staked point is stored if either of the configured difference limits are exceeded.

STAKEOUT Difference Limit Exceeded

The availability of the fields depends on the configured **<Stake Mode:>** and **<Use DTM:>**. For example for **<Use DTM: DTM only>**, position relevant fields are unavailable.

The limits that have been exceeded are shown in bold and indicated by a !.



BACK (F1)
To return to **STAKEOUT XX Stakeout** without storing the point. Staking out of the same point continues.

STORE (F3)
To accept the coordinate differences, store the point information and return to **STAKEOUT XX Stakeout**.

SKIP (F4)
To return to **STAKEOUT XX Stakeout** without storing the point. According to filter and sort settings the subsequent point in **<Stakeout Job:>** is suggested for staking out.

Description of fields

Field	Option	Description
<Point ID:>	Output	The point ID of the point to be staked.
<Store ID:>	User input	The unique number which is used to store the staked point. Allows a different point ID to be typed in if needed.
<Δ DISTANCE:>	Output	The difference of the horizontal distance to the point to be staked and the current position.
<2D-Diff:>	Output	Displays the horizontal difference from the staked point to the point to be staked.
<3D-Diff:>	Output	Displays the spatial difference from the staked point to the point to be staked.

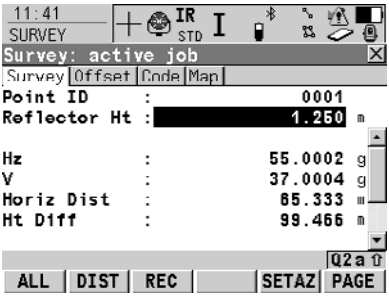
13 Survey - General

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **SURVEY Survey**.

SURVEY Survey: Job Name, Survey page

The fields shown are those from a typical configuration set.The screen described consists of the **Survey** page and the **Map** page. The explanations for the softkeys given below are valid for the **Survey** page.



ALL (F1)
To measure and store distances and angles.

STOP (F1)
Stops the distance measurements. **(F1)** changes back to **ALL**.

DIST (F2)
To measure and display distances.

REC (F3)
To record data.

REMOT (F4)
To measure a remote point.

SETAZ (F5)
To set the horizontal angle.

SETUP (F5) (For Add Points Later)
Available when the setup is incomplete.

TEST (F5)
To access the **SURVEY EDM Test Signal/Frequency** screen.

SHIFT CONF (F2)
To configure auto points and remote point measurements.

SHIFT AVGE (F2)
To check the residuals for the averaged point. Available for **<Averaging Mode: Average>** and for more than one measured coordinate triplet recorded for the same point.

SHIFT ABS (F2)
To check the absolute difference between the measurements. Available for **<Averaging Mode: Absolute Diffs>** and for more than one measured coordinate triplet recorded for the same point.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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:>	User input	The identifier for measured points. The configured point ID template is used. The ID can be changed: • To start a new sequence of point ID's overtype the point ID. • For an individual number independent of the ID template **SHIFT INDIV (F5)**. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.
<Reflector Ht:>	User input	The last used reflector height is suggested when accessing the Survey application program. An individual reflector height can by typed in.
<Hz:>	Output	The current horizontal angle.
<V:>	Output	The current vertical angle.
<Horiz Dist:>	Output	The horizontal distance after **DIST (F2)** was pressed. No distance is displayed when accessing the screen and after **REC (F3)** or **ALL (F1)**.
<Ht Diff:>	Output	The height difference between station and measured point after **DIST (F2)**. Displays ----- when accessing the screen and after **REC (F3)** or **ALL (F1)**.
<Easting:>	Output	Easting coordinate of the measured point.
<Northing:>	Output	Northing coordinate of the measured point.
<Height:>	Output	Elevation of the measured point.

Next step
PAGE (F6) changes to another page on this screen.

14 Survey - Auto Points

14.1 Overview

Description

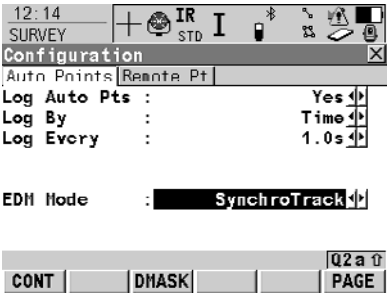
- Auto points is used to automatically measure and store points at a specific rate. Additionally, individual auto points can be stored outside the defined rate. Auto points logged between starting and stopping logging of auto points form one chain. A new chain is formed each time logging of auto points is started.
- Auto points can be collected in the Survey application program. An **Auto** page is visible when logging of auto points is active.
- 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. Refer to "14.4 Offset Points of Auto Points".

14.2 Configuring Auto Points

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **SURVEY Configuration**.

SURVEY Configuration, Auto Points page



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DMASK (F3)
Available for **<Log Auto Pts: Yes>**. To configure what is viewed in the **Auto** page in the Survey application program.

Description of fields

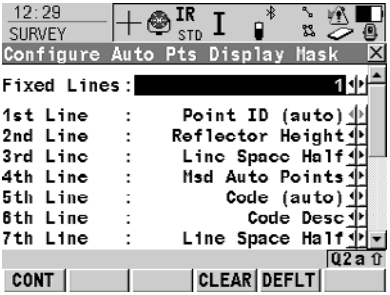
Field	Option	Description
<Log Auto Pts:>	**Yes** or **No**	Activates or deactivates logging of auto points and all fields on this screen.
<Log By:>	**Time**	Auto points are stored according to a time interval.
	Distance	The difference in distance from the last stored auto point, which must be reached before the next auto point is measured. The auto point is stored with the next available measured position.
	Height Diff	The height difference from the last stored auto point, which must be reached before the next auto point is measured. The auto point is stored with the next available measured position.
	Dist or Ht	Before the next auto point is measured, either the difference in distance or the difference in height must be reached. The auto point is stored with the next available measured position.
	Stop & Go	An auto point is stored when the position of the reflector does not move more than the distance configured in **<Stop Position:>** within the **<Stop Time:>**.

Field	Option	Description
	User Decides	An auto point is stored upon pressing **REC (F3)** in **SURVEY Survey: Job Name, Auto** page. In the beginning, the chain to which the auto points should be assigned must be started with **START (F1)**. In the end, the chain must be closed with **STOP (F1)**.
<Log Every:>		Available unless **<Log By: Dist or Ht>**.
	User input	For **<Log By: Distance>** and **<Log By: Height Diff>**. The difference in distance or height before the next auto point is logged.
	For **<Log By: Time>** from **0.1s** to **60.0s**	For **<Log By: Time>**. The time interval before the next auto point is logged.
<Min Distance:>	User input	Available for **<Log By: Dist or Ht>**. The value for the difference in distance before the next auto point is logged.
<Min Height:>	User input	Available for **<Log By: Dist or Ht>**. The value for the height difference before the next auto point is logged.
<Stop Position:>	User input	Available for **<Log By: Stop & Go>**. The maximum distance within which the position is considered stationary.
<Stop Time:>	User input	Available for **<Log By: Stop & Go>**. The time while the position must be stationary until an auto point is stored.
<EDM Mode:>	**Tracking**	Continuous distance measurement with 0.3 s measuring time and 5 mm + 2 ppm accuracy. When the logging of auto points has started, **TRK** is displayed as an icon.
	SynchroTrack	Available only for **<EDM Type: Reflector (IR)>**. This is the measurement mode for the interpolation of angle measurements in IR LOCK Tracking mode. In difference to normal IR LOCK Tracking mode, where angle measurements are only assigned to certain distance measurements, SynchroTrack will perform a linear interpolation between the previous and following angle measurement, based upon the timestamp of the EDM measurement.

Field	Option	Description
		When the logging of auto points has started, **SYNC** is displayed as an icon.

Next step
DMASK (F3) to configure a display mask.

SURVEY
Configure Auto Pts
Display Mask



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

CLEAR (F4)
To set all fields to **<XX. Line: Line Space Full>**.

DEFLT (F5)
Available if the active configuration set is a default configuration set. To recall the default settings.

Description of fields

Field	Option	Description
<Fixed Lines:>	From **0** to **5**	Defines how many lines do not scroll in **SURVEY Survey: Job Name, Auto** page when that display mask is used.
<1st Line:>	Output	Fixed to **<1st Line: Point ID (auto)>**.
<2nd Line:> to **<16th Line:>**	Add. Constant	Output field for the additive constant of the currently selected reflector.
	Angle Right	Output field for the angle right.
	Annotation 1-4	Input field for comments to be stored with the point.
	Attrib (free) 01-20	Output field for attributes for free codes.
	Attrib (pt) 01-03	Input field for attributes for point codes.
	Azimuth	Output field for the azimuth.
	Code (auto)	Choicelist or input field for auto point codes.
	Code (free)	Output field for free codes.
	Code Desc	Output field for the description of codes.
	Code Desc (free)	Output field for the description of free codes.
	Code Type	Output field for the description of point codes.
	EDM Mode	Output field displaying the current EDM mode.

Field	Option	Description
	EDM Type	Output field displaying the current EDM type.
	Easting	Output field for the Easting coordinate of the measured point.
	Height	Output field for the height coordinate of the measured point
	Height Diff	Output field for the height difference between station and reflector.
	Horiz Dist	Output field for the horizontal distance calculated from the measured slope distance and the vertical angle.
	Hz-Angle	Output field for the horizontal angle.
	Line Space Full	Insert full line space.
	Line Space Half	Insert half line space.
	Linework	Choicelist with instructions how the software should flag a line/area.
	Msd Auto Points	Output field for the number of auto points logged after pressing **START (F1)** in **SURVEY Survey: Job Name, Auto** page. Counting starts from 0 every time **START (F1)** is pressed.
	Northing	Output field for the North coordinate of the measured point.
	Offset Cross	Input field for the horizontal distance offset for the measured point, perpendicular to the line of sight.
	Offset Height	Input field for the height offset of the measured point.
	Offset Length	Input field for the horizontal distance offset, in the direction of line of sight.
	Reflector	Output field for the chosen reflector.
	Reflector Height	Input field for the reflector height.
	SD-Last Rec	Output field for the last recorded distance.
	Slope Dist	Output field for the measured slope distance.
	Time at Point	Output field for the time from when the point is occupied until point occupation is stopped. Appears in the display mask during the point occupation.
	V-Angle	Output field for the vertical angle.

Next steps

CONT (F1) closes the screen and returns to **SURVEY Configuration, Auto Points** page.

14.3 Auto Points

Requirements

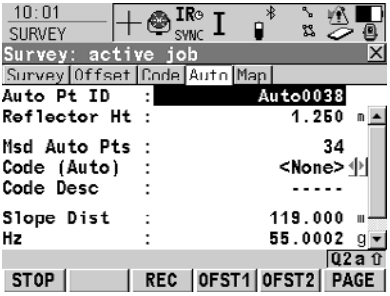
<Log Auto Pts: Yes> in **SURVEY Configuration, Auto Points** page.

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **SURVEY Survey**.
4.	Press **PAGE (F6)** until the **Auto** page is visible.

SURVEY Survey: Job Name, Auto page

The softkeys and the field **<Auto Pt ID:>** are always displayed. Other fields may be displayed depending on the display mask configured.



START (F1)
To start logging of auto points and offset points if configured or, for **<Log By: User Decides>**, to start the chain to which the auto points should be assigned. The first auto point is stored.

STOP (F1)
To end recording of auto points and offset points if configured or, for **<Log By: User Decides>**, to end the chain to which the auto points are assigned.

REC (F3)
Available for **STOP (F1)**. To store an auto point at any time.

OFST1 (F4)
To configure recording of the first type of offset points.

OFST2 (F5)
To configure recording of a second type of offset points.

SHIFT CONF (F2)
To configure auto points.

SHIFT QUIT (F6)
To exit the Survey application program. Point information logged until pressing **SHIFT QUIT (F6)** is saved in the database.

Description of fields

Field	Option	Description
<Auto Pt ID:>	User input	Available unless **<Auto Pts: Time & Date>** in **CONFIGURE 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 ID's overtype the point ID.
	Time and Date	Available for **<Auto Pts: Time & Date>** in **CONFIGURE ID Templates**. The current local time and date is used as identifier for auto points.
<Reflector Ht:>	User input	The default reflector height as defined in the active configuration set is suggested.
<Msd Auto Pts:>	Output	Available after pressing **START (F1)** and before pressing **STOP (F1)**. The number of auto points measured since **START (F1)** has been pressed.
<Auto Pt Code:>		The thematical code for the auto point.
	Choicelist	Available for **<Thematc Codes: With Codelist>**. All point codes from the job codelist can be selected. The attributes are shown as output, input or choicelist fields depending on their definition.
	User input	Available for **<Thematc Codes: Without Codelist>**. 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.
<Code Desc:>	Output	The description of the code.
<Slope Dist:>	Output	The measured slope distance. When **START (F1)** is pressed, **<EDM Mode: Tracking>** is set and the slope distance is constantly updated.
<Hz:>	Output	The current horizontal angle.
<V:>	Output	The current vertical angle.

Next step

IF	THEN
auto points are to be logged	**START (F1)** to start logging of auto points. Then, for **<Log By: User Decides>**, **REC (F3)** whenever an auto point is to be logged.

IF	THEN
offset points are to be configured	**OFST1 (F4)** or **OFST2 (F5)**. Refer to "14.4 Offset Points of Auto Points".

14.4 Offset Points of Auto Points

14.4.1 Overview

Description

- Offset points
  - can be created with auto points when auto points are stored to the DB-X.
  - 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. Subsequently 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.
- 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** 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

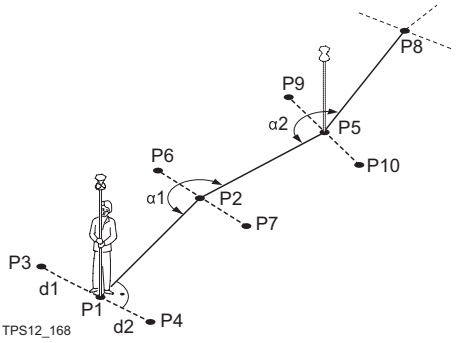
The configured offsets are applied perpendicular to the line between two auto points.

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.



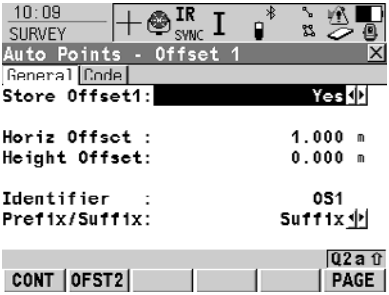
P1	First auto point
P2	Second auto point
P3	First offset point for P1
P4	Second offset point for P1
P5	Third auto point
P6	First offset point for P2
P7	Second offset point for P2
P8	Fourth auto point
P9	First offset point for P5
P10	Second offset point for P5
d1	Horizontal offset to the left
d2	Horizontal offset to the right
α1	Angle between P1 and P5
α2	Angle between P2 and P8

14.4.2 Configuring Offset Points

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **SURVEY Survey**.
4.	Press **PAGE (F6)** until the **Auto** page is visible.
5.	Press **OFST1 (F4)**/**OFST2 (F5)** to access **SURVEY Auto Points - Offset**.

SURVEY Auto Points - Offset, General page



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

OFST2 (F2) and **OFST1 (F2)**
To switch between configuring offset point type one and two.

Description of fields

Field	Option	Description
<Store Offset1:> and **<Store Offset2:>**	**Yes** or **No**	Activates or deactivates the logging of offset points and all fields on this screen.
<Horiz Offset:>	User input	The horizontal offset between -1000 m and 1000 m at which the offset point is collected.
<Height Offset:>	User input	The height offset between -100 m and 100 m from the related auto point.
<Identifier:>	User input	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.
<Prefix/Suffix:>	**Prefix** or **Suffix**	Adds the setting for **<Identifier:>** in front of or at the end of the auto point ID.

Next step

PAGE (F6) changes to the **Code** page. The setting for **<Thematc Codes:>** in **CONFIGURE Coding & Linework** determines the availability of the fields and softkeys. They are identical to those of thematical coding with/without codelist. Up to three attribute values can be stored. Refer to the TPS1200 System Field Manual for information on coding.

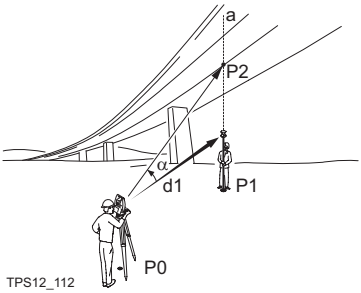
15 Survey - Remote Point

15.1 Overview

Description

Remote point is used to determine the 3D coordinates of inaccessible points, for example on bridges. The horizontal distance to a base point directly underneath or above the remote point is measured. Then the instrument is aimed at the remote point. The coordinates of the remote point are calculated with the distance measured to the base point and the angles measured to the remote point.

Diagram



P0	Instrument station
P1	Base point
P2	Remote point
d1	horizontal distance to the base point
á	vertical angle between base point and remote point
a	Vertical axis from P1 to P2

To ensure correct results, the remote point and the reflector must be lined up vertically. If it is not possible to maintain an exactly vertical line, the acceptable **<Hz Dist Tol:>** must be chosen. The horizontal distance to the remote point and to the base point should coincide.

15.2 Configuring Remote Point

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **SURVEY Configuration**.

SURVEY Configuration, Remote Pt page

Description of fields

Field	Option	Description
<Use Remote Pt:>	**Yes** or **No**	Activates or deactivates the remote point function.
<Hz Dist Tol:>	User input	The horizontal distance to the remote point is equal to the horizontal distance of the base point. The value for **<Hz Dist Tol:>** is the maximum tolerated length of the chord between the base point and the remote point.
<Display Mask:>	Choicelist	Displays **<None>** until a display mask is chosen.

Next step

CONT (F1) exits the screen **SURVEY Configuration**.

15.3 Remote Point

Description

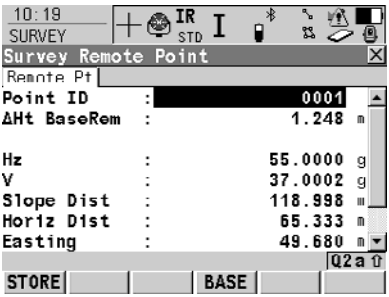
Remote point measurements are possible from the Survey application program when **<Use Remote Pt: Yes>** is set in the **SURVEY Configuration, Remote Pt** page and a valid distance measurement is available. Refer to "15.2 Configuring Remote Point".

Unless **<Display Mask: None>** in **SURVEY Configuration, Remote Pt** page, this screen contains an additional, user defined display mask.

Access

REMOT (F4) in **SURVEY Survey: Job Name** after one point is measured.

SURVEY Survey Remote Point, Remote Pt page



STORE (F1)
Stores the remote point. Stays in the **SURVEY Survey Remote Point** screen.

BASE (F4)
Returns to **SURVEY Survey: Job Name**. The distance measurement is cleared. **BASE (F4)** has the same behaviour as **L.GO (F5)** when **<Automation: LOCK>** was set before pressing **REMOT (F4)**.

Description of fields

Field	Option	Description
<Point ID:>	User input	Displays the point ID for the remote point. The point ID in **SURVEY Survey Remote Point** is always identical to the point ID in **SURVEY Survey: Job Name**.
<ΔHt BasRem:>	Output	The elevation difference between the base point and the remote point.
<Hz:> or **<V:>**	Output	The current horizontal or vertical angle.
<Slope Dist:>	Output	The current slope distance to the remote point calculated from the horizontal distance to the base point and the current vertical angle.
<Horiz Dist:>	Output	The horizontal distance measured to the base point.
<Easting:>, **<Northing:>** and **<Height:>**	Output	Calculated Easting, Northing coordinate or height for the remote point.

Next step

STORE (F1) stores the remote point.

16 Survey Cross Section

16.1 Overview

Description

- The Survey Cross Section application program allows for the automatic changing of codes during a survey.
- 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.

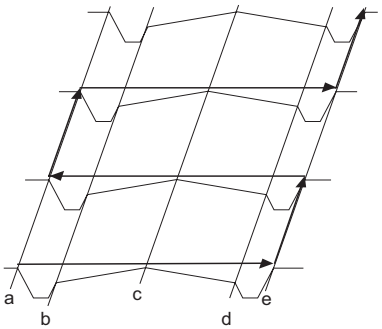
Template

- 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

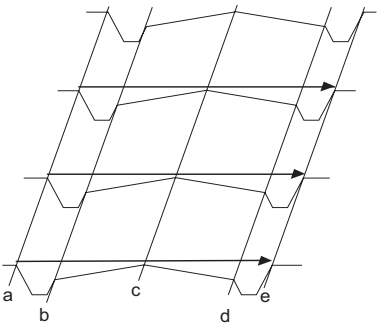
- Templates can be applied
  - to the ZigZag method or the Same Direction method.
  - in either a forward direction or in a backward direction.

ZigZag



GPS12_168

Same Direction



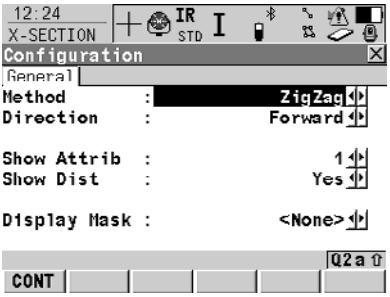
GPS12_169

16.2 Configuring Survey Cross Section

Access

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey Cross Section** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **X-SECTION Configuration**.

X-SECTION Configuration, General page



CONT (F1)
To accept changes and return to the screen from where this screen was accessed.

DMASK (F3)
Available for **<Display Mask:>** being highlighted on **General** page. To edit the display mask currently being displayed in this field.

SHIFT ABOUT (F5)
To display information about the program name, the version number, the date of the version, the copyright and the article number.

Description of fields

Field	Option	Description
<Method:>	**ZigZag** or **Same Direction**	Method by which subsequent cross sections will be surveyed. Refer to "16.1 Overview" for a diagram.
<Direction:>	**Forward**	The cross sections will be surveyed in the same way as the elements are defined in the selected **<Template:>** in **X-SECTION Survey: Job Name**.
	Backward	The cross sections will be surveyed in the reverse way as the elements are defined in the selected **<Template:>** in **X-SECTION Survey: Job Name**.
<Show Attrib:>	Choicelist	Defines which attribute field is displayed in **X-SECTION Survey: Job Name**. Useful if the surveyor is stringing - can then see that the correct string attribute value is being used.

Field	Option	Description
<Show Dist:>	**Yes** or **No**	Activates an output field in **X-SECTION Survey: Job Name**. The horizontal grid distance from the current position to the point last surveyed for the same cross section will be displayed.
<Display Mask:>	Choicelist	The user defined display mask is shown in **X-SECTION Survey: Job Name**.

Next step
CONT (F1) to return to **X-SECTION Begin** followed by **CONT (F1)** to access **X-SECTION Survey: Job Name**.

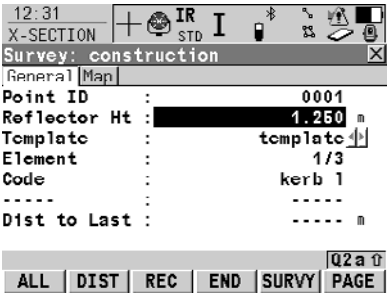
16.3 Surveying Cross Sections

Access

Refer to "16.2 Configuring Survey Cross Section" to access **X-SECTION Survey: Job Name**.

X-SECTION Survey: Job Name, General page

The pages shown are those from a typical configuration set. An additional page is available when a user defined display mask is used.



ALL (F1)
To measure and store distances and angles. Available if a template has been opened with **START (F4)**.

DIST (F2)
To measure and display distances.

REC (F3)
To record data.

START (F4) and **END (F4)**
To open and close the selected cross section template. While the template is open, the elements of the cross section can be surveyed.

SURVY (F5)
To manually occupy 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 (F4)**.

SHIFT CONF (F2)
To configure the Cross Section Survey application program.

SHIFT PREV (F3)
To select the previous element of the cross section template. The currently measured element will not be stored. Available for **STOP (F4)** being displayed.

SHIFT NEXT (F4)
To select the next element of the cross section template. The currently measured element will not be stored. Available for **STOP (F4)** being displayed.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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:>	User input	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 ID's type over the point ID. • For an individual point ID independent of the ID template **SHIFT INDIV (F5)**. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.
<Reflector Ht:>	User input	The reflector height.
<Template:>	Choicelist Output	The cross section template is closed. ----- is displayed if no template is defined. The cross section template is open.
<Element:>	Output	x Number of next element on active template. y Total number of elements on active template.
<Code:>	Output	The name of the code.
<Stringline ID:>	Output	Available for **<String Attrib:>** being activated in **CONFIGURE Coding & Linework**, **Coding** page. Points that have the same code attached and belong to different cross sections are strung to one line.
<Dist to Last:>	Output	The horizontal grid distance from the current position to the last surveyed point. ----- is displayed for unavailable information.

Next step

IF	THEN
a cross section template is to be opened	select the desired **<Template:>**. **START (F4)**.
an element of a cross section is to be surveyed	**ALL (F1)**.
a cross section template is to be closed	select the desired **<Template:>**. **END (F4)**.
data is to be viewed graphically	**PAGE (F6)**. An element of a cross section template can also be surveyed from the **Map** page.

16.4 Cross Section Templates

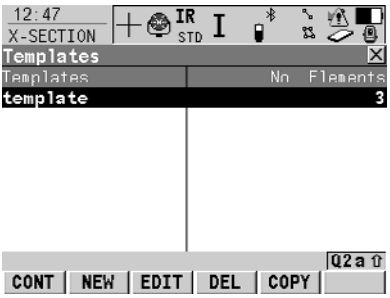
16.4.1 Accessing Cross Section Template Management

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Survey Cross Section** and press **CONT (F1)**.
3.	Press **CONT (F1)** in **X-SECTION Begin** to access **X-SECTION Survey: Job Name**.
4.	**X-SECTION Survey: Job Name**, **General** page Open the choicelist for **<Template:>**.

X-SECTION Templates

All cross section templates stored in the active job are listed in alphabetical order, including the number of elements in each cross section template.



CONT (F1)
To select the highlighted cross section template and to return to the screen from where this screen was accessed.

NEW (F2)
To create a cross section template. Refer to "16.4.2 Creating/Editing a Cross Section Template".

EDIT (F3)
To edit the highlighted cross section template. Refer to "16.4.2 Creating/Editing a Cross Section Template".

DEL (F4)
To delete the highlighted cross section template.

COPY (F5)
To create a cross section template based on the one currently highlighted.

Next step

Step	Description
1.	highlight the desired cross section template.
2.	**CONT (F1)** closes the screen and returns to the screen from where **X-SECTION Templates** was accessed.

16.4.2 Creating/Editing a Cross Section Template

Access

Step	Description
1.	Open the choicelist for **<Template:>** in **X-SECTION Survey: Job Name**, **General** page.
2.	**X-SECTION Templates** • Is a cross section template to be created from scratch? **NEW (F2)** to access **X-SECTION New Template**. • Is a cross section template to be created based on the one currently highlighted? **COPY (F5)** to access **X-SECTION New Template**. • Is a cross section template to be edited? **EDIT (F3)** to access **X-SECTION Edit Template**.

☞ Copying and editing cross section templates is similar to creating a new cross section template. For simplicity, the screens are called **MANAGE XX Template**.

X-SECTION New Template, General page

Type in a name for the new cross section template.

Next step
PAGE (F6) changes to the **Elements** page.

X-SECTION New Template, Elements page

The elements existing in the template are listed.

Description of columns

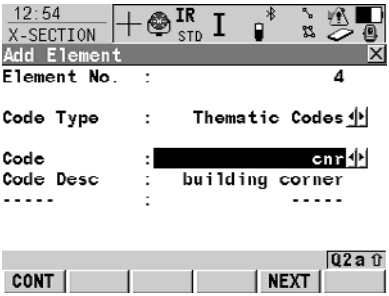
Field	Description
No.	The number of the element.
Code	The code assigned to the element. ----- is displayed if no code is assigned to the element.
Code Type	The type of the code assigned to the element.

Next step

IF	THEN
the creation of a template is finished	**STORE (F1)**.
an element is to be added	**ADD (F2)** or **->ADD (F5)**. Refer to paragraph "X-SECTION Add Element".
an element is to be edited	**EDIT (F3)**. Refer to paragraph "X-SECTION Add Element".

X-SECTION Add Element

The functionality of the screens **X-SECTION Insert Element** and **X-SECTION Edit Element in Template** is very similar.



CONT (F1)
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 (F5)
Available in **X-SECTION Add Element**. To add the element at the end of the cross section template. To stay in this screen and create the next element.

PREV (F5)
Available in **X-SECTION Edit Element in Template**. To store the changes. To stay in this screen and edit the previous element.

NEXT (F6)
Available in **X-SECTION Edit Element in Template**. To store the changes. To stay in this screen and add the next element.

Description of columns

Field	Option	Description
<Element No.:>	Output	For **X-SECTION Add Element** and **X-SECTION Insert Element**: The number of the element to be added. For **X-SECTION Edit Element in Template**: x Number of the element to be edited. y Total number of elements on the active template.
<Code Type:>	**Free Code** **Thematic Codes**	To store a code independent of the element as time related information. To store a code together with the element.
<Rec Free Code:>	**After Point** or **Before Point**	Available for **<Code Type: Free Code>**. Determines if a free code is stored before or after the point.
<Code (free):>	Choicelist	The code which will be stored before or after the point/line. Available for **<Code Type: Free Code>**.
<Code:>	Choicelist	The code which will be stored with the next point/line. Available for **<Code Type: Thematic Codes>**.

Field	Option	Description
Attribute name	Output	The attribute and the attribute value which will be stored with the point/line. Available unless **<Show Attrib: Do Not Show>** in **X-SECTION Configuration**.

Next step

CONT (F1) adds the element or stores the changes and returns to **X-SECTION New Template**, **Elements** page.

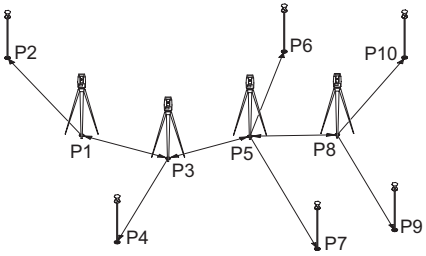
17 Traverse

17.1 Overview

Description

The Traverse application is to fulfill 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 stake.

Diagram



TPS12_140

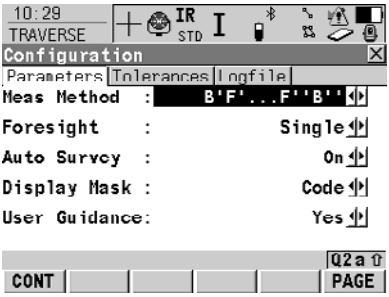
P1 Traverse point
P2 Backsight point
P3 Traverse point
P4 Sideshot point
P5 Traverse point
P6 Sideshot point
P7 Sideshot point
P8 Closing point
P9 Sideshot point
P10 Closing angle point

17.2 Configuring Traverse

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Traverse** and press **CONT (F1)**.
3.	Press **CONF (F2)** to access **TRAVERSE Configuration**.

TRAVERSE Configuration, Parameters page



CONT (F1)
To accept changes and to access the subsequent screen.

DMASK (F3)
To edit the display mask currently being displayed in this field. Available for **<Display Mask:>** being highlighted on **Parameters** page.

Description of fields

Field	Option	Description
<MeasMethod:>	**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.
	B'B''F'F''	Backsight point is measured in face I immediately followed by the 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 the face II. Other points are measured in alternating face order.
	B'F'...	All points are measured in face I only.
<Foresight:>	**Single** or **Multiple**	Option to define if only one foresight point or multiple points are used during the sets.
<Auto Survey:>	**On** or **Off**	For instruments with ATR and **<Auto Survey: On>** ATR search and ATR measurements are done to specified targets and subsequent sets.
<Display Mask:>	Choicelist	The user defined display mask to be shown in **TRAVERSE XX, Set:X/X**.

Field	Option	Description
<User Guidance:>	**Yes** or **No**	To activate/deactivate helpful message dialogs to assist in using the Traverse program.

Next step
PAGE (F6) changes to **Tolerances** page.

TRAVERSE Configuration, Tolerances page

Description of fields

Field	Option	Description
<Use Tolerance:>	**Yes** or **No**	The entered horizontal, vertical and distance tolerances are checked during the measurements to verify accurate pointing and measurements.
<Hz Tolerance:>, **<V Tolerance:>** or **<Dist Tol:>**	User input	Tolerance for horizontal, vertical directions and distances.
<BS Ht Tol:>	User input	Tolerance for the backsight height.

Next step
PAGE (F6) changes to **Logfile** page. Refer to "1.2 Configuration of a Logfile".

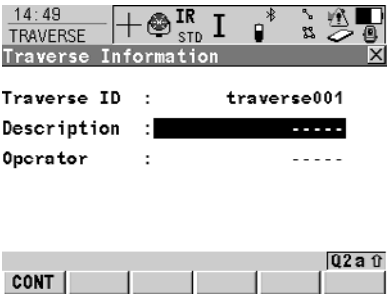
17.3 Traverse Methods

17.3.1 Starting Traverse

Access step-by-step

Step	Description
1.	**PROG**. The **PROG** key opens the **TPS1200 Programs** menu.
2.	Select **Traverse** and press **CONT (F1)**.
3.	Press **CONT (F1)** to access **TRAVERSE Traverse Information**.

TRAVERSE Traverse Information



CONT (F1)
To accept changes and to access the subsequent screen.

DATA (F5)
To view existing traverse data.

END T (F6)
To end the existing traverse.

SHIFT CONF (F2)
To change the configuration settings.

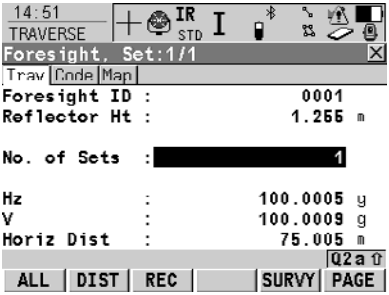
Next step

IF	THEN
a new traverse is started	**CONT (F1)** accesses **SETUP Station Setup** to set up the station. All setup methods can be used.
an existing traverse is continued	**CONT (F1)** accesses **TRAVERSE XX, Set X/X**.

17.3.2 Measuring Traverse

TRAVERSE XX, Set:X/X

Measuring a backsight point is similar to measuring a foresight point.
For simplicity the screen **TRAVERSE Foresight, Set:X/X** is explained.



DONE (F4)
Available for **<Foresight: Multiple>** to finish measuring foresight points.

SURVY (F5)
To measure sideshot points.

SHIFT GETPT (F4)
To get a point from the **<Fixpoint Job:>** to be used as closing point, check point or normal foresight point. Available for foresight point.

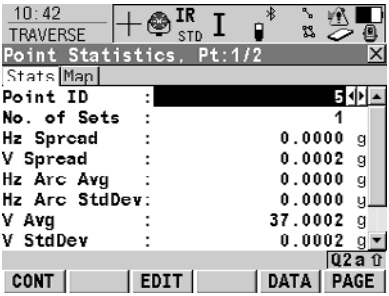
Description of fields

Field	Option	Description
<Station ID:>	Output	The point ID of the station ID. Available on the first backsight screen.
<Instrument Ht:>	User input	The instrument height of the station ID. Available on the first backsight screen.
<Backsight ID:>	Output	Available for the backsight point. The point ID of the backsight point.
<Foresight ID:>	User input or Output	Available for the foresight point. The point ID of the foresight point.
<Reflector Ht:>	User input or Output	The reflector height of the foresight/backsight point.
<No. of Sets:>	User input or Output	The number of sets to be measured.

Next step
ALL (F1) measures all sets and accesses **TRAVERSE Point Statistics**.

17.3.3 Traverse Point Statistics and Traverse Results

TRAVERSE Point Statistics, Set:X/X



CONT (F1)
To access the subsequent screen.

EDIT (F3)
To edit point code and annotations.

DATA (F5)
To display traverse data.

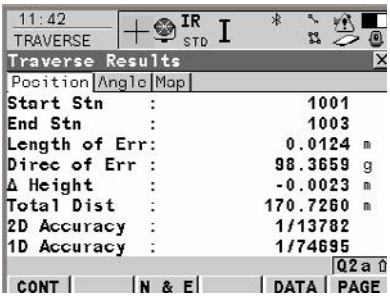
Description of fields

Field	Option	Description
<Point ID:>	Choicelist	Selected point ID.
<No. of Sets:>	Output	The number of sets the point was measured in.
<Hz Spread:>	Output	Spread of horizontal angle.
<V Spread:>	Output	Spread of vertical angle.
<Hz Arc Avg:>	Output	Average horizontal angle.
<Hz Arc StdDev:>	Output	Standard deviation of horizontal angle.
<V Avg:>	Output	Average vertical angle.
<V StdDev:>	Output	Standard deviation of vertical angle
<Dist Avg:>	Output	Average distance.
<Dist StdDev:>	Output	Standard deviation of distance.

Next step

IF the traverse	THEN
is to be continued	**CONT (F1)** allows to: • **MOVE (F1)** moves to next station. • **SURVY (F3)** measures a sideshot point. • **DATA (F5)** views traverse data. • **END T (F6)** ends Traverse application program.
point was a closing point	**CONT (F1)** accesses **TRAVERSE Traverse Results**.

TRAVERSE
Traverse Results, Position page



CONT (F1)
To access the subsequent screen.

N & E (F3) or **L & D (F3)**
To view error in north/east or length/direction of misclosure error.

DATA (F5)
To display traverse data.

Description of fields

Field	Option	Description
<Start Stn:> or **<End Stn:>**	Output	The point ID of the traverse start point or traverse end point.
<Length of Err:> or **<Direc. of Err:>**	Output	The length or direction of the misclosure error.
<Δ North:>, **<Δ East:>** or **<Δ Height:>**	Output	Error in north, east or height.
<Total Dist:>	Output	Total length of the traverse.
<2D Accuracy:> or **<1D Accuracy:>**	Output	Position or height ratio of misclosure.

Next step

PAGE (F6) changes to the Angle page.

TRAVERSE
Traverse Results, Angle page

Description of fields

Field	Option	Description
<Foresight ID:>	Output	Point ID of the closing angle point. Displays ----- if no values are available.
<FS Azimuth:>	Output	Defined azimuth of closing line. Displays ----- if no values are available.
<Azimuth Avg:>	Output	Mean value of the measured azimuth closing line. Displays ----- if no values are available.
<Angular Misc:>	Output	Angular misclosure of traverse. Displays ----- if no values are available.

Next step

IF the traverse	THEN
is to be closed	**CONT (F1)** allows to:

IF the traverse	THEN
	• **C ANG (F1)** closes the traverse with angular closure. Available if a point was selected from the database with **SHIFT GETPT (F4)** unless closing angle is already measured. • **SURVY (F3)** measures a sideshot point. • **DATA (F5)** views traverse data. • **END T (F6)** ends Traverse application program.

17.3.4 Traverse Close Angle

TRAVERSE Close Angle

Description of fields

Field	Option	Description
<FS Type:>	**Known Point**	To measure onto a known point.
	Known Azimuth	To measure onto a known azimuth.
<Foresight ID:>	Choicelist or User input	The point ID of the foresight point.
<FS Azimuth:>	User input	Available for **<FS Type: Known Azimuth>**. Known azimuth for foresight point.

Next step

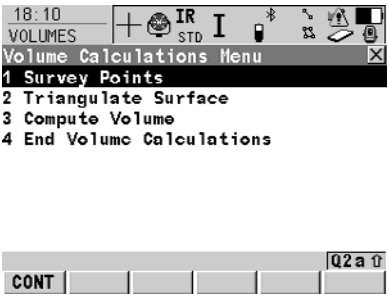
CONT (F1) accesses **TRAVERSE XX, Set:X/X** and measures all sets.

18 Volume Calculations

18.1 The Volume Calculations Menu

The menu

- This menu lists all of the necessary steps and the option to close the program.



CONT (F1)
To select the highlighted option and to continue with the subsequent screen.

SHIFT CONF (F2)
To configure the program.

Menu Option	Description
Step 1) **Survey Points**	To measure points defining a new surface or extending existing surfaces currently stored in the active job.
Step 2) **Triangulate Surface**	To triangulate (delauny triangulation) the measured surface points to establish the surface.
Step 3) **Compute Volume**	To compute the volume of a surface by a reference (3D point, entered elevation) or by the stockpile method.
Step 4) **End Volume Calculations**	To end Volume Calculations and return to the screen from where Volume Calculations was accessed.

Next step

IF	THEN
to start the program	highlight the relevant option and press **CONT (F1)**.
to configure the program	press **SHIFT CONF (F2)**.
to close the program	highlight **End Volume Calculations**, press **CONT (F1)**.

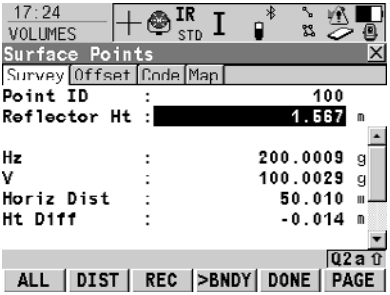
18.2 Step 1) Surveying the Points

Description

- To measure points to a new surface or to an existing surface in the active job. If no surfaces currently exist in the active job, the user has to enter a **New Surface** first in **VOLUMES Choose Task & Surface**. The menu items **Triangulate Surface** and **Compute Volume** within the **VOLUMES Volumes & Surfaces Menu** are marked grey if no surface exists in the active job.

Surveying points

- This menu lists all of the necessary steps and the option to close the program.



ALL (F1)
To measure and store distances and angles.

STOP (F1)
Available if **<EDM Mode: Tracking>** and **DIST (F2)** was pressed. Stops the distance measurements. **(F1)** changes back to **ALL**.

DIST (F2)
To measure and display distances. Available unless **<EDM Mode: Tracking>** and/or **<Log Auto Pts: Yes>**, after the tracking or logging is started.

REC (F3)
To record data.
If **<EDM Mode: Tracking>** and/or **<Log Auto Pts: Yes>**, records measured point and continues tracking.

>BNDY (F3) / **>SURF (F3)**
To change the class of the point to be measured between surface point and boundary point.

DONE (F5)
To finish measuring and to return to the **Volumes Calculations Menu**.

PAGE (F6)
To change to another page on this screen.

SHIFT INDIV (F5) and **SHIFT RUN (F5)**
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:>	User input	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 ID's type over the point ID. For an individual point ID independent of the ID template **SHIFT INDIV (F5)**. **SHIFT RUN (F5)** changes back to the next ID from the configured ID template.
<Reflector Ht:>	User input	The last used reflector height is suggested when accessing the Survey application program. An individual reflector height can by typed in.
<Hz:>	Output	The current horizontal angle.
<V:>	Output	The current vertical angle.
<Horiz Dist:>	Output	The horizontal distance after **DIST (F2)** was pressed. No distance is displayed when accessing the screen and after **REC (F3)** or **ALL (F1)**.
<Ht Diff:>	Output	The height difference between station and measured point after **DIST (F2)**. Displays ----- when accessing the screen and after **REC (F3)** or **ALL (F1)**.

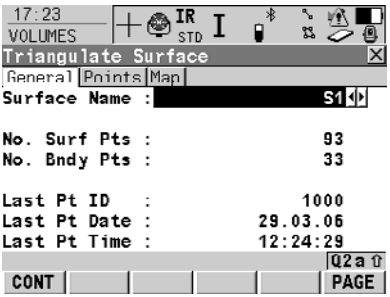
Next step

Press **ESC** returns to the **VOLUMES Choose Task & Surface** screen.
Press **ESC** again to return to the **VOLUMES Volume Calculations Menu** screen.

18.3 Step 2) Triangulating the Surface

Triangulating the surface

- To calculate a surface by establishing a triangulation (triangulation method: delauny) of the measured surface points.



CONT (F1)
To access **VOLUMES Boundary Definition**. **(F1)** changes to **CALC**.

PAGE (F6)
To change to another page on this screen.

SHIFT CONF (F2)
To configure the program.

SHIFT DEL S (F4)
To delete the surface.

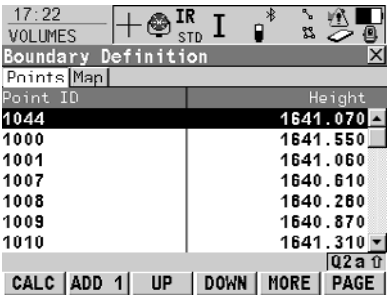
Description of fields

Field	Option	Description
<Surface Name:>	Choicelist	Name of the surface to be triangulated.
<No. Surf Pts:>	Output	Number of the measured surface points.
<No. Bndy Pts:>	Output	Number of the measured boundary points.
<Last Pt ID:>	Output	ID of the last measured point of the chosen surface.
<Last Pt Date:>	Output	Date of the last measured point of the chosen surface.
<Last Pt Time:>	Output	Time of the last measured point of the chosen surface.

Next step

CONT (F1) continues to the **VOLUMES Boundary Definition** screen.

Defining the boundary



CALC (F1)
To start calculating the triangulation and to access to the **VOLUMES Triangulation Results**.

ADD 1 (F2)
To add points from the active job to the surface.

UP (F3)
To move the focused point one step up within the boundary definition.

DOWN (F4)
To move the focused point one step down within the boundary definition.

MORE (F5)
To display information about the code group, the code type, the code description and the quick codes if available.

PAGE (F6)
To change to another page on this screen.

SHIFT HOME (F2)
To move the focus to the top of the points list.

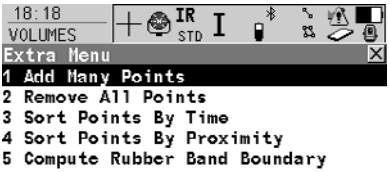
SHIFT END (F3)
To move the focus to the bottom of the points list.

SHIFT REM 1 (F4)
To remove the marked point from the surface.

SHIFT EXTRA (F5)
To access to the **VOLUMES Extra Menu**.

Next step
SHIFT EXTRA (F5) continues to the **VOLUMES Extra Menu** screen.

The Extra menu



CONT (F1)
To select the highlighted option and to continue with the subsequent screen.

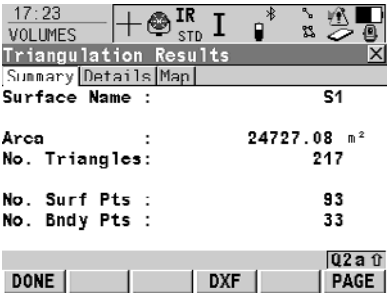
Menu Option	Description
Add Many Points	Access Data Manage and all points that are in the list.
Remove All Points	Method to remove all points that are indicated in the **Boundary Definition** points page.
Sort Points by Time	Method to sort all points in the **Boundary Definition** points page by the time they were stored.
Sort Points by Proximity	Method to sort all points in the **Boundary Definition** points page by the closest proximity.
Compute Rubber Band Boundary	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

CONT (F1) returns to the previous screen.

CALC (F1) calculates the triangulation and continues to the **VOLUMES Triangulation Results** screen.

Triangulation results



DONE (F1)
To close the triangulation of the surface and return to **Volumes Calculations Menu**.

DXF (F4)
To export the triangulation results to a DXF file on the data or root directory of the CF Card.

PAGE (F6)
To change to another page on this screen.

SHIFT CONF (F2)
To configure the program.

Description of fields

Field	Option	Description
<Surface Name:>	Output	Name of the surface.
<Area:>	Output	Area of the base plane.
<No. Triangles:>	Output	Number of triangles used within the triangulation.
<No. Surf Pts:>	Output	Number of points inside the surface.
<No. Bndy Pts:>	Output	Number of boundary points of the surface.

Next step

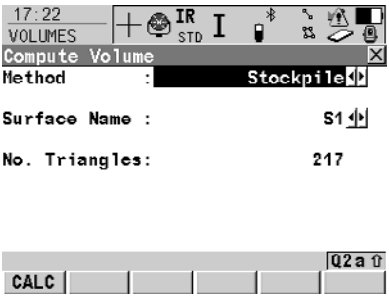
DONE (F1) returns to the **Volume Calculation Menu** screen.

18.4 Step 3) Computing the Volume

Description

- To calculate a surface by establishing a triangulation (triangulation method: delauny) of the measured surface points.
- To compute the volume of the triangulated surface by using either:
  - the stockpile method,
  - an elevation plane as a reference,
  - a single point as a reference.

Computing the volume



CALC (F1)
Computing the volume and access to the **VOLUMES Volume Calculation Results page**. **(F1)** changes to **CONT**.

SHIFT CONF (F2)
To configure the program.

Description of fields

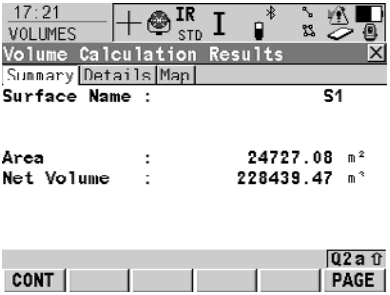
Field	Option	Description
<Method:>	Choicelist	To calculate the volume of the triangulated surface.
	Stockpile	To calculate a volume between the triangulated surface and the surface defined by the boundary points of the surface.
	Surface to Elev	To calculate a volume between the triangulated surface and the height entered by the user.
	Surface to Point	To calculate a volume between the triangulated surface and the height of a selected point.
<Surface Name:>	Choicelist	The surface chosen from the triangulated surfaces currently stored to the active job.
<No. Triangles:>	Output	The number of triangles from the triangulated surface
<To Elevation:>	User Input	To enter a height for the elevation plane. This height will be used as the reference when **<Method: Surface To Elev>** is selected.
<To Point:>	Choicelist	To select a point from the active job. This point height will be used as the reference when **<Method: Surface To Point>** is selected.

Field	Option	Description
<Elevation:>	Output	The elevation of the selected point.

Next step

CALC (F1) calculates the volume and continues to the **VOLUMES Volume Calculation Results** screen.

Volume calculation results



CONT (F1)
Computing the volume and access to the **VOLUMES Volume Calculation Results page**. **(F1)** changes to **CONT**.

PAGE (F6)
To change to another page on this screen.

SHIFT CONF (F2)
To configure the program.

Description of fields

Field	Option	Description
<Surface Name:>	Output	Surface.
<Area:>	Output	Area of the base plane.
<Net Volume:>	Output	Volume of the surface.

Next step

CONT (F1) returns to the **Volume Calculation Menu** screen.

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Leica Geosystems AG
Heinrich-Wild-Strasse
CH-9435 Heerbrugg
Switzerland
Phone +41 71 727 31 31
www.leica-geosystems.com

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