Leica GPS1200
Applications
Field Manual

Version 5.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a GPS1200 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

- Windows and Windows CE are a registered trademark of Microsoft Corporation
- 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.

Validity of this manual

- This manual applies to all GPS1200 instruments. Differences between the various models are marked and described.
- The RX1200 is available as RX1210 or with touch screen functionality as RX1210T, RX1250X, RX1250Xc, RX1250T or RX1250Tc. The name RX1210 is used throughout the manual and may also represent the touch screen models. Only use the supplied stylus on the screens of the touch screen models.
- This manual covers standard real-time surveying applications. Refer to the GPS1200 Technical Reference Manual for information about other functionality available.

Available documentation

Name	Description	Format	
			
User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	x	x

Name	Description	Format	
			
System Field Manual	Describes the general working of the product in standard use. Intended as a quick reference field guide.	-	x
Application Programs Field Manual	Describes specific onboard application programs in standard use. Intended as a quick reference field guide. The RoadRunner application program is described in a separate manual.	x	x
Technical Reference Manual	Overall comprehensive guide to the product and program functions. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists.	-	x

Refer to the following resources for all GPS1200 documentation and software:

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

Table of Contents

In this manual

1 Application Programs - Getting Started

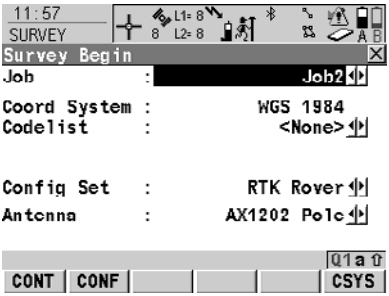
1.1 Starting an Application Program

Access an application program step-by-step

Step	Description
1.	Press **PROG**. The **PROG** key opens the application programs menu **GPS1200 Programs**.
2.	**GPS1200 Programs** Select an option in the menu.
3.	**CONT (F1)** to access **XX Begin**.
☞	Some application programs are protected. They are activated through a specific licence key. This can either be typed in 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. The first screen of Wake-Up Sessions differs from **XX Begin** and is explained in the chapter on Wake-Up Sessions.



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

CONF (F2)
To configure the application program.

CSYS (F6)
To select a different coordinate system.

Description of fields

Field	Option	Description
<Control Job:>	Choicelist	Available for Reference Line. The original points to be staked and the reference lines/arcs are stored in this job.
<Stakeout Job:>	Choicelist	Available for Stakeout. The job containing the points to be staked.
<Job:>	Choicelist	The active job. For Stakeout and Reference Line: Points which are occupied after staking out are stored in this job. The original points to be staked are not copied to 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.
<Antenna:>	Choicelist	The antenna currently defined to be used in the selected configuration set.

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.
<WGS84 Pts 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.

IF the application program	THEN
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.	Refer to "1.1 Starting an Application Program" to access **XX Begin**.
2.	**CONF (F2)** to access **XX Configuration**.
3.	**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 to perform **co**ordinate **g**e**o**metry calculations such as

- coordinates of points.
- bearings between points.
- distances between points.

The calculations can be made from

- existing point data in the job, known distances or known azimuths.
- manually occupied 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.	Refer to "1.1 Starting an Application Program" to access **COGO COGO Menu**.
2.	**COGO COGO Menu** The COGO menu lists all COGO calculation methods and the option to end COGO. Highlight the COGO calculation method to be started.
3.	**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.

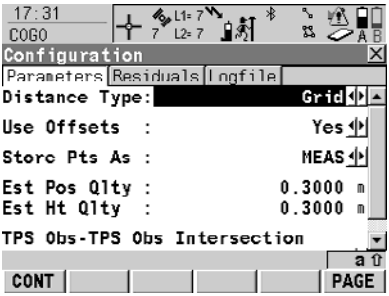
2.3 Configuring COGO

Access

Step	Description
1.	Press **PROG**.
2.	Highlight **COGO**.
3.	**CONT (F1)**
4.	In **COGO COGO Begin** press **CONF (F2)** to access **COGO Configuration**.

COGO Configuration, Parameters page

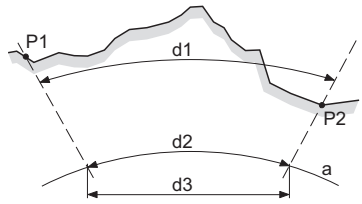
The explanations for the softkeys given below are valid for all pages, unless otherwise stated.



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

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
<Distance Type:>	**Grid**, **Ground** or **Ellipsoid**	The type of distances and offsets to be accepted as input or 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	
<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**	Defines the point class of COGO calculated and stored points as **MEAS** or **CTRL** triplets.
<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.

Field	Option	Description
<Est Ht Qlty:>	User input	The estimated value for the height quality assigned to all calculated heights which is used for the averaging calculation.
<TPS Obs - TPS Obs Intersection>	Output text	COGO method for which only the following configuration setting is valid.
<Compute Ht:>	**Using Average, Use Upper Height** or **Use Lower Height**	Defines the height being used within TPS Obs - TPS Obs Intersection.

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.

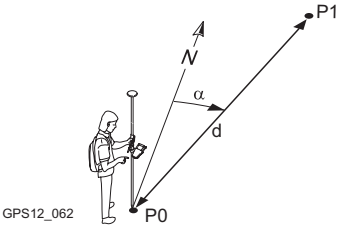
Next step
PAGE (F6) changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".

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

2.4 COGO Calculation - Inverse Method

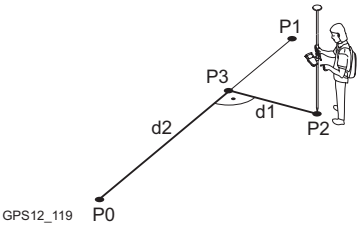
Diagram

Point - Point



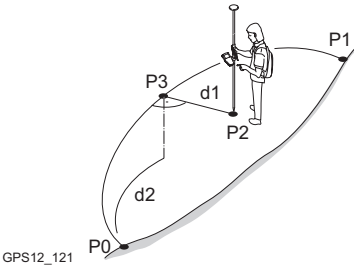
Known
P0 First known point
P1 Second known point
Unknown
α Direction from P0 to P1
d1 Slope distance between P0 and P1
d2 Horizontal distance between P0 and P1
d3 Height difference between P0 and P1

Point - Line



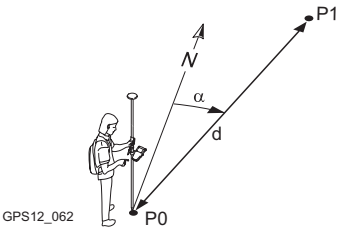
Known
P0 Start point
P1 End point
P2 Offset point
Unknown
P3 Base point
d1 Offset-XX
d2 ΔLine-XX

Point - Arc



Known
P0 Start point
P1 End point
P2 Offset point
Unknown
P3 Base point
d1 Offset-XX
d2 ΔArcDist-XX

Point - Current Position



Known
P0 Current position
P1 Second known point
Unknown
α Direction from P0 to P1
d1 Slope distance between P0 and P1
d2 Horizontal distance between P0 and P1
d3 Height difference between P0 and P1

Access

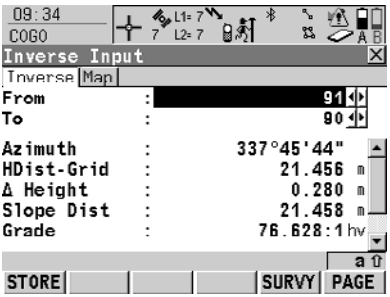
Refer to "2.2 Accessing COGO" to access **COGO Inverse**.

2.4.1 Inverse Point - Point

COGO Inverse Input, Inverse page

The COGO calculation results are displayed on the same page.

----- is displayed for unavailable information, for example if a position only point is used, **<Δ Height:>** cannot be calculated.



STORE (F1)
To store the result.

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

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

SHIFT QUIT (F6)
To not store the calculated results and exits COGO calculation.

Description of fields

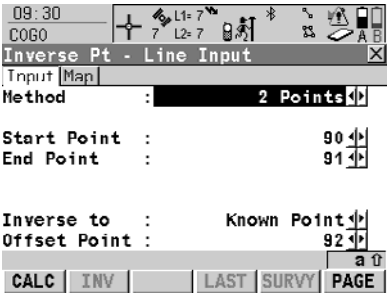
Field	Option	Description
<From:> or **<To:>**	Choicelist	The point ID of the known points. To type in coordinates for a known point open the choicelist when **<From:>** or **<To:>** is highlighted. Press **NEW (F2)** to create a new point.
<Azimuth:>	Output	The direction from the first to the second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

Next step

Step	Description
1.	**PAGE (F6)** changes to the **Map** page.
2.	**STORE (F1)** stores the result. For **<Write Logfile: Yes>** in **COGO Configuration**, **Logfile** page the result is written to the logfile.

2.4.2 Inverse Point - Line

COGO
Inverse
Pt - Line Input, Inverse page



CALC (F1)
To calculate the inverse between point and line.

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

LAST (F4)
To recall previous results from COGO inverse calculations. Available if **<Azimuth:>** or **<HDist-XX:>** is highlighted.

SURVY (F5)
To manually occupy a point for the COGO calculation. Available if **<Start Point:>, <End Point:>** or **<Offset Point:>** 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:>**, **<HDist-XX:>** or **<Offset:>** is highlighted.

Description of fields

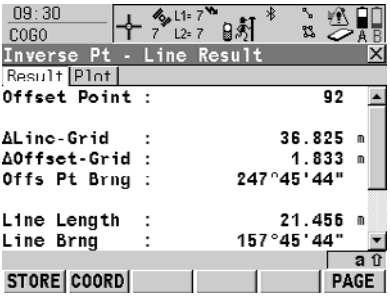
Field	Option	Description
<Method:>		The method by which the line will be defined.
	2 Points	Uses two known points to define the line.
	Pt/Brg/Dist	Defines the line using a known point, a distance and an azimuth of the line.
<Start Point:>	Choicelist	The start point of the line.
<End Point:>	Choicelist	The end point of the line. Available for **<Method: 2 Points>**.
<Azimuth:>	User input	The azimuth of the line. Available for **<Method: Pt/Brg/Dist>**.

Field	Option	Description
<HDist-Grid:>	User input	The horizontal distance from the start point to the end point of the line. Available for **<Method: Pt/Brg/Dist>**.
<Inverse to:>		The method by which the inverse will be calculated.
	Known Point	Uses two known points to define the line.
	Current Position	Defines the line using a known point, a distance and an azimuth of the line.
<OffsetPoint:>	Choicelist	The offset point. Available for **<Inverse To: Known Point>**.

Next step

CALC (F1) calculates the result and accesses **COGO Inverse Pt - Line Result**.

COGO Inverse Pt - Line Result, Result page



STORE (F1)
To store the result.

SURVY (F5)
To manually occupy a point for the COGO calculation. Available if **<Start Point:>, <End Point:>** or **<Offset Point:>** is highlighted.

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

SHIFT QUIT (F6)
To not store the calculated results and exits COGO calculation.

Description of fields

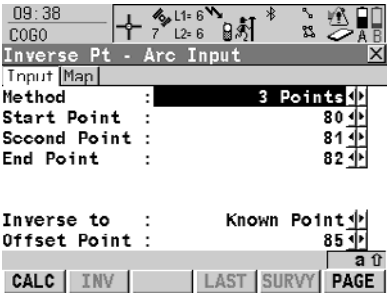
Field	Option	Description
<Offset Point:>	Output	The offset point.
<ΔLine-Grid:>	Output	Horizontal distance from start point to base point.
<ΔOffset-Grid:>	Output	Offset from base point to offset point. Positive to the right and negative to the left of the line.
<Offs Pt Brng:>	Output	Bearing of offset point to base point.
<Line Length:>	Output	Length of line from first to second point.
<Line Brng:>	Output	Bearing of line from first to second point.

Next step

Step	Description
1.	**PAGE (F6)** changes to the **Map** page.
2.	**STORE (F1)** stores the result. For **<Write Logfile: Yes>** in **COGO Configuration**, **Logfile** page the result is written to the logfile.

2.4.3 Inverse Point - Arc

COGO
Inverse
Pt - Arc Input,
Inverse page



STORE (F1)
To store the result.

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

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

SHIFT QUIT (F6)
To not store the calculated results and exits COGO calculation.

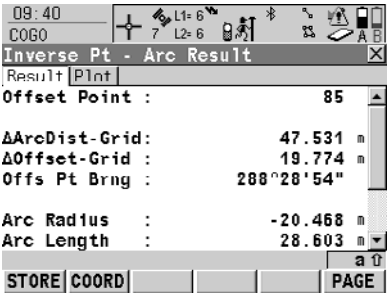
Description of fields

Field	Option	Description
<Method:>		The method by which the arc will be defined.
	3 Points	Uses three known points to define the arc.
	2 Points/Radius	Defines the arc using two known points and a radius of the arc.
	2 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 arc.
<Second Point:>	Choicelist	The second point of the arc.
<End Point:>	Choicelist	The end point of the arc.
<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>**.

Field	Option	Description
<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>**.
<Inverse to:>	Choicelist	**<Inverse To: Known Point>** or **<Inverse To: Current Position>**.
<Offset Point:>	Choicelist	The offset point. Available for **<Inverse To: Known Point>**.

Next step
CALC (F1) calculates the result and accesses **COGO Inverse Pt - Arc Result**.

COGO Inverse Pt - Arc Result, Result page



STORE (F1)
To store the result.
COORD (F2)
To view other coordinate types.
SHIFT ELL H (F2)
To change between the ellipsoidal and the orthometric height. Available for local coordinates.
SHIFT QUIT (F6)
To not store the calculated results and exits COGO calculation.

Description of fields

Field	Option	Description
<Offset Point:>	Output	The offset point.
<ΔArcDist-Grid:>	Output	Horizontal distance along the arc from start point to base point.
<ΔOffset-Grid:>	Output	Offset from base point to offset point. Positive to the right and negative to the left of the arc.
<Offs Pt Brng:>	Output	Bearing of offset point from base point to offset point.
<Arc Radius:>	Output	Computed radius of arc.
<Arc Length:>	Output	Computed length of arc.

Next step

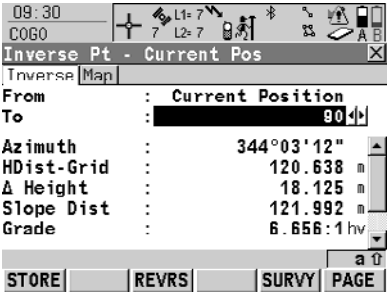
Step	Description
1.	**PAGE (F6)** changes to the **Plot** page.
2.	**STORE (F1)** stores the result. For **<Write Logfile: Yes>** in **COGO Configuration**, **Logfile** page the result is written to the logfile.

2.4.4 Inverse Point - Current Position

COGO
Inverse Pt - Current Position, Inverse page

The COGO calculation results are displayed on the same page.

----- is displayed for unavailable information, for example if a position only point is used, **<Δ Height:>** cannot be calculated.



STORE (F1)
To store the result.

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

REVRS (F3)
To change **<From:>** and **<To:>** for the COGO calculation.

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

SHIFT QUIT (F6)
To not store the calculated results and exits COGO calculation.

Description of fields

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

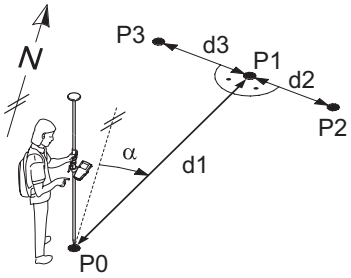
Next step

Step	Description
1.	**PAGE (F6)** changes to the **Map** page.
2.	**STORE (F1)** stores the result. For **<Write Logfile: Yes>** in **COGO Configuration**, **Logfile** page the result is written to the logfile.

2.5 COGO Calculation - Traverse Method

Diagrams

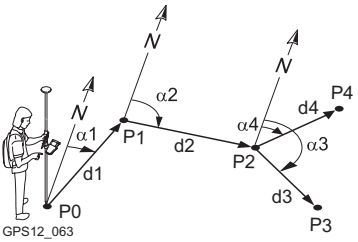
COGO traverse calculation with offset for a single point



GPS12_106

Known
P0 Known point
α Direction from P0 to P1
d1 Distance between P0 and P1
d2 Positive offset to the right
d3 Negative offset to the left
Unknown
P1 COGO point without offset
P2 COGO point with positive offset
P3 COGO point with negative offset

COGO traverse calculation without offset for multiple points



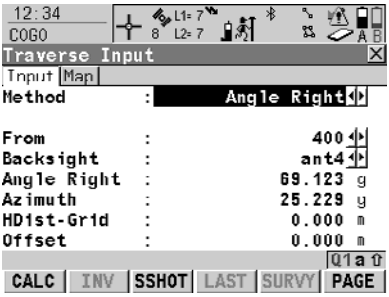
GPS12_063

Known
P0 Known point
α1 Direction from P0 to P1
α2 Direction from P1 to P2
α3 Direction from P2 to P3
α4 Direction from P2 to P4
d1 Distance between P0 and P1
d2 Distance between P1 and P2
d3 Distance between P2 and P3
d4 Distance between P2 and P4
Unknown
P1 First COGO point
P2 Second COGO point
P3 Third COGO point - sideshot
P4 Fourth COGO point

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, the 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 recall previous results from COGO inverse calculations. Available if **<Azimuth:>**, **<HDist-XX:>** or **<Offset:>** is highlighted.

SURVY (F5)
To manually occupy 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

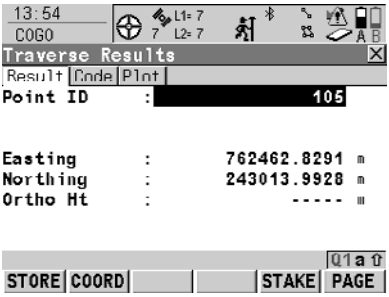
Field	Option	Description
<Method:>	**Azimuth** or **Angle Right**	The direction from the known point to the COGO point.
<From:>	Choicelist	The point ID of the known point. ☞ To type in coordinates for a known point open the choicelist when **<From:>** is highlighted. Press **NEW (F2)** to create a new 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 counterclockwise 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:>**.
<HDist-XX:>	User input	The horizontal distance between the known point and the COGO point.

Field	Option	Description
<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.
STAKE (F5)
To access the Stakeout application program and stake out the calculated COGO point.
SHIFT ELL H (F2) and **SHIFT ORTH (F2)**
To change between the ellipsoidal and the orthometric height. Available for local coordinates.
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.
SHIFT QUIT (F6)
Does not store the COGO point and exits COGO calculations.

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 in the following way: • 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 free ID from the configured ID template.
<Ortho Ht:> or **<Local Ell Ht:>**	User input	The height of the known point used in the COGO calculation is suggested. A height value to be stored with the calculated point can be typed in.

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

COGO Traverse Results, Code page

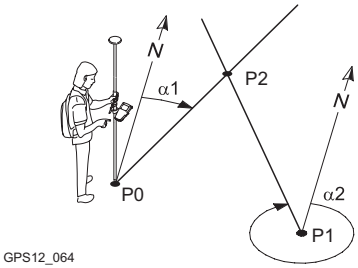
The setting for **<Thematc Codes:>** in **CONFIGURE Coding & Linework** determines the availability of the fields and softkeys. They are identical to those of thematical coding with/without codelist. Refer to the GPS1200 Technical Reference Manual for information on coding.

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

2.6 COGO Calculation - Intersections Method

Diagrams

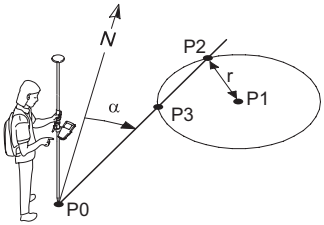
Bearing - Bearing



GPS12_064

Known
P0 First known point
P1 Second known point
α1 Direction from P0 to P2
α2 Direction from P1 to P2
Unknown
P2 COGO point

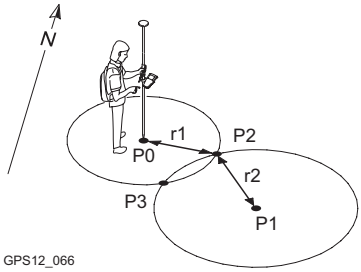
Bearing - Distance



GPS12_065

Known
P0 First known point
P1 Second known point
α Direction from P0 to P2
r Radius, as defined by the distance from P1 to P2
Unknown
P2 First COGO point
P3 Second COGO point

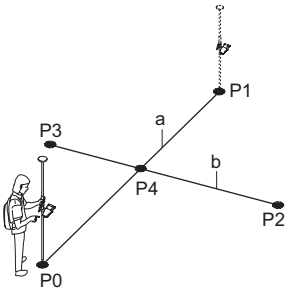
Distance - Distance



GPS12_066

Known
P0 First known point
P1 Second known point
r1 Radius, as defined by the distance from P0 to P2
r2 Radius, as defined by the distance from P1 to P2
Unknown
P2 First COGO point
P3 Second COGO point

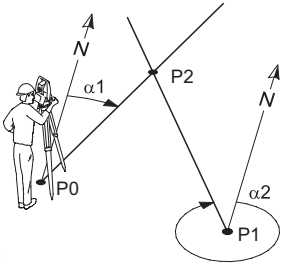
By Points



GPS12_107

Known
P0 First known point
P1 Second known point
P2 Third known point
P3 Fourth known point
a Line from P0 to P1
b Line from P2 to P3
Unknown
P4 COGO point

TPS Observation - TPS Observation



GPS12_170

Known
P0 First known point (TPS Stn)
P1 Second known point (TPS Stn)
α1 Direction from P0 to P2
α2 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	The point ID of the known point. Only available for **<Method: TPS Obs- TPS Obs>**.
<TPS Measmnt:>	Choicelist	The point ID of the TPS measurement made from the selected station for **<1st TPS Stn:>** or **<2st TPS Stn:>**. Only available for **<Method: TPS Obs- TPS Obs>**.
<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. • 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.

Field	Option	Description
		• 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 known point and the COGO point. Available for **<Method: Brng & Dist>** and **<Method: Dist & Dist>**.

Next step

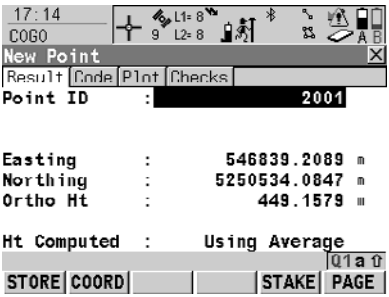
CALC (F1) calculates the result and accesses **COGO XX Results**.

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.

COORD (F2)
To view other coordinate types.

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.

SHIFT ELL H (F2) and **SHIFT ORTH (F2)**
To change between the ellipsoidal and the orthometric height. Available for local coordinates.

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 the COGO point. The configured point ID template is used. The ID can be changed in the following way: • 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 free 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 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 GPS1200 Technical Reference Manual for information on coding.

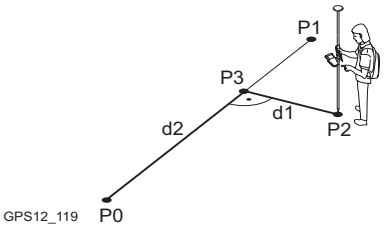
Next step
PAGE (F6) changes to the **Plot** page.

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

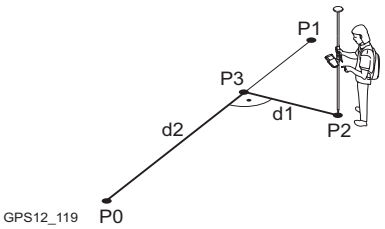
Base Point



GPS12_119

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

Offset Point



GPS12_119

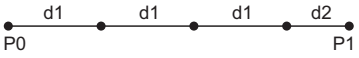
Known
P0 **<Start Point:>**
P1 **<End Point:>**
d1 **<Offset-XX:>**
d2 **<ΔLine-XX:>**
Unknown
P2 **<Offset Point:>**
P3 Base point

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.



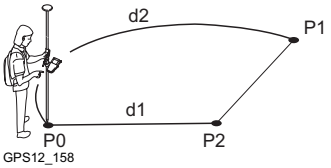
GPS12_145

Line divided by **<Method: Segment Length>**

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

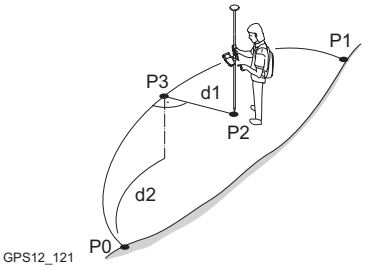
Diagrams
Arc Calculation

Arc Center



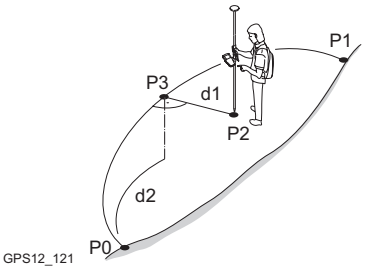
Known
P0 **<Start Point:>**
P1 **<End Point:>**
d1 **<Arc Radius:>**
Unknown
P2 Arc center
d2 **<Arc Length:>**

Base Point



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

Offset Point



Known
P0 **<Start Point:>**
P1 **<End Point:>**
d1 **<ΔOffset-XX:>**
d2 **<ΔArcDist-XX:>**
Unknown
P2 **<Offset Point:>**
P3 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.
	3 Points	Uses three known points to define the arc.

Field	Option	Description
	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/arc.
<Second Point:>	Choicelist	The second point of the arc.
<End Point:>	Choicelist	The end point of the line/arc. 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 in the following way: • 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 free ID from the configured ID template.
<Ortho Ht:> or **<Local Ell Ht:>**	User input	The height of the start point of the line/arc is suggested. 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>**.
<ΔLine-XX:>	Output	Horizontal distance from start point to base point. Available for **<Task: Calc Base Point>**.

Field	Option	Description
<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 GPS1200 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:>**.
<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.

Field	Option	Description
<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.

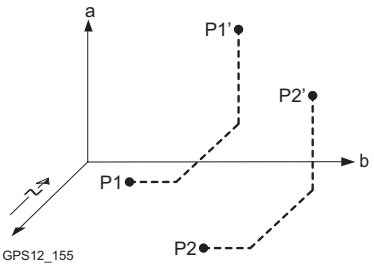
Next step
PAGE (F6) changes to the **Plot** page.

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

Description

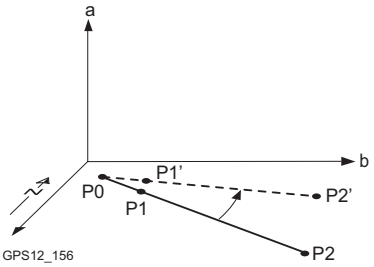
The COGO calculation shift, rotate & scale (manual) applies shifts and/or rotation and/or scale to one or several known points. The values for shifts and/or rotation and/or scale are typed in manually.

Diagrams



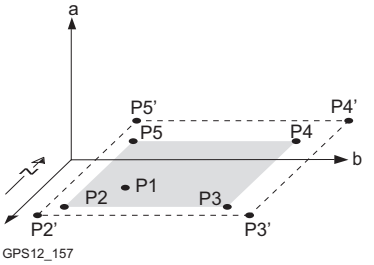
Shift

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

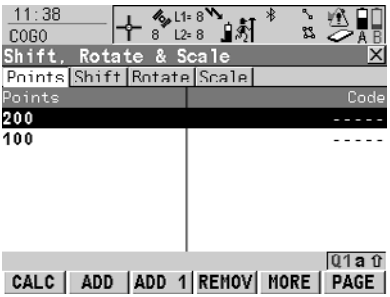
a	Height
b	Easting
P1	**<Rotation Pt:>**, can be held fixed, all other points are then scaled from here
P2-P5	Known point
P2'-P5'	Scaled point

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 all 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**	Scaling is performed by multiplying the original coordinates of the points by **<Scale:>**.
	Yes	**<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.
	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.

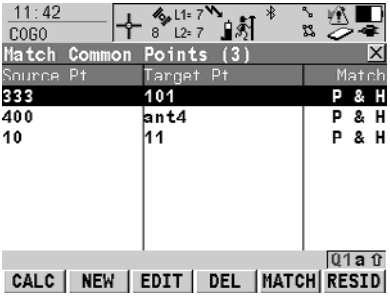
The number of pairs of points matched determines whether the shift, rotation and scale values are computed.

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.

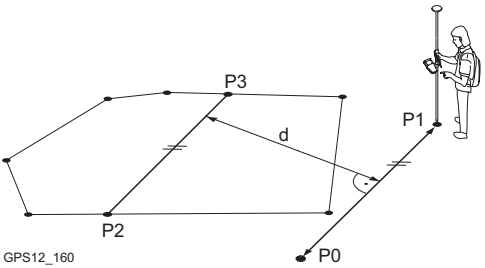
Next step

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

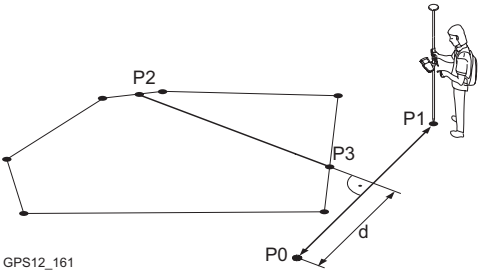
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Parallel Line**	**By Distance**
2.	**By Percentage**	**Parallel Line**	-
3.	**By Area**	**Parallel Line**	-



GPS12_160

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:>**

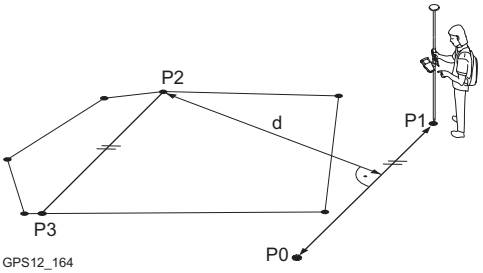
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Perpendic Line**	**By Distance**
2.	**By Percentage**	**Perpendic Line**	-
3.	**By Area**	**Perpendic Line**	-



GPS12_161

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:>**

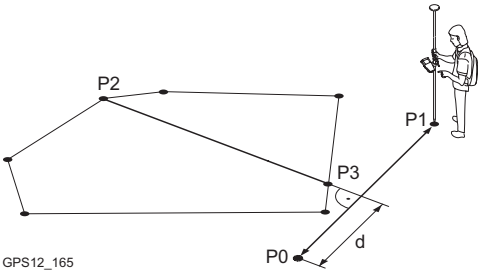
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Parallel Line**	**Through Point**



GPS12_164

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:>**

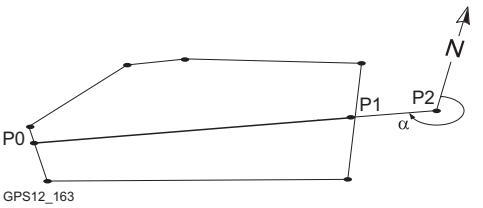
Area division method	<Divide:>	<Using:>	<Shift:>
1.	**By Defined Line**	**Perpendic Line**	**Through Point**



GPS12_165

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**	-



GPS12_163

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

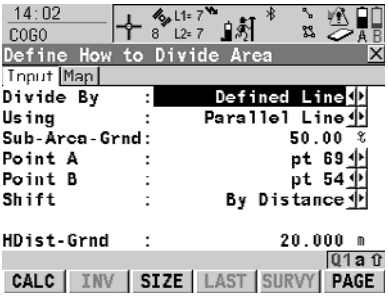
Description of fields

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

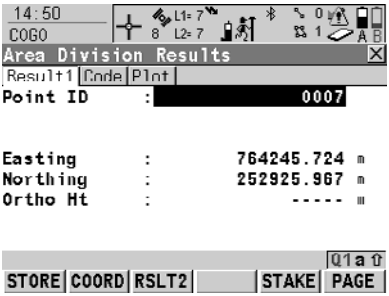
Description of fields

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 stake out the calculated COGO point.

SHIFT ELL H (F2) and **SHIFT ORTH (F2)**
To change between the ellipsoidal and the orthometric height.

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. 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 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 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.

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.
	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.

Coordinate system determination method	Characteristic	Description
	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 Determine Coordinate System

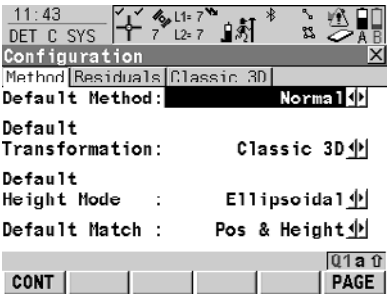
3.2.1 Configuring Determine Coordinate System - Normal

Access step-by-step

Step	Description
1.	Press **PROG**.
2.	Highlight **Determine Coordinate System**.
3.	**CONT (F1)**
4.	**CONF (F2)** to access **DET C SYS Configuration**.
5.	In **DET C SYS Configuration**, **Method** page 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 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 Determine Coordinate System - One Point Localisation

Access step-by-step

Step	Description
1.	Press **PROG**.
2.	Highlight **Determine Coordinate System**.
3.	**CONT (F1)**
4.	**CONF (F2)** to access **DET C SYS Configuration**.
5.	In **DET C SYS Configuration**, **Method** page 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 Determine Coordinate 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.

Field	Option	Description
	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**	Scale factor can be manually typed in.
	Compute CSF	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**	The source of the height information to use in the transformation.

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.	Press **PROG**.
2.	Highlight **Determine Coordinate System**.
3.	**CONT (F1)**.
4.	In **DET C SYS Determine Coord System Begin**, select **<Method: Normal>**.
5.	**CONT (F1)** to access **DET C SYS Step 1: Choose Transform Type**.

☞ 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 coordinate system. If a coordinate system is being updated then its name is displayed.
<Transfrm Type:>	**Onestep**, **Twostep** or **Classic 3D**	Available when determining a new coordinate system.
	Output	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**	Available when determining a new coordinate system.
	Output	Available when updating a coordinate system. The height type 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**.

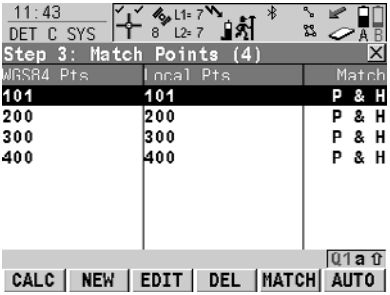
Description of fields

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 fixed 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.

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 manually occupied.

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**.

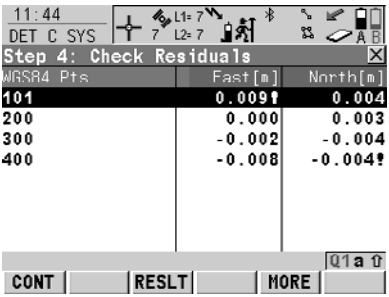
Description of columns

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 help improve residuals.

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** to return 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)** to continue 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, Northing and Height residuals 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 descriptions 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.

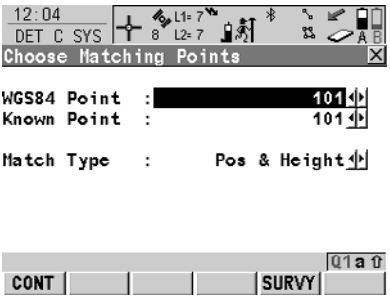
4.2 Selecting/Editing a Pair of Matching Points

Access step-by-step

Step	Description
1.	"4.1 Determining a New/Updating a Coordinate System". Follow the instructions to access **DET C SYS Step 3: Match Points (n)**.
2.	**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 outlined.

DET C SYS XX Matching Points



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

SURVY (F5).
To manually occupy a point and store it in the job.

Description of fields

Field	Option	Description
<WGS84 Point:>	Choicelist	A WGS 1984 control point. All WGS 1984 stored points from **MANAGE Data: Job Name** can be selected.
<Known Point:>	Choicelist	A local control point. All local stored points from **MANAGE Data: Job Name** of any class, except **NONE**, can be selected.
<Match Type:>	**Pos & Ht**, **Pos Only**, **Height Only** or **None**	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

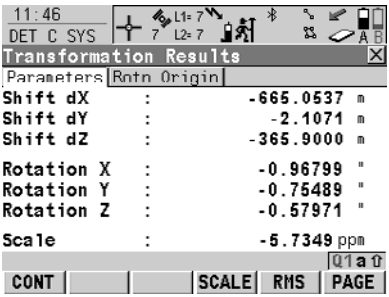
Step	Description
1.	Select a control point form both jobs that occupy the same position on the different datums.
2.	**CONT (F1)** returns to **DET C SYS Step 3: Match Points (n)** and adds a new line of matched points to the matched points list.

4.3 Transformation Results

Access step-by-step

Step	Description
1.	"4.1 Determining a New/Updating a Coordinate System". Follow the instructions to access **DET C SYS Step 4: Check Residuals**.
2.	**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.
<Shift dZ:>	Output	Shift in Z direction.
<Rotation:>	Output	Rotation of transformation.
<Rotation X:>, **<Rotation 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 Classic 3D Parameters**.
<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 Determine Coordinate 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.	Press **PROG**.
2.	Highlight **Determine Coordinate System**.
3.	**CONT (F1)**.
4.	In **DET C SYS Determine Coord System Begin**, select **<Method: One Pt Localistn>**.
5.	**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 use 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 Determine Coordinate System - Onestep/Twostep Transformation".
<Transfrm Type: Classic 3D>	**CONT (F1)** to access **DET C SYS Step 2: Choose Parameters**. Refer to "5.3 Determine Coordinate System - Classic 3D Transformation".

5.2 Determine Coordinate System - Onestep/Twostep Transformation

5.2.1 Determining a New Coordinate System

Access

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

DET C SYS Step 2: Choose Parameters

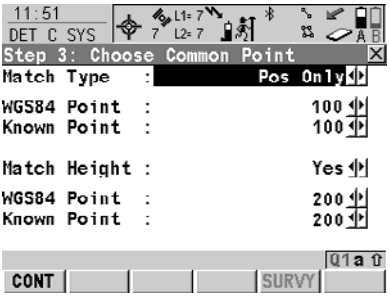
Description of fields

Field	Option	Description
<Pre Transform:>	Choicelist	Available for **<Transfrm Type: Twostep>**. The pre-transformation 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 fixed 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)
Available for **<WGS84 Point:>** being highlighted. To manually occupy a point and store it in **<WGS84 Pts Job:>**.

Description of fields

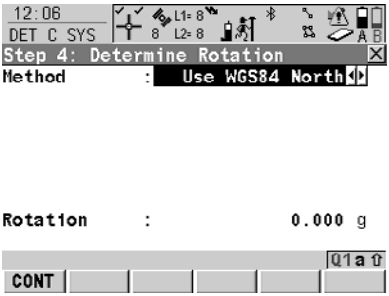
Field	Option	Description
<Match Type:>	**Pos & Height**	Position and height are taken from the same pair of matching points.
	Pos Only	Position is taken from one pair of matching points. The height can be taken from another pair of matching points.

Field	Option	Description
<WGS84 Point:>	Choicelist	The point ID of the horizontal and/or vertical control point chosen from **<WGS84 Pts Job:>**.
<Known Point:>	Choicelist	The point ID of the horizontal and/or vertical 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^{o}.

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.

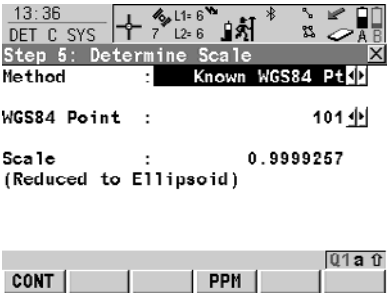
Field	Option	Description
<Rotation:>	Output	The rotation of the transformation calculated as **<Reqd Azimuth>** minus **<Azimuth>**. The field is updated as **<Point 1:>**, **<Point 2:>** and **<Reqd Azimuth:>** are changed.

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 distance from the centre of the ellipsoid to the WGS 1984 point selected in **DET C SYS Step 3: Choose Common Point** and 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 **<Transfrm Type: Twostep>** where **<Method: Compute CSF>**.

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

SURVY (F5)
To manually occupy a point and store it in **<WGS84 Pts Job:>**. Available for **<Transfrm Type: Onestep>** where **<Method: Known WGS84 Pt:>** when **<WGS84 Point:>** is highlighted.

For <Transfrm Type: Onestep>

Description of 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

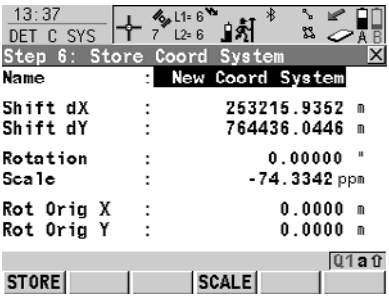
Field	Option	Description
<Method:>	**User Entered** or **Compute CSF**	The default method for determining the **C**ombined **S**cale **F**actor to be used in the transformation process.
<Grid SF:>	Output	Available for **<Method: Compute CSF>**. The grid scale factor as computed in **DET C SYS Compute 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**.

Field	Option	Description
<Combined SF:>	User input	Available for **<Method: User Entered>**. The scale factor can be typed in.
	Output	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 **GPS1200 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 **GPS1200 Main Menu**.

5.2.2 Computing the Grid Scale Factor for Twostep Transformations

Access step-by-step

Step	Description
1.	Refer to "5.1 Accessing Determine Coordinate 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.	**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:>**. The grid scale factor is computed using this point and 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 Transformations

Access step-by-step

Step	Description
1.	Refer to "5.1 Accessing Determine Coordinate 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.	**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 an entered height value.
<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 Determine Coordinate System - Classic 3D Transformation

Access

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

DET C SYS Step 2: Choose Parameters

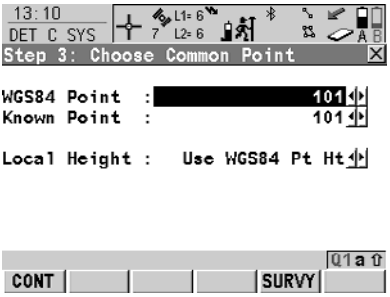
Description of fields

Refer to "5.2 Determine Coordinate 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 manually occupy a point and store it in **<WGS84 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 to the DB-X, attaches the system to **<WGS84 Pts Job:>** that was selected in **DET C SYS Determine Coord System Begin** and returns to **GPS1200 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 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 Determine Coordinate 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.	**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) calculates the required azimuth and returns to **DET C SYS Step 4: Determine Rotation**.

6 Reference Line

6.1 Overview

Reference line tasks

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

- Measuring to a line/arc where the coordinates of a target point can be calculated from its position relative to the defined reference line/arc.
- Staking to a line/arc where the position of a target point is known and instructions to locate the point are given relative to the reference line/arc.
- Gridstaking a line/arc where a grid can be staked relative to a reference line/arc.

☞ Measuring and staking out of points is possible for **<R-Time Mode: Rover>** and **<R-Time Mode: None>**.

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/arc" 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/arc

A reference line can be defined in the following ways:

- Two known points
- One known point, an azimuth, a distance and a gradient
- One known point, an azimuth, a distance and a difference in height

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 should always be considered to also mean **<Bearing:>**.

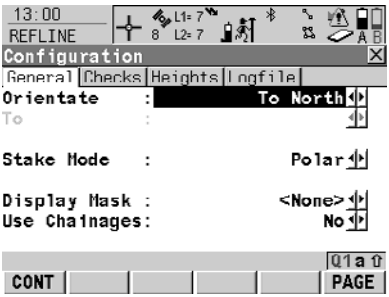
6.2 Configuring Reference Line

Access step-by-step

Step	Description
1.	Press **PROG**.
2.	Highlight **Reference Line**.
3.	**CONT (F1)**
4.	In **REFLINE Reference Line/Arc Begin** press **CONF (F2)** to access **REFLINE Configuration**.
5.	**PAGE (F6)** until the **General** page is active.

REFLINE Configuration, 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
<Use Chainages:>	**Yes** or **No**	Activates the use of chainages within the reference line application program.
<Chain Format:>	Choicelist	Available for **<Use Chainages: Yes>**. Selects display format for all chainage information fields.

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

REFLINE Configuration, 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.
	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

IF	THEN
a logfile is to be configured	**PAGE (F6)** changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".
the configuration is finished	**CONT (F1)** to return to **REFLINE Reference Line/Arc Begin** followed by **CONT (F1)** to access **REFLINE Choose Task & Reference Line**.

6.3 Managing Reference Lines/Arcs

6.3.1 Overview

Description

There are two ways by which a reference line/arc can be defined.

Manually Enter

- A reference line/arc can be defined by manually entering known parameters.
- The line is only temporary and is not stored once the Reference Line application program has been exited.

Select from Job

- Reference lines/arcs can be created, edited, stored and deleted in the **<Control Job:>**.
- The reference lines/arcs can be recalled for use later.

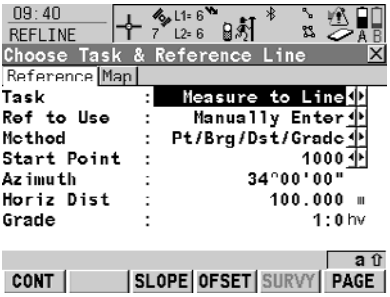
6.3.2 Manually Entering a Reference Line/Arc

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **REFLINE Reference Line/Arc Begin**.
2.	**CONT (F1)** to access **REFLINE Choose Task & Reference Line**.
3.	**REFLINE Choose Task & Reference Line**, **Reference** page Select **<Ref to Use: Manually Enter>**.

REFLINE Choose Task & Reference Line, 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 define reference line/arc slope.

OFSET (F4)
To define reference line/arc offsets, shifts, rotations, height offsets and DTM offsets.

SURVY (F5)
To manually occupy a point. Available when a point field is highlighted.

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

Description of fields

Field	Option	Description
<Task:>	Choicelist	Defines the task to be performed.
<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.
<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>**.

Field	Option	Description
		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 grid 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 **REFLINE Choose Task & Reference Line**, **Map** page.

REFLINE Choose Task & Reference Line, 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 "6.4 Measuring to a Reference Line/Arc".
<Task: Stake to XX>	**CONT (F1)** accepts the changes and accesses **REFLINE Enter Offset Values**. Refer to "6.5 Staking to a Reference Line/Arc".
<Task: Gridstake XX>	**CONT (F1)** accepts the changes and accesses **REFLINE Define Grid**. Refer to "6.6 Gridstaking to a Reference Line/Arc".

6.3.3 Selecting a Reference Line/Arc from the Job

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **REFLINE Reference Line/Arc Begin**.
2.	**CONT (F1)** to access **REFLINE Choose Task & Reference Line**.
3.	**REFLINE Choose Task & Reference Line**, **Reference** page Select **<Ref to Use: Select from Job>**.

REFLINE Choose Task & Reference Line, Reference page

The explanations for the softkeys and the fields are as for **<Ref to Use: Manually Enter>**. The **<Method:>** field is not available and all line definition fields are outputs, all other differences are described below. Refer to "6.3.2 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.

Next step
PAGE (F6) changes to **REFLINE Choose Task & Reference Line**, **Map** page.

REFLINE Choose Task & Reference Line, Map page

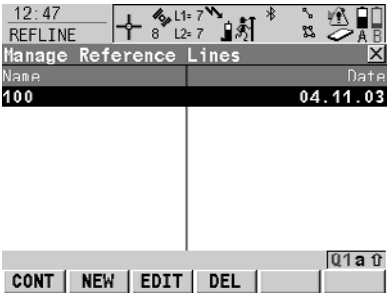
The **Map** page provides an interactive display of the data. The reference line/arc can be viewed but not defined using this page.

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 **RELINE Manage Reference XX**. Refer to paragraph "REFLINE Manage Reference XX".
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 "6.4 Measuring to a Reference Line/Arc". • For **<Task: Stake to XX>** **CONT (F1)** to access **REFLINE Enter Offset Values**. Refer to "6.5 Staking to a Reference Line/Arc".

IF	THEN
	• For **<Task: Gridstake XX>** **CONT (F1)** to access **REFLINE Define Grid**. Refer to "6.6 Gridstaking to a Reference Line/Arc".

REFLINE Manage Reference XX



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.

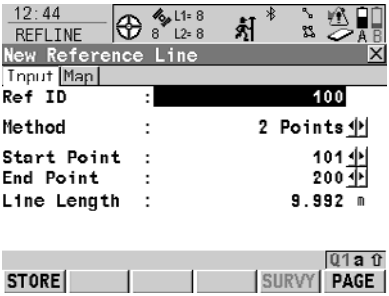
Description of columns

Column	Description
Name	Names of all the reference lines/arcs available in the **<Control 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 "REFLINE New Reference XX, Input page". ☞ 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.

REFLINE
New Reference XX, Input page



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

SURVY (F5)
To manually occupy a point. Available when creating a new reference line/arc, 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 "6.3.2 Manually Entering a Reference Line/Arc" for descriptions.

Next step
PAGE (F6) changes to **REFLINE Choose Task & Reference Line**, **Map** page.

REFLINE
New Reference XX, 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**.

6.3.4 Defining Reference Line/Arc Offsets

Description

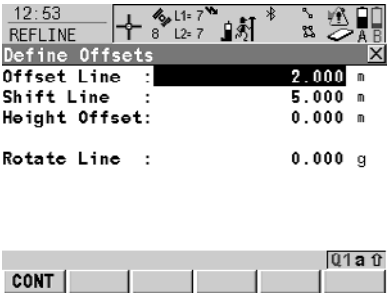
A reference line can be offset, shifted and rotated, a reference arc can be offset.

Access step-by-step

Step	Description
1.	Refer to "6.3 Managing Reference Lines/Arcs" to access **REFLINE Choose Task & Reference Line**.
2.	**OFFSET (F4)** to access **REFLINE Define Offsets**.

REFLINE Define 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>**.
<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**.

6.3.5 Defining Reference Line/Arc Slope

Description

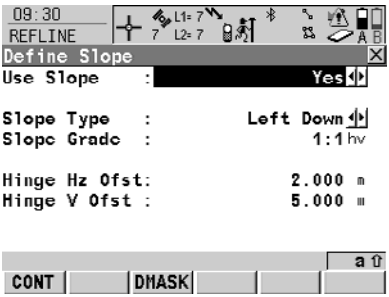
It is possible to measure points and stake points on slopes related to a reference line/arc. A slope can be defined and cut/fill values can then be displayed to the slope when measuring along the reference line/arc. The slope is a plane from the reference line/arc and extends along the length of the 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.	Refer to "6.3 Managing Reference Lines/Arcs" to access **REFLINE Choose Task & Reference Line**.
2.	**SLOPE (F3)** to access **REFLINE Define Slope**.

REFLINE Define Slope



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
<Use Slope:>	**Yes** or **No**	**<Use Slope:Yes>** to define a slope.
<Slope Type:>	Choicelist	The method how the slope will be created.
	Left down	Creates a downward plane extending to the left of the defined reference line/arc.
	Right down	Creates a downward plane extending to the right of the defined reference line/arc.
	Left up	Creates a upward plane extending to the left of the defined reference line/arc.
	Left down	Creates a upward plane extending to the right of the defined reference line/arc.
<Slope Grade:>	User input	Inclination of the slope.
<Hinge Hz Ofst:>	User input	Horizontal offset from the line/arc that sets where the slope starts.
<Hinge V Ofst:>	User input	Vertical offset from the line/arc that sets where the slope starts.

Next step

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

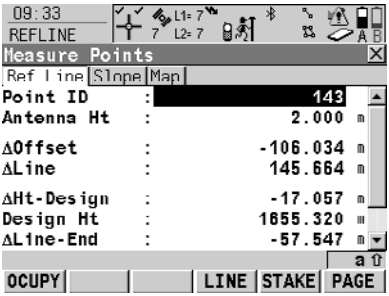
6.4 Measuring to a Reference Line/Arc

Access step-by-step

Step	Description
1.	Refer to "6.3 Managing Reference Lines/Arcs" to access **REFLINE Choose Task & Reference Line**.
2.	**REFLINE Choose Task & Reference Line** **<Task: Measure to XX>**
3.	**CONT (F1)** to access **REFLINE Measure Points**.

REFLINE Measure Points, Ref XX 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.



OCUPY (F1)
To start measuring the point. The position mode icon changes to the static icon. **(F1)** changes to **STOP**. The difference between the current position and the point being staked is still displayed.

STOP (F1)
To end measuring the point. The position mode icon changes to the moving icon. **(F1)** changes to **STORE**.

STORE (F1)
To store the measured point. **(F1)** changes to **OCUPY**.

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 the reference line/arc. Available for **OCUPY (F1)** being displayed.

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 **OCUPY (F1)** or **STORE (F1)** being displayed.

SHIFT INIT (F4)
To force a new initialisation. Available for **OCUPY (F1)** or **STORE (F1)** being displayed and 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.

SHIFT QUIT (F6)
To exit Reference Line application program.

Description of fields

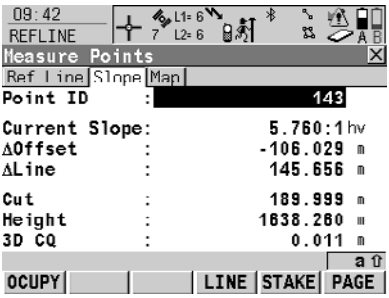
Field	Option	Description
<Point ID:>	User input	The point ID of the point to be measured.
<Antenna Ht:>	User input	The height of the antenna that is being used. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.
<ΔOffset:>	Output	Perpendicular offset from the reference line/arc measured from the reference point to the measured point.
<Chainage>	Output	Chainage of the current position along the line/arc. This is the chainage of the start of the reference line/arc plus **<ΔLine:>**/**<ΔArc:>**.
<Design Slope:>	Output	Slope grade as defined by the user.
<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.
<SD to Hinge:>	Output	Slope distance offset from line/arc to the measured point.
<SD to Line:>	Output	Slope distance offset from hinge to the measured 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.

Field	Option	Description
<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 on the line and the measured point.
<ΔPerp Dist:>	Output	Slope distance between the reference point and the measured point, perpendicular to the reference line.
<ΔSpatial Dist:>	Output	Slope distance between the start point and the reference point.
<ΔHt-Arc:>	Output	Height difference between the reference point on the arc and the measured 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 current position.
<ΔHt-Hinge:>	Output	Height difference from the current position to the hinge.

Next step

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

REFLINE Measure Points, Slope page



OCUPY (F1)

To start measuring the point. The position mode icon changes to the static icon. **(F1)** changes to **STOP**. The difference between the current position and the point being staked is still displayed.

STOP (F1)

To end measuring the point. The position mode icon changes to the moving icon. **(F1)** changes to **STORE**.

STORE (F1)

To store the measured point. **(F1)** changes to **OCUPY**.

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 the reference line/arc. Available for **OCUPY (F1)** being displayed.

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 **OCUPY (F1)** or **STORE (F1)** being displayed.

SHIFT INIT (F4)
To force a new initialisation. Available for **OCUPY (F1)** or **STORE (F1)** being displayed and 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.

SHIFT QUIT (F6)
To exit Reference Line application program.

Description of fields

Field	Option	Description
<Point ID:>	User input	The point ID of the point to be measured.
<Current Slope:>	Output	The current slope of the position to the hinge.
<ΔOffset:>	Output	Perpendicular offset from the reference line/arc measured from the reference point to the measured point.
<ΔOffset Hinge:>	Output	Perpendicular offset from the hinge to the measured point.
<ΔLine:>	Output	Horizontal distance along the reference line from the start point to the reference point.
<Cut:> / <Fill:>	Output	Difference between the elevation of the actual position to the slope elevation at that position. Cut is above the slope, Fill is below the slope.
<Height:>	Output	Height of measured point.
<3D CQ:>	Output	The current 3D qualitity of the computed position.

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

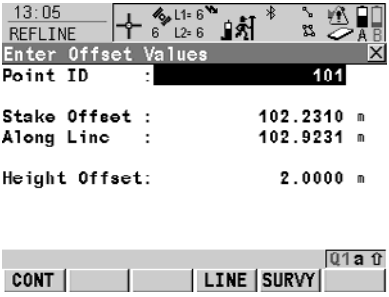
6.5 Staking to a Reference Line/Arc

Access step-by-step

Step	Description
1.	Refer to "6.3 Managing Reference Lines/Arcs" to access **REFLINE Choose Task & Reference Line**.
2.	**REFLINE Choose Task & Reference Line, Reference page** **<Task: Stake to XX>**
3.	**CONT (F1)** to access **REFLINE Enter Offset Values**.

REFLINE Enter Offset Values

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

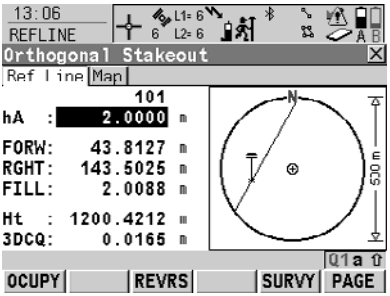
Field	Option	Description
<Height Offset:>	User input	Available for **<Edit Height: No>** unless **<Heights: Use DTM Model>** in **REFLINE Configuration**. The height offset of the target point is calculated as the height of the start/reference point plus **<Height Offset:>**.
<Design Ht:>	User input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

Next step

CONT (F1) accepts changes and continues to **REFLINE XX Stakeout**, **Ref XX** page.

REFLINE XX Stakeout, Ref XX 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 "6.4 Measuring to a Reference Line/Arc" for information on the softkeys.



REVRS (F3)

To reverse the graphical display top to bottom.

SURVY (F5)

To measure a point relative to 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
First field on the screen	Choicelist	The point ID of the point to be staked.
<hA:>	User input	The default antenna height as defined in the active configuration set is suggested. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.

Field	Option	Description
<Ht:>	Output	Available for **<Edit Height: No>** in **REFLINE Configuration**, **Heights** page. The orthometric height of the current position is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed.
<D Ht:>	User input	Available for **<Edit Height: Yes>** in **REFLINE Configuration**, **Heights** page. The design height, which is the orthometric height of the point to be staked, is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. Changing the value for **<D Ht:>** changes the values displayed for **<CUT:>** and **<FILL:>**.

Next step

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

6.6 Gridstaking to a Reference Line/Arc

Access step-by-step

Step	Description
1.	Refer to "6.3 Managing Reference Lines/Arcs" to access **REFLINE Define Grid**.
2.	**REFLINE Choose Task & Reference Line, Reference page** **<Task: Gridstake XX>**
3.	**CONT (F1)** to access **REFLINE Define Grid**.

REFLINE Define Grid

The softkeys are identical to those available for staking to a reference line/arc. Refer to "6.5 Staking to a Reference Line/Arc" for information on the softkeys.

Description of fields

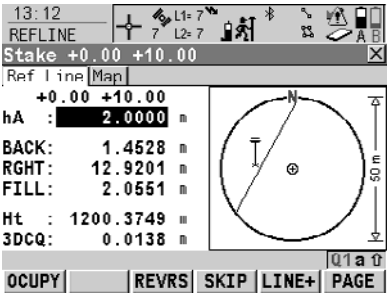
Field	Option	Description
<Begin Grid At:>	User input	Distance along the reference line/arc from the start point to the first target point to be staked.
<Chainage:>	User input	Chainage of the first target point to be staked along the line/arc. This is the chainage of the start of the reference line/arc 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**	The point ID for grid points 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**.

REFLINE Stake +yyy.yy +xxx.xx, Ref XX 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 "6.5 Staking to a Reference Line/Arc" for information on all other softkeys and fields.



SKIP (F4)
To skip the currently displayed station and increment to the next station. Available for **OCUPY (F1)** being displayed.

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:>**. Available for **OCUPY (F1)** being displayed.

Description of fields

Field	Option	Description
First field on the screen	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.
<Ht:>	Output	Available for **<Edit Height: No>** in **REFLINE Configuration**, **Heights** page. The orthometric height of the current position is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed.
<D Ht:>	User input	Available for **<Edit Height: Yes>** in **REFLINE Configuration**, **Heights** page. The design height, which is the orthometric height of the point to be staked, is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. 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.

7 Reference Plane

7.1 Overview

Reference plane tasks

The Reference Plane 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.

Planes can only be computed with grid coordinates.

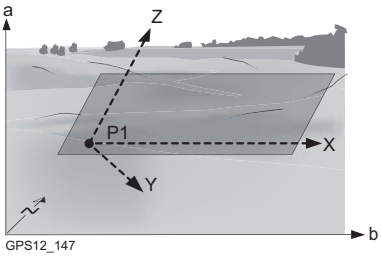
Defining a reference plane

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 plane.

- For GPS1200 the Reference Plane application program is only applicable for tilted plane definitions.
- For TPS1200, the Reference Plane application program is also applicable for vertical plane definitions.

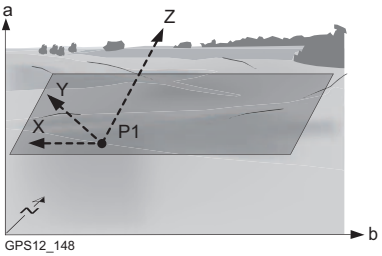
Tilted plane

Any number of points define the plane. The axis of the tilted reference plane are:



GPS12_147

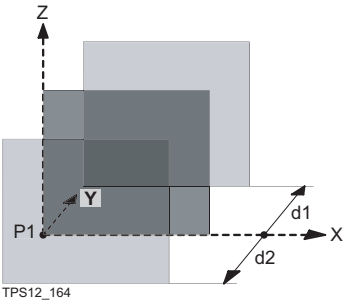
a	Height
b	Easting
N	Northing
P1	Origin of plane
X	X axis of plane
Y	Y axis of plane
Z	Z axis of plane



GPS12_148

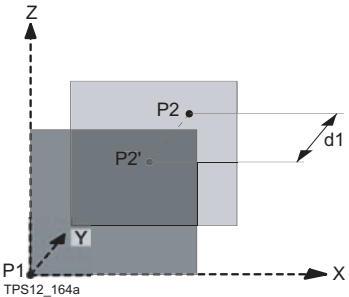
a	Height
b	Easting
N	Northing
P1	Origin of plane
X	X axis of plane
Y	Y axis of plane
Z	Z axis of plane

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

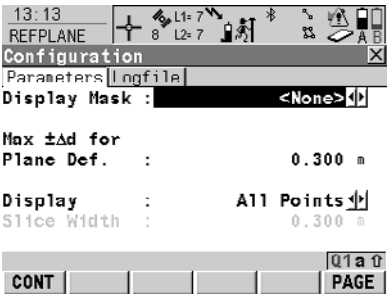
P1 Origin of plane
P2 Point defining offset of plane
P2' P2 projected on original plane
d1 Offset defined by P2
X X axis of plane
Y Y axis of plane
Z Z axis of plane

7.2 Configuring Reference Plane

Access step-by-step

Step	Description
1.	Press **PROG**.
2.	Highlight **Reference Plane**.
3.	**CONT (F1)**
4.	In **REFPLANE Reference Plane Begin** 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 on Plane**.
<Max ±Δd for Plane Def.:>	User input	The maximum perpendicular deviation of a point from the calculated plane.
<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:>**.
<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".

7.3 Managing Reference Planes

Description

A reference plane is used to measure points relative to the plane.

Measure to 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.

Access

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **REFPLANE Reference Plane Begin**.
2.	**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**	Defines a new reference plane.
	Select From Job	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.
<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".

IF	THEN
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 on Plane, Reference** page. Refer to "7.4 Measuring Points to a Reference Plane".

REFPLANE New Reference Plane, General page

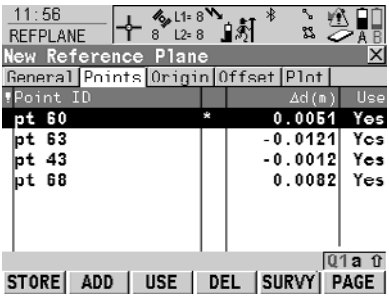
Description of fields

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.
<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 ORIGN (F4)
To use the highlighted point as the origin of the plane.

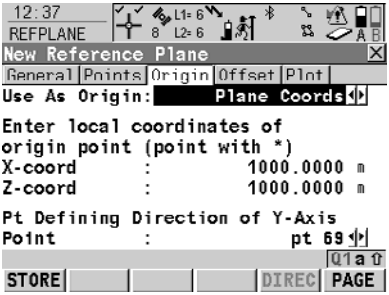
Description of columns

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 hight-lighted. To access **REFPLANE Survey: XX**. Measure a point to define the positive plane direction.

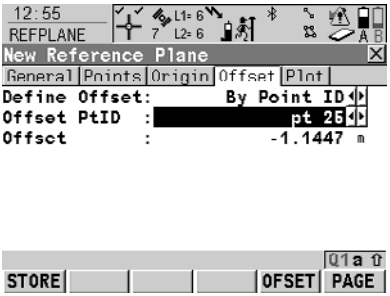
Description of fields

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 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.

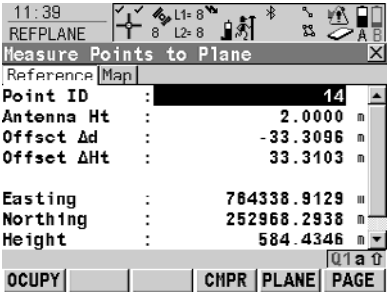
Next step
STORE (F1) to compute and store the reference plane.

7.4 Measuring Points to a Reference Plane

Access

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **REFPLANE Reference Plane Begin**.
2.	**CONT (F1)** to access **REFPLANE Choose Task & Reference Plane**.
3.	**REFPLANE Choose Task & Reference Plane** Select a reference plane.
4.	**CONT (F1)** to access **REFPLANE Measure Points to Plane**, **Reference** page.

REFPLANE
Measure Points **to** Plane, Reference page



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. **(F1)** changes to **STOP**.

STORE (F1)
To store the measured point. **(F1)** changes to **OCUPY**.

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 ΔPer 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.

8 Stakeout

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

A staked point can be manually occupied as a check.

Stakeout modes

Points can be staked using different modes:

- Polar mode.
- Orthogonal mode.

Staking out is possible for **<R-Time Mode: Rover>** and **<R-Time Mode: None>**.

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 with local coordinates and the active coordinate system is WGS 1984.

Height source

Heights can be taken into account from

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

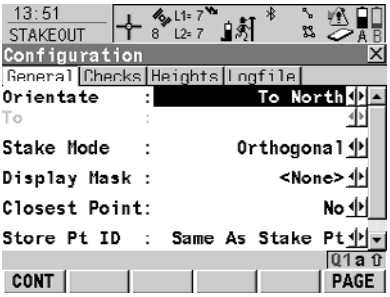
8.2 Configuring Stakeout

Access

Step	Description
1.	Press **PROG**.
2.	Highlight **Stakeout**.
3.	**CONT (F1)**
4.	In **STAKEOUT Stakeout Begin** 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.

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
<Orientate:>		The reference direction to be used to stakeout points.
	To North	The North direction shown in the graphic based on the active coordinate system.
	To Sun	The position of the sun calculated from the current position, the time and the date.
	To Last Point	Timewise the last recorded point.
	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**.

Field	Option	Description
	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 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:>	Choicelist	Available for **<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.
<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:>**.
<Store Pt ID:>	**Same as Stake Pt**	The 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 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 receiver 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 height of the point to be staked is displayed while staking out. 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.
	No	No DTM file is used. The positions and heights of points in the selected **<Stakeout Job:>** are staked out.

Field	Option	Description
	DTM only	Activates the stakeout of heights without positions. Heights relative to the selected **<DTM Job:>** are staked out. No actual points 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

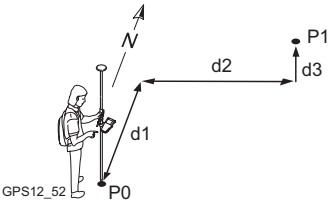
IF	THEN
a logfile is to be configured	**PAGE (F6)** changes to the **Logfile** page. Refer to "1.2 Configuration of a Logfile".
the configuration is finished	**CONT (F1)** to return to **STAKEOUT Stakeout Begin** followed by **CONT (F1)** to access **STAKEOUT XX Stakeout**.

8.3 Staking Out

Diagrams

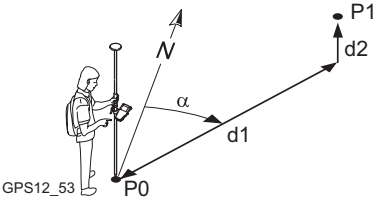
The diagrams show examples for staking out with **<Orientate: To North>**.

Orthogonal mode



P0 Current position
P1 Point to be staked
d1 **<FORW:>** or **<BACK:>**
d2 **<RGHT:>** or **<LEFT:>**
d3 **<FILL:>** or **<CUT:>**

Polar mode



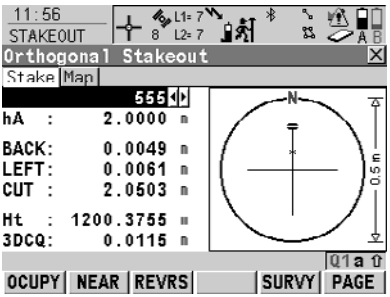
P0 Current position
P1 Point to be staked
d1 **<DIST:>**
d2 **<CUT:>** or **<FILL:>**
α **<DIRC:>**

Access

Refer to "8.2 Configuring Stakeout" 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.



OCUPY (F1)
To start measuring the point being staked. **(F1)** changes to **STOP**. The difference between the current position and the point being staked is still displayed.

STOP (F1)
To end measuring the point being staked. **(F1)** changes to **STORE**. After ending the measurements, the differences between the measured point and the point to be staked are displayed.

STORE (F1)
To store the measured point. **(F1)** changes to **OCUPY**.

NEAR (F2)
To search **<Stakeout Job:>** for the point nearest to the current position when the key is pressed. The point is selected as the point to be staked and is displayed in the first field on the screen. Available when **OCUPY (F1)** is displayed.

REVRS (F3)
To reverse the graphic top to bottom.

SURVY (F5)
To survey additional points which may be needed during staking out. To return to Stakeout application program, press **SHIFT QUIT (F6)** or **ESC**. Available for **OCUPY (F1)** being displayed.

SHIFT CONF (F2)
To configure the Stakeout application program. Available for **OCUPY (F1)** being displayed.

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 **OCUPY (F1)** or **STORE (F1)** being displayed and for real-time devices of type digital cellular phone or modem.

SHIFT INIT (F4)
To force a new initialisation. Available for **OCUPY (F1)** or **STORE (F1)** being displayed and for configuration sets allowing phase fixed solutions.

Description of fields

Field	Option	Description
First field on the screen	Choicelist	The point ID of the point to be staked.
<hA:>	User input	The default antenna height as defined in the active configuration set is suggested. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.
<Ht:>	Output	Available for **<Edit Height: No>** in **STAKEOUT Configuration**, **Heights** page.

Field	Option	Description
		The orthometric height of the current position is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed.
<D Ht:>	User input	Available for **<Edit Height: Yes>** in **STAKEOUT Configuration**, **Heights** page. The design height, which is the orthometric height of the point to be staked, is displayed. If the orthometric height cannot be displayed, the local ellipsoidal height is displayed. If it is not possible to display the local ellipsoidal height, the WGS 1984 height is displayed. The value for **<Height Offset:>** configured in **STAKEOUT Configuration**, **Heights** page is not taken into account.

Next step

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

8.4 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.

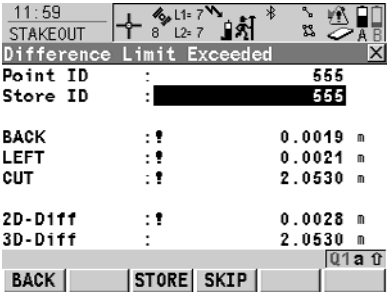
Access

The screen shown below is accessed automatically when the 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 are 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 BEARING:>	Output	The bearing from the staked point to the point to be staked.
<Δ DISTANCE:>	Output	Horizontal distance from the staked point to the point to be staked.
<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.

9 Survey - General

9.1 Pre-Survey Preparations

Pre-survey preparations step-by-step

Step	Description
1.	Decide on the GNSS surveying technique.
2.	For static operations, prepare an observation schedule.
3.	Organise the communication between the survey parties.
4.	Decide on the equipment setup • suiting the local conditions. • depending on the available equipment.
5.	Get the required equipment together.
6.	For real-time reference and rover operations: • If radios are used as real-time device, all radios must be configured for the same frequency range. The radio on the reference must be configured to transmit data. The radio on the rover must be configured to receive data. • If digital cellular phones are used as real-time device, all digital cellular phones must either be registered or equipped with a SIM card. Data transfer must be supported.
7.	Fully charge all batteries.
8.	Check that there is enough spare memory available on the CompactFlash card or the internal memory, if fitted.
9.	On the receiver, select an job. OR Create a new job.
10.	On the receiver, select a typical configuration set for the GNSS surveying technique. OR Create a new configuration set for the GNSS surveying technique.
☞	For static operations, coordinates of the points used as reference station might be needed for post-processing.
☞	For static, post-processed kinematic and real-time rover operations, data from the closest reference station might be required for post-processing. Run one receiver as static operation or real-time reference at the same time. OR Get data from the closest reference station for the same time interval.

Step	Description
11.	For real-time reference operations: Are coordinates of the point used as reference station known? • If **yes**, create a new point with these coordinates on the receiver. • If **no**, the coordinates can be determined in the field.

9.2 Static Operations

Requirements

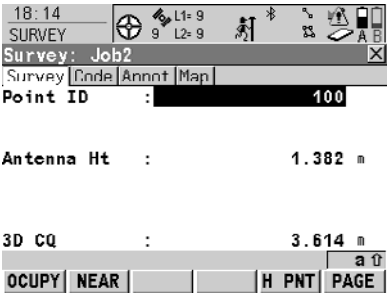
<R-Time Mode: None> in **CONFIGURE Real-Time Mode**.

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **SURVEY Survey Begin**.
2.	**SURVEY Survey Begin** Check the settings. Select a typical configuration set for static operations.
3.	**CONT (F1)** to access **SURVEY Survey: Job Name**.

SURVEY Survey: Job Name, Survey page

The fields shown are those from a typical configuration set for static operations. 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.



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. **(F1)** changes to **STORE**.

STORE (F1)
To store the measured point. **(F1)** changes to **OCUPY**.

H PNT (F5)
To measure a hidden point.

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

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.

Field	Option	Description
		• 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.
<Antenna Ht:>	User input	The default antenna height as defined in the active configuration set is suggested. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.
<3D CQ:>	Output	The current 3D coordinate quality of the computed position.

Next step

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

Observation times

Observation times depend on

- Baseline length
- Number of satellites
- Satellite geometry, GDOP
- Ionosphere. Refer to "Ionospheric disturbance".

Observation times for dual frequency receivers

The following table is an approximate guide as it is impossible to quote observation times that can be fully guaranteed. The quoted observation times are based on tests in mid-latitudes under normal ionospheric disturbance with a dual frequency receiver.

Observation method	Minimum number of satellites, GDOP < 8	Baseline length [km]	Approximate observation time [min]
Static	4	15 - 30	10 - 15
	4	> 30	30 - 60

Observation times for single frequency receivers

Providing recommendations for required observation times is more difficult for single frequency receivers than for dual frequency receivers. The following table is an approximate guide since it is impossible to quote observation times that can be fully guaranteed. A minimum of five satellites above 15° and a GDOP < 8 must be available.

As a rule of thumb the baseline observation time should be 5 min per km of the baseline length with a minimum time of 15 min.

Baseline length [km]	1	2	3	4	5	6	7	8	9	10	> 10

Approximate observation time [min]	15	15	15	20	25	30	35	40	45	50	> 60

Ionospheric disturbance

Ionospheric disturbance varies with

- day/night. At night, it is much lower than during the day.
- month/year.
- position on earth's surface. The influence is usually less in mid latitudes than in polar and equatorial regions.

Signals from low elevation satellites are more affected by atmospheric disturbance than those from high satellites.

9.3 Post-Processed Kinematic Operations

Requirements

- **<R-Time Mode: None>** in **CONFIGURE Real-Time Mode**.
- **<Log Raw Obs: Static & Moving>** in **CONFIGURE Logging of Raw Obs**.

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **SURVEY Survey Begin**.
2.	**SURVEY Survey Begin** Check the settings. Select a typical configuration set for post-processed kinematic operations.
3.	**CONT (F1)** to access **SURVEY Survey: Job Name**.

SURVEY Survey: Job Name, Survey page

Refer to "9.2 Static Operations" for information on the softkeys.

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

9.4 Real-Time Reference Operations

Requirements

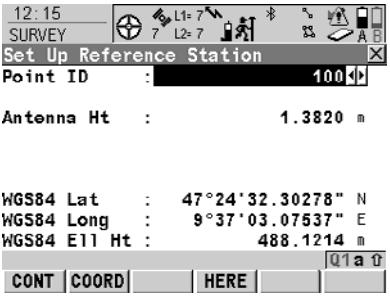
- **<R-Time Mode: Reference>** in **CONFIGURE Real-Time Mode**
- A real-time interface is configured correctly.
- The real-time device is attached to the receiver and working properly.

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **SURVEY Survey Begin**.
2.	**SURVEY Survey Begin** Check the settings. Select a typical configuration set for real-time reference operations.
3.	**CONT (F1)** to access **SURVEY Set Up Reference Station**.

SURVEY Set Up Reference Station

The settings on this screen set the reference station and its coordinates.



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

COORD (F2)
To view other coordinate types. Local coordinates are available if a local coordinate system is active.

LAST (F3)
To use the same coordinates as when the receiver was last used as reference station. Available if the receiver has previously been used as reference station and if no point in the active job has the same point ID as the one last used as reference station.

HERE (F4)
To use the coordinates of the current navigation position as reference station coordinates.

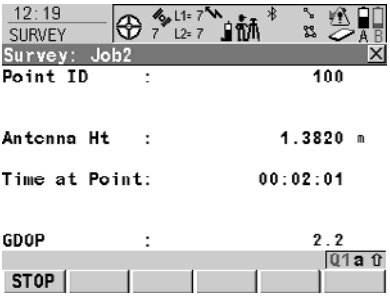
SHIFT ELL H (F2) and **SHIFT ORTH (F2)**
Available for local coordinates. To change between the ellipsoidal and the orthometric height.

Next step

Step	Description
1.	Type in the reference station coordinates.
2.	**CONT (F1)** to access **SURVEY Survey: Job Name**.
☞	The point occupation starts.

SURVEY Survey: Job Name

The appearance and functionality of the screen is identical for all real-time reference configuration sets.



STOP (F1)
To end the point occupation, store the point and to return to **GPS1200 Main Menu**.

Description of fields

Field	Option	Description
<Point ID:>	Output	The identifier for the reference station point.
<Antenna Ht:>	Output	The antenna height as entered in **SURVEY Set Up Reference Station** is displayed.
<Time at Point:>	Output	The time from when the point is occupied until point occupation is stopped.
<GDOP:>	Output	The current GDOP of the computed position.

Next step
STOP (F1) to end the point occupation, store the point and to return to **GPS1200 Main Menu**.

9.5 Real-Time Rover Operations

Requirements

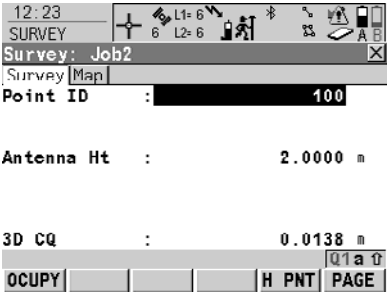
- **<R-Time Mode: Rover>** in **CONFIGURE Real-Time Mode**
- A real-time interface is configured correctly.
- The according real-time device is attached and working properly.

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **SURVEY Survey Begin**.
2.	**SURVEY Survey Begin** Check the settings. Select a typical configuration set for real-time rover operations.
3.	**CONT (F1)** to access **SURVEY Survey: Job Name**.
☞	The arrow at the real-time device and real-time status icon flashes when real-time messages are being received.
☞	Fixing ambiguity begins. The current position status is indicated by the position status icon. When working with code only corrections, an ambiguity solution is not attempted.
☞	The position mode icon is the moving icon. This indicates that the antenna can be moved around and that no static observations are being recorded.

SURVEY Survey: Job Name, Survey page

The fields shown are those from a typical configuration set for real-time rover operations. 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. The majority of softkeys is identical to those available for static operations. Refer to "9.2 Static Operations" for information on the identical softkeys.



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 real-time devices of type digital cellular phone or modem. Available for **<Auto CONEC: No>** in **CONFIGURE GSM Connection**.

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 the measurements. Available for **<Averaging Mode: Absolute Diffs>** and for more than one measured coordinate triplet recorded for the same point.

SHIFT INIT (F4)
Available for configuration sets allowing phase fixed solutions. To force a new initialisation.

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 free ID from the configured ID template.
<Antenna Ht:>	User input	The default antenna height as defined in the active configuration set is suggested. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.
<3D CQ:>	Output	The current 3D coordinate quality of the computed position.

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

10 Survey - Auto Points

10.1 Overview

Description

Auto points is used to automatically log points at a specific rate. Additionally, individual auto points can be stored outside the defined rate. Auto points are used in real-time or post-processed moving applications to document the track which was walked or driven along. Auto points are logged between starting and stopping logging of auto points form one chain. A new chain is formed each time logging of auto points is started.

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.

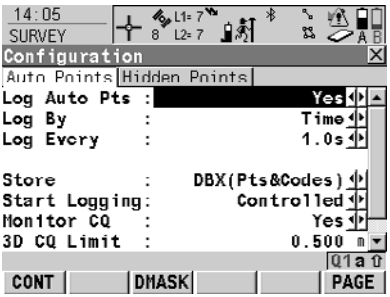
Logging of auto points is possible for **<R-Time Mode: Rover>** and **<R-Time Mode: None>**.

10.2 Configuring Auto Points

Access

Step	Description
1.	Select **Main Menu: Survey**.
2.	In **SURVEY Survey Begin** 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 the logging of auto points and all fields on this screen.
<Log By:>	**Time**	Auto points are logged according to a time interval. The time interval is independent from the update interval for the position on the screen.
	Distance	The difference in distance from the last stored auto point, which must be reached before the next auto point is logged. The auto point is logged with the next available computed position.
	Height Diff	The height difference from the last stored auto point, which must be reached before the next auto point is logged. The auto point is logged with the next available computed position.
	Dist or Ht	Before the next auto point is logged, either the difference in distance or the minimal difference in height must be reached. The auto point is logged with the next available computed position.
	Stop & Go	An auto point is stored when the position of the antenna does not move more than the distance configured in **<Stop Position:>** within the **<Stop Time:>**.

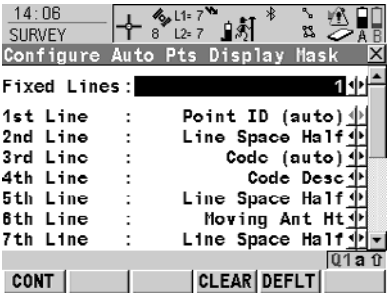
Field	Option	Description
	User Decides	An auto point is stored upon pressing **OCUPY (F3)** in **SURVEY Survey: Job Name**, **Auto** page. In the beginning, the chain to which the auto points should be assigned must be started with **START (F1)**. In the end, the chain must be closed with **STOP (F1)**.
<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 **0.05s** 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.
<Store:>		☞ Changing this setting while auto points are being logged stops the logging. It must then be restarted.
	File (Pts Only)	Logs auto point to the measurement database. Point logging at up to 20 Hz. Coding and logging of offset points is not possible.
	DBX(Pnts & Codes)	Logs auto points to the DB-X. Point logging at up to 1 Hz. Coding and logging of offset points is possible.
<Start Logging:>	**Immediately**	Logging of auto points starts immediately when the **SURVEY** screen is accessed.
	Controlled	Logging of auto points starts upon pressing **START (F1)** on the **Auto** page in **SURVEY**.
<Monitor CQ:>	**Yes** or **No**	Activates monitoring of the coordinate quality. Auto points are stored when the coordinate quality is within the defined limit.

Field	Option	Description
<3D CQ Limit:>	User input	Available for **<Monitor CQ: Yes>**. Limit for the coordinate quality above which an auto point is no longer automatically stored. When the CQ of the auto point falls again below the defined value then the storing of auto points begins again.
<Beep When:>	**Logging**	Instrument beeps when storing an auto point.
	Not Logging	Available for **<Monitor CQ: Yes>**. Instrument gives a single alarm beep each time an auto point is not recorded because the limit for the coordinate quality is exceeded. For **<Log By: Time>** the beep is given at the time when the point should have been recorded. Unless **<Log By: Time>**, the beep is given at 1 Hz once the auto logging has stopped due to the exceeded coordinate quality.
	Never	Instrument never beeps.

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)>**.

Field	Option	Description
<2nd Line:> to **<16th Line:>**	**Annot 1-4**	Input field for comments to be stored with the point.
	Attrib (free) 01-20	Output field for attributes for free codes.
	Attrib 01-03	Input field for attributes for codes. Up to three attribute values can be stored.
	Code (auto)	Choicelist or input field for codes.
	Code (free)	Output field for free codes.
	Code Type	Output field for the type of code, for example point code, line code or area code.
	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.

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

10.3 Auto Points for Post-Processed Kinematic and Real-Time Rover Operations

Requirements

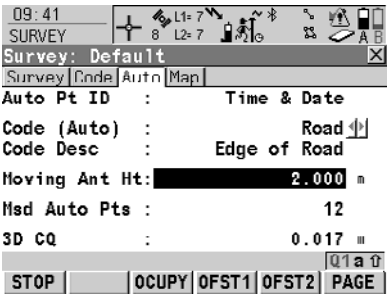
- **<R-Time Mode: None>** or **<R-Time Mode: Rover>** in **CONFIGURE Real-Time Mode**.
- **<Log Auto Pts: Yes>** in **SURVEY Configuration, Auto Points** page.

Access step-by-step

Step	Description
1.	Refer to "1.1 Starting an Application Program" to access **SURVEY Survey Begin**.
2.	In **SURVEY Survey Begin** select a job.
3.	Select a configuration set with **<R-Time Mode: None>** or **<R-Time Mode: Rover>**.
4.	Select an antenna.
5.	**CONT (F1)** to access **SURVEY Survey: Job Name**.
☞	For **<Start Logging: Immediately>**, logging of auto points begins.
6.	**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.

OCUPY (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. Available for **<Store: DBX(Pnts & Codes)>** in **SURVEY Configuration**, **Auto Points** page.

OFST2 (F5)
To configure recording of a second type of offset points. Available for **<Store: DBX(Pnts & Codes)>** in **SURVEY Configuration**, **Auto Points** page.

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 type over the point ID.
	Time & Date	Available for **<Auto Pts: Time & Date>** in **CONFIGURE ID Templates**. The current local time and date is used as identifier for auto points.
<Code (Auto):>		The thematical code for the auto point. • If a point code is selected then any open line/area is closed. The occupied point is stored with the selected code idependently of any line/area. • If a line code is selected then any open line is closed and a new line with the selected code is created. The line ID is defined by the configured line ID template. The occupied point is assigned to that line. The line stays open until it is closed manually or another line code is selected. • If an area code is selected then the behaviour is as for lines.
	Choicelist	Available for **<Thematc Codes: With Codelist>**. The setting for **<Show Codes:>** in **CONFIGURE Coding & Linework** determines if either all codes or only point codes are available. 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. Configure a display mask with a choicelist for code types to define if a point, line or area code is typed in.

Next step

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

10.4 Offset Points of Auto Points

10.4.1 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.

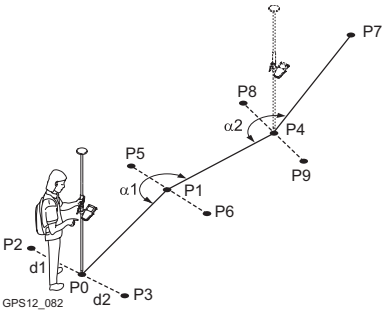
One auto point

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



P0	First auto point
P1	Second auto point
P2	First offset point for P0
P3	Second offset point for P0
P4	Third auto point
P5	First offset point for P1
P6	Second offset point for P1
P7	Fourth auto point
P8	First offset point for P4
P9	Second offset point for P4
d1	Horizontal offset to the left
d2	Horizontal offset to the right
α1	Angle between P0 and P4
α2	Angle between P1 and P7

10.4.2 Configuring Offset Points

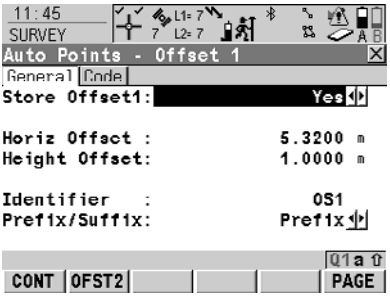
Requirements

<Store: DBX(Pnts & Codes)> in **SURVEY Configuration**, **Auto Points** page.

Access step-by-step

Step	Description
1.	Refer to "10.3 Auto Points for Post-Processed Kinematic and Real-Time Rover Operations" to access **SURVEY Survey: Job Name**.
2.	**PAGE (F6)** until the **Auto** page is active.
3.	**OFST1 (F4)** or **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 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. The setting for **<Show Codes:>** in **CONFIGURE Coding & Linework** determines if either all codes or only point codes are available in the choicelist for **<Point Code:>**.

11 Survey - Hidden Points

11.1 Overview

Description

Hidden points cannot be measured directly by GPS. This is because they can not be physically reached or because satellites are obstructed, for example by trees or tall buildings.

- A hidden point can be calculated by measuring distances and/or azimuths to the hidden point using a hidden point measurement device. Or for distances a tape may be used.
- Additional auxiliary points may be manually occupied.
- Bearings may be computed from previously occupied points.

☞ A hidden point measurement device can be attached to the receiver such that the measurements are automatically transferred to the receiver.

☞ Changing coordinates of a point which has been previously used in hidden point measurements does not result in the hidden point being recomputed.

☞ Hidden point measurements are possible for **<R-Time Mode: Rover>** and **<R-Time Mode: None>**. For **<R-Time Mode: None>** the hidden point can be calculated in LGO.

Hidden point measurement methods

A hidden point can be measured by

- Bearing and distance
- Double bearing
- Double distance
- Chainage and offset
- Backwards bearing and distance

Heights

Heights are taken into account if configured. Refer to the GPS System Field Manual for information on configuring height offsets.

Configure hidden point measurements

Refer to the GPS System Field Manual for information on how to configure hidden point measurements.

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

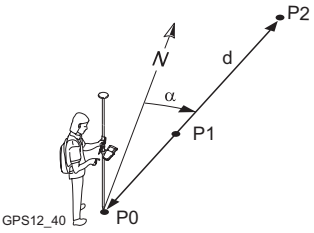
Auxiliary points

Auxiliary points are used to compute azimuths required for the calculation of hidden point coordinates. Auxiliary points can be points existing in the job or they can be manually occupied. The point ID template configured for **<Auxil Pts:>** in **CONFIGURE ID Templates** is applied.

11.2 Measuring Hidden Points

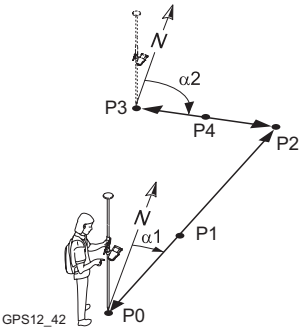
Diagrams

Bearing & Distance



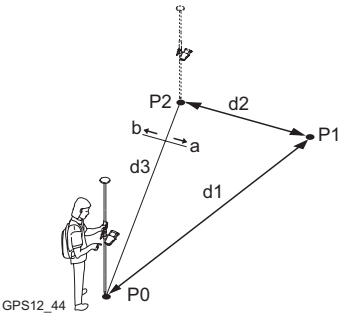
Known
P0 Known point, **<Point:>**
To be measured
d Distance from P0 to P2
α Bearing from P0 to P2
P1 Auxiliary point, optional
Unknown
P2 Hidden point

Double Bearing



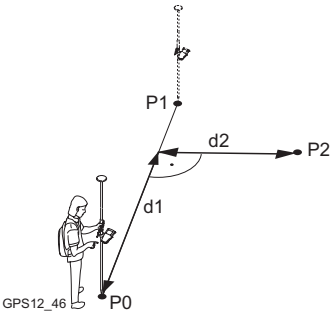
Known
P0 First known point, **<Point A:>**
P3 Second known point, **<Point B:>**
To be measured
α1 Bearing from P0 to P2
α2 Bearing from P3 to P2
P1 First auxiliary point, optional
P4 Second auxiliary point, optional
Unknown
P2 Hidden point

Double Distance



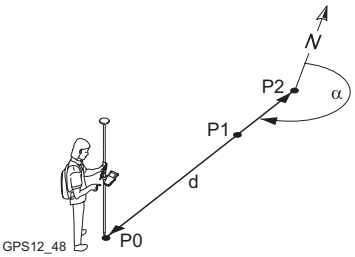
Known
P0 First known point, **<Point A:>**
P2 Second known point, **<Point B:>**
d3 Line from P0 to P2
a Right of d3
b Left of d3
To be measured
d1 Distance from P0 to P1
d2 Distance from P2 to P1
Unknown
P1 Hidden point

Chainage & Offset



Known
P0 First known point, **<Point A:>**
P1 Second known point, **<Point B:>**
To be measured
d1 Chainage
d2 Offset
Unknown
P2 Hidden point

Backwards Bearing & Distance



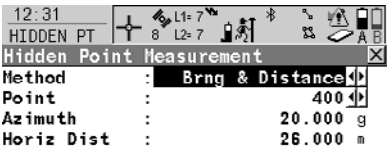
Known
P0 Known point, **<Point:>**
To be measured
α Bearing from P2 to P0
d Distance from P2 to P0
P1 Auxiliary point, optional
Unknown
P2 Hidden point

Access

Press **H PNT (F5)** in **SURVEY Survey: Job Name**, **Survey** page.

HIDDEN PT Hidden Point Measurement

The setting for **<Method:>** in this screen determines the availability of the subsequent fields and softkeys.



CALC (F1)
To calculate the hidden point and to display the results.

EAO (F2)
To change or enter an **E**xternal **A**ngle **O**ffset. Available for some methods when **<EAO Method: New for Each Point>** or **<EAO Method: Permanent>** in **CONFIGURE Hidden Point Device Offsets**.

DIST (F2)
To measure the distance without pressing DIST on the Disto. Available for Leica Disto™ pro⁴ and Leica Disto™ pro⁴ a when a distance field is highlighted.

SUN (F3)

The azimuth from the direction of the sun to a known point is computed. The location of the hidden point can be away from the sun or in the direction towards the sun. Ensure the shadow of the pole falls in the direction of the hidden point. Available if **<Azimuth:>** is highlighted.

AZMTH (F4)

To select or manually occupy an auxiliary point and to compute the azimuth. The location of the auxiliary point can be in the direction towards the hidden point or away from the hidden point. Available if **<Azimuth:>** is highlighted.

POS? (F4)

To determine chainage and offset of the current position relative to the line between the two known points. The values are displayed in **<Chainage:>** and **<Offset:>**. The point from where the chainage has been measured is selected in **<Chainage From:>**. Available for **<Method: Chainage & Offset>**.

SURVY (F5)

To manually occupy the known point for the calculation of the hidden point. Available if **<Point:>**, **<Point A:>** or **<Point B:>** is highlighted.

SLOPE (F5)

To measure a slope distance and an elevation angle or percentage grade. The slope distance and the elevation angle can either be typed in or measured with a hidden point measurement device. The values are used to compute the horizontal distance. Available if **<Horiz Dist:>** is highlighted.

SHIFT CONF (F2)

To configure hidden point measurements.

Description of fields

Field	Option	Description
<Method:>	Choicelist	The hidden point measurement method.

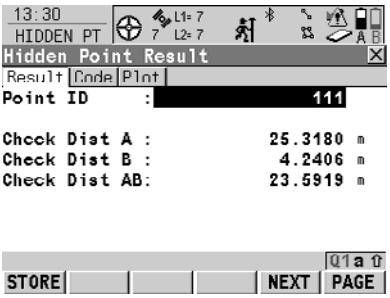
Field	Option	Description
<Point:>, **<Point A:>** or **<Point B:>**	Choicelist	The point ID of the current position. This is a known point for the calculation of the hidden point. ☞ To type in coordinates for the known point open the choicelist when this field is highlighted. Press **NEW (F2)** to create a new point.
<Azimuth:>	User input	The azimuth from the known point to the hidden point. Available for **<Method: Brng & Distance>**, **<Method: Double Bearing>** and **<Method: Back Brng & Dist>**. ☞ When a hidden point measurement device is attached to the receiver to measure the azimuth, the value is automatically transferred.
<Horiz Dist:>	User input	The horizontal distance from the known point to the hidden point. Available for **<Method: Brng & Distance>**, **<Method: Double Distance>** and **<Method: Back Brng & Dist>**. ☞ When a hidden point measurement device is attached to the receiver to measure the distance, the value is automatically transferred.
<Location:>	Choicelist	The location of the hidden point relative to the line from **<Point A:>** to **<Point B:>**. Available for **<Method: Double Distance>** and **<Method: Chainage & Offset>**.
<Chainage:>	User input	The chainage from one known point along the line between the two known points. Available for **<Method: Chainage & Offset>**. ☞ When a hidden point measurement device is attached to the receiver to measure the distance, the value is automatically transferred.
<Chainage From:>	Choicelist	The point from where the chainage has been measured. Looking from this point, a positive chainage is into the direction of the second known point. A negative chainage is into the opposite direction of the second known point. Available for **<Method: Chainage & Offset>**.
<Offset:>	User input	The offset of the hidden point to the line between the two known points. Available for **<Method: Chainage & Offset>**.

Next step

CALC (F1) calculates the hidden point and displays the results in **HIDDEN PT Hidden Point Result**, **Result** page.

HIDDEN PT Hidden Point Result, Result page

The displayed fields and softkeys depend on the hidden point measurement method used.



STORE (F1)
To store the hidden point and to return to the screen from where **HIDDEN PT Hidden Point Measurement** was accessed.

NEXT (F5)
To store the hidden point and to return to **HIDDEN PT Hidden Point Measurement**. Another hidden point can be measured.

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.

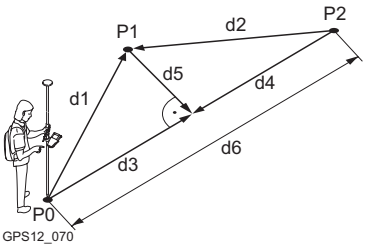
SHIFT QUIT (F6)
To not store the hidden point and to return to the screen from where **HIDDEN PT Hidden Point Measurement** was accessed.

Description of fields

Field	Option	Description
<Point ID:>	User input	The identifier for the hidden point. The configured point ID template is used. The ID can be changed in the following way: • 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 free ID from the configured ID template.
<Check Dist AB:>	Output	The computed horizontal distance between **<Point A:>** and **<Point B:>**. Available for **<Method: Double Bearing>**, **<Method: Double Distance>** and **<Method: Chainage & Offset>**.
<Check Brg AB:>	Output	The computed bearing from **<Point A:>** to **<Point B:>**. Available for **<Method: Double Bearing>**.

Field	Option	Description
<Check Dist A:>	Output	The computed horizontal distance between **<Point A:>** and the hidden point. Available for **<Method: Double Bearing>** and **<Method: Chainage & Offset>**.
<Check Dist B:>	Output	The computed horizontal distance between **<Point B:>** and the hidden point. Available for **<Method: Double Bearing>** and **<Method: Chainage & Offset>**.
<Check Chng A:>	Output	The computed distance on the line from **<Point A:>** to **<Point B:>** from **<Point A:>** to the point of intersection with **<Check Offset:>**. Available for **<Method: Double Distance>**.
<Check Chng B:>	Output	The computed distance on the line from **<Point B:>** to **<Point A:>** from **<Point B:>** to the point of intersection with **<Check Offset:>**. Available for **<Method: Double Distance>**.
<Check Offset:>	Output	The computed perpendicular distance from the hidden point to the line from **<Point> A>** to **<Point B:>**. Available for **<Method: Double Distance>**.

Computed distances for <Method: Double Distance>



P0 First known point, **<Point A:>**
P1 Hidden point
P2 Second known point, **<Point B:>**
d1 Distance from P0 to P1
d2 Distance from P2 to P1
d3 **<Check Chng A:>**
d4 **<Check Chng B:>**
d5 **<Check Offset:>**
d6 **<Check Dist AB:>**

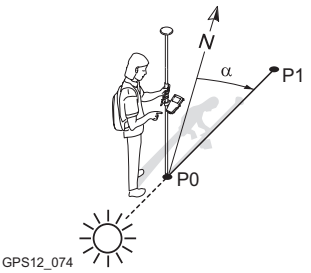
Next step
PAGE (F6) changes to **Code** page.

HIDDEN PT Hidden Point Result, Code page

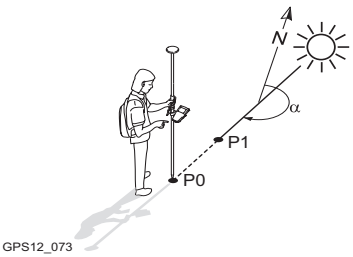
The setting for **<Thematc Codes:>** in **CONFIGURE Coding & Linework** determines the availability of the fields and softkeys. They are identical to those of thematical coding with/without codelist. Refer to the GPS1200 Technical Reference Manual for information on coding.

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

Compute an azimuth using the sun - diagram

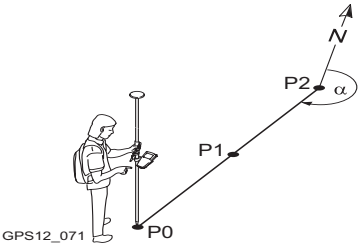


P0 Known point
P1 Hidden point
α Bearing from P0 to P1

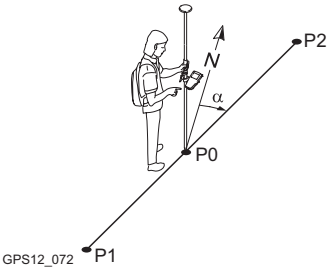


P0 Known point
P1 Hidden point
α Bearing from P0 to P1

Compute an azimuth using auxiliary points - diagram

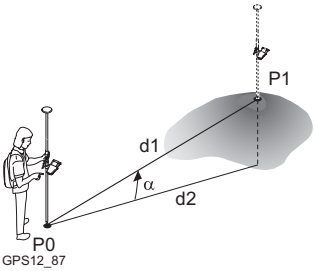


P0 Known point
P1 Auxiliary point, **<Azimuth Pt:>**
P2 Hidden point
α Bearing from P2 to P0



P0 Known point
P1 Auxiliary point, **<Azimuth Pt:>**
P2 Hidden point
α Bearing from P0 to P2

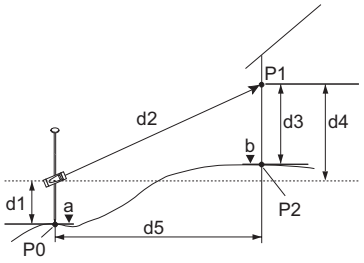
Compute horizontal distances from slope distances - diagram



P0 Known point
P1 Hidden point
d1 Slope distance
d2 Horizontal distance
α Elevation angle

11.3 Hidden Point Measurement Including Heights

Diagram



P0 Known point
P1 Target point
P2 Hidden point
a Height of P0
b Height of P2 = a + d1 + d4 - d3
d1 Device height: Height of hidden point measurement device above P0
d2 Slope distance
d3 Target height: Height of P1 above P2
d4 Height difference between hidden point measurement device and P1
d5 Horizontal distance

Requirements

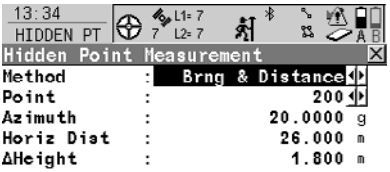
- **<Compute Ht: Yes>** in **CONFIGURE Hidden Point Measurements**.
- **<Height Offset: Device & Trgt Ht>** in **CONFIGURE Hidden Pt Device Offsets**.

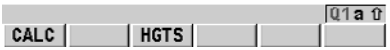
Access

Press **H PNT (F5)** in **SURVEY Survey: Job Name**, **Survey** page.

HIDDEN PT Hidden Point Measurement

Most of the fields and softkeys are identical to those available for hidden point measurements without heights. Refer to "11.2 Measuring Hidden Points" for information on the identical fields and softkeys.





HGTS (F3)
To define the device and the target height.

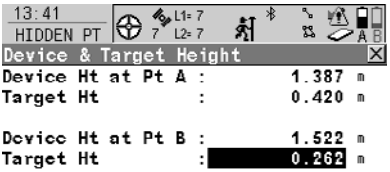
Description of fields

Field	Option	Description
<ΔHeight:>	User input	The positive or negative height difference between the centre of the hidden point measurement device and the target point. When a hidden point measurement device is attached to the receiver to measure the height difference, the value is automatically transferred. For hidden point measurement methods using two known points, **<ΔHeight:>** must be determined from each known point. **<ΔHeight:>** can be computed using **SLOPE (F5)**.

Next step

HGTS (F3) accesses **HIDDEN PT Device & Target Height**.

HIDDEN PT Device & Target Height



CONT (F1)

To return to **HIDDEN PT Hidden Point Measurement**.

Description of fields

Field	Option	Description
<Device Ht at Pt A:>	User input	The height of the hidden point measurement device above **<Point:>** respective **<Point A:>**.
<Target Ht:>	User input	The height of the target point above the hidden point when measured from **<Point:>** respective **<Point A:>**.
<Device Ht at Pt B:>	User input	Available for hidden point measurement methods using two known points. The height of the hidden point measurement device above **<Point B:>**.
<Target Ht:>	User input	Available for hidden point measurement methods using two known points. The height of the target point above the hidden point when measured from **<Point B:>**.

Next step

Step	Description
1.	**CONT (F1)** to close the screen and to return to **HIDDEN PT Hidden Point Measurement**.
☞	**<ΔHeight:>** in **HIDDEN PT Hidden Point Measurement** still displays the positive or negative height difference between the centre of the hidden point measurement device and the target point. The height of the hidden point measurement device above the ground and the height of the target point above the hidden point are applied when the hidden point is computed.
2.	**HIDDEN PT Hidden Point Measurement** Continue with the hidden point measurements.

Step	Description
☞	When **STORE (F1)** is pressed in **HIDDEN PT Hidden Point Measurement**, the height of the hidden point is computed and stored. For hidden point measurement methods using two known points, this is done for each known point. In this case, the height of the hidden point is the average.

12 Survey Cross Section

12.1 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

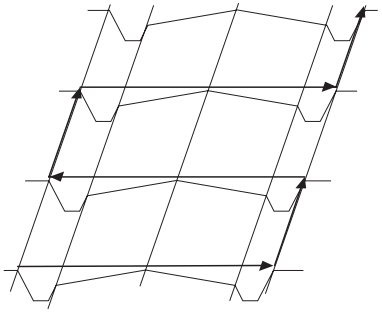
- the coding sequence of a cross section.
- the type of coding.

Cross section methods and directions

Templates can be applied

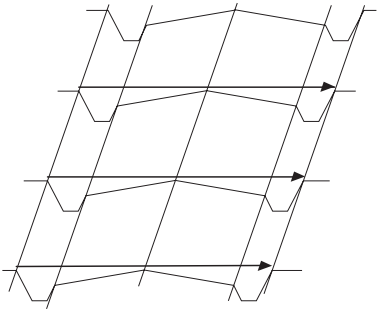
- to the ZigZag method or the Same Direction method.
- in either a forward direction or in a backward direction.

ZigZag



GPS12_168

Same Direction



GPS12_169

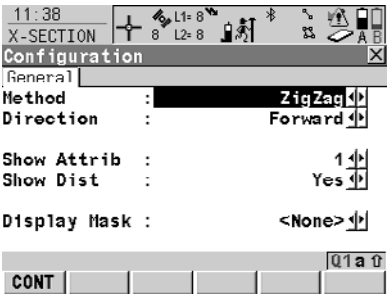
☞ Survey Cross Section is possible for **<R-Time Mode: Rover>** and **<R-Time Mode: None>**.

12.2 Configuring Survey Cross Section

Access

Step	Description
1.	Press **PROG**.
2.	Highlight **Survey Cross Section**.
3.	**CONT (F1)**
4.	In **X-SECTION Begin** 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 "12.1 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**.

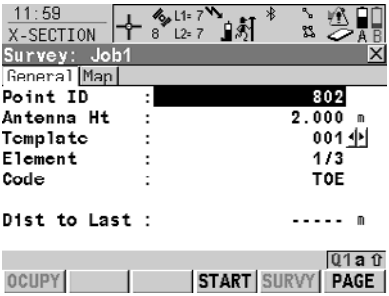
12.3 Surveying Cross Sections

Access

Refer to "12.2 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.



OCUPY (F1)
To start measuring the next point of the cross section. **(F1)** changes to **STOP**. Available if a template has been opened with **START (F4)**.

STOP (F1)
To end measuring the point. **(F1)** changes to **STORE**.

STORE (F1)
To store the measured point. **(F1)** changes to **OCUPY**.

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.
<Antenna Ht:>	User input	The default antenna height as defined in the active configuration set is suggested. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.
<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	**OCUPY (F1)**, **STOP (F1)** and then **STORE (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.

12.4 Cross Section Templates

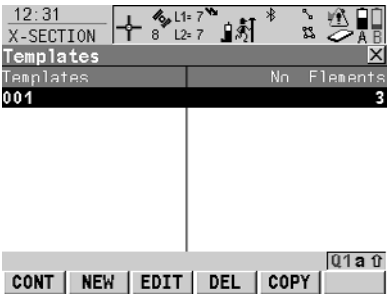
12.4.1 Accessing Cross Section Template Management

Access step-by-step

Step	Description
1.	Press **PROG**.
2.	Highlight **Survey Cross Section**.
3.	**CONT (F1)**
4.	In **X-SECTION Begin** press **CONT (F1)** to access **X-SECTION Survey: Job Name**.
5.	**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 "12.4.2 Creating/Editing a Cross Section Template".

EDIT (F3)
To edit the highlighted cross section template. Refer to "12.4.2 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.

12.4.2 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

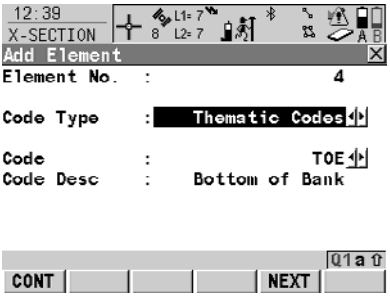
Field	Description
No.	The number of the element.
Code	The code assigned to the element. ----- is displayed if no code is assigned to the element.
Code Type	The type of the code assigned to the element.

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.

13 Volume Calculations

13.1 Overview

Description

The Volume Calculations application program allows surfaces to be measured and volumes (and other information) to be computed from these surfaces. It can be used for the following tasks:

- Measuring points defining a surface.
- Calculating the triangulation of the measured surface points to establish the surface.
- Calculating the volume between a triangulated surface and a reference.

Volume calculations are possible for **<R-Time Mode: Rover>** and **<R-Time Mode: None>**.

Point types

Surfaces can be created from points stored as:

- Local grid.

Height mode can be ellipsoidal or orthometric.

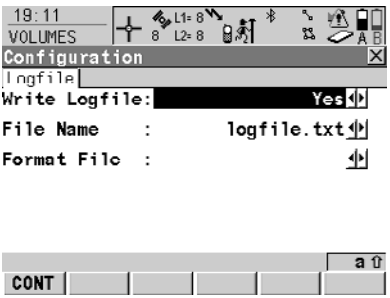
13.2 Configuring Volume Calculations

Access

Step	Description
1.	Press **PROG**.
2.	Highlight **Volume Calculations**.
3.	**CONT (F1)**
4.	In **VOLUMES Volume Calculations Begin** press **CONF (F2)** to access **VOLUMES Configuration**.

VOLUMES Configuration, Logfile 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.

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
<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) returns to the screen from where this screen was accessed

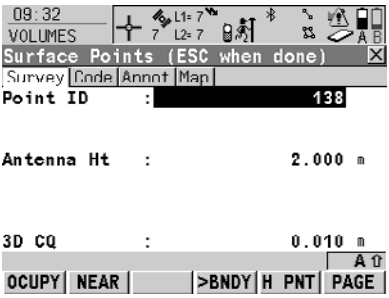
13.3 Survey Points

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.

VOLUMES Surface Points Survey page

The pages shown are those from a typical configuration set.



OCUPY (F1)
To start measuring the surface point. **(F1)** changes to **STOP**.

STOP (F1)
To end measuring the surface point. **(F1)** changes to **STORE**.

STORE (F1)
To store the measured surface point. **(F1)** changes to **STORE**.

NEAR (F2)
To search **<Volumes Job:>** for the point nearest to the current position when the key is pressed. The point is selected as the point to be measured and is displayed in the first field on the screen. Available when **OCUPY (F1)** is displayed.

>BNDY (F3) / **>SURF (F3)**
To change the class of the point to be measured between surface point and boundary 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 **OCUPY (F1)** or **STORE (F1)** being displayed and for real-time devices of type digital cellular phone or modem.

SHIFT INIT (F4)
To force a new initialisation. Available for **OCUPY (F1)** or **STORE (F1)** being displayed and 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 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 free ID from the configured ID template.
<Antenna Ht:>	User input	The default antenna height as defined in the active configuration set is suggested. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.
<3D CQ:>	Output	The current 3D coordinate quality of the computed position.

Next step

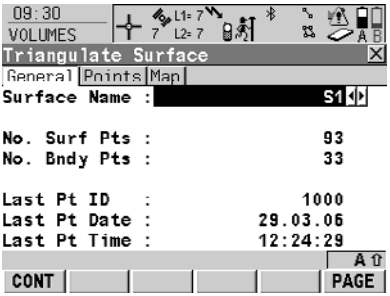
Press **ESC** returns to the **VOLUMES Choose Task & Surface** screen.
Press **ESC** again returns to the **VOLUMES Volume Calculations Menu** screen.

13.4 Triangulate Surfaces

Definition

To calculate the triangulation (triangulation method: delauny) of the measured surface points to establish the surface.

VOLUMES Triangulate Surface, General page



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.

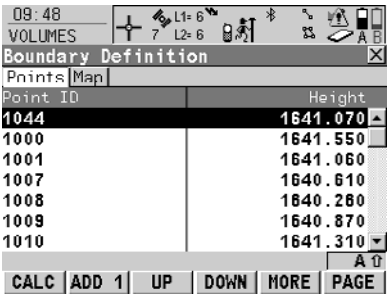
SHIFT DEL S (F4)
To delete the surface.

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.

VOLUMES Boundary Definition, Points page



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.

SHIFT HOME (F2)
To move the focus to the top of the points list.

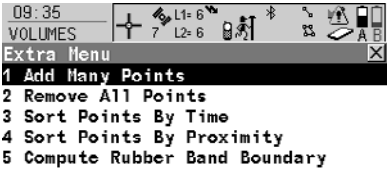
SHIFT END (F3)
To move the focus to the bottom of the points list.

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 (F5) continues to the **VOLUMES Extra Menu** screen.

The Extra menu

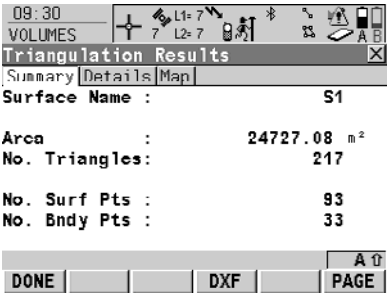


CONT (F1)
To select the highlighted option and to continue with the subsequent screen.

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.

VOLUMES Triangulation Results, Summary page



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.

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.

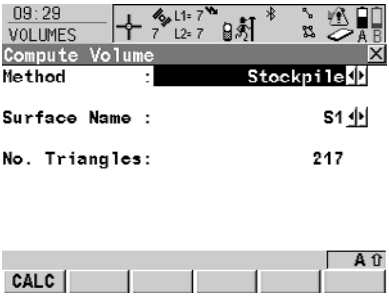
Next step
DONE (F1) returns to the **Volume Calculation Menu** screen.

13.5 Compute Volumes

Description

To compute the volume of an triangulated surface by using a reference (3D point or elevation) or the stockpile method.

VOLUMES Compute Volume



CALC (F1)
Computing the volume and access to the **VOLUMES Volume Calculation Results page**. **(F1)** changes to **CONT**.

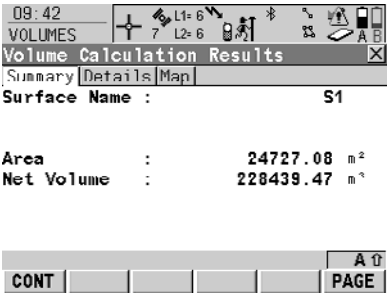
SHIFT CONF (F2)
To configure the program.

Description of fields

Field	Option	Description
<Method:>	Choicelist	To calculate the volume of the triangulated surface using: • Stockpile (volume between the triangulated surface and the plane defined by the boundary points of the surface). • Surface to Elev (volume between the triangulated surface and the height entered by the user). • Surface to Point (volume between the triangulated surface and the height of a selected point).
<Surface Name:>	Choicelist	Surface chosen from the triangulated surfaces currently stored to the active job.
<No. Triangles:>	Output	Number of triangles from the triangulated surface.

Next step
CALC (F1) calculates the volume and continues to the **VOLUMES Volume Calculation Results** screen.

VOLUMES
Volume Calculation Results
Summary page



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
PAGE (F1) changes to the **Details page**.

VOLUMES
Volume Calculation Results
Details page

Description of fields

Field	Option	Description
<Min Elevation:>	Output	Minimal elevation of the calculated volume.
<Max Elevation:>	Output	Maximal elevation of the calculated volume.
<Avg Thickness:>	Output	Average thickness of the calculated volume.
<Perimeter:>	Output	Perimeter of the measured surface area (intersection of the measured surface to the reference datum).

Next step
CONT (F1) returns to the **Volume Calculation Menu** screen.

---

14 Wake-Up

14.1 Overview

Description

Wake-up sessions are static point occupations for which the receiver is preprogrammed with an automatic start time and a duration during which the point's position is measured.

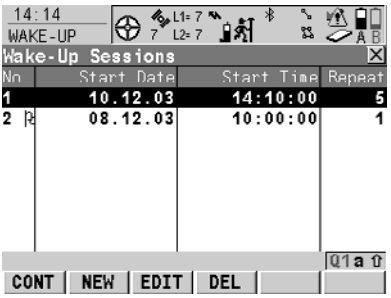
☞ A CompactFlash card must be inserted when the receiver wakes up. If no CompactFlash card is fitted or it is damaged, not formatted or full then the session will not be executed.

☞ The PIN code, if activated in **CONFIGURE Start Up & Power Down**, **PIN Code** page, is not checked if a wake-up session starts.

Access

Select **Main Menu: Programs...\Wake-Up**.

WAKE-UP
Wake-Up Sessions



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

NEW (F2)
To create a new wake-up session.

EDIT (F3)
To edit a wake-up session.

DEL (F4)
To delete a wake-up session.

SHIFT DEL-A (F4)
To delete all stored wake-up sessions.

Description of columns

Column	Description
No.	The wake-up session number, from 1 to 20.
	Indicates which wake-up session is next to be activated.
Start Date	The local starting date of the wake-up session.
Start Time	The local starting time of the wake-up session.
Repeat	The number of times the wake-up session will be repeated.

Next step

IF	THEN
the wake-up sessions do not need to be changed	**CONT (F1)** closes the screen and returns to the screen from where **WAKE-UP Wake-Up Sessions** was accessed.
a wake-up session is to be created	**NEW (F2)**. Refer to "14.2 Creating a New Wake-Up Session/Editing a Wake-Up Session".
a wake-up session is to be edited	highlight the wake-up session and **EDIT (F3)**. Refer to "14.2 Creating a New Wake-Up Session/Editing a Wake-Up Session".

14.2 Creating a New Wake-Up Session/Editing a Wake-Up Session

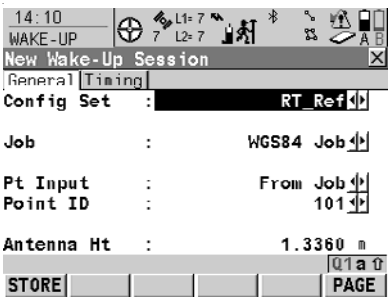
Access step-by-step

Step	Description
1.	Refer to "14.1 Overview" to access **WAKE-UP Wake-Up Sessions**.
2.	**NEW (F2)/EDIT (F3)** to access **WAKE-UP New Wake-Up Session/WAKE-UP Edit Wake-Up Session**.

☞ Editing a wake-up session is similar to creating a new wake-up session. For simplicity the screens are called **WAKE-UP XX Wake-Up Session** and differences are clearly outlined.

☞ A new wake-up session can still be created when there is no CompactFlash card fitted, though there will be differences in the way the menu works.

WAKE-UP XX Wake-Up Session, General page



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

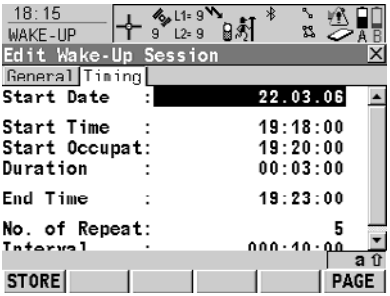
TMPLT (F3)
Available for some options for **<Pt Input:>**. To configure ID templates.

Description of fields

Field	Option	Description
<Config Set:>	Choicelist	The active configuration set for the wake-up session.
<Job:>	Choicelist	The active job for the wake-up session.
<Pt Input:>	**From Job** or **Manual**	Allows points from the job to be selected or point ID's to be typed in for **<Point ID:>**.
	Pt ID Template	Allows points from an point ID template to be entered for **<Point ID:>**.
<Point ID:>	Choicelist	Available for **<Pt Input: From Job>**.
	User input	Available for **<Pt Input: Manual>**. Input a new point ID.
	Output	Available for **<Pt Input: Pt ID Template>**. A point ID can be selected from an ID template using **TMPLT (F3)**.
<Antenna Ht:>	User input	Height of the antenna to be used during the wake-up session. Changing the antenna height here does not update the default antenna height as defined in the active configuration set.

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

WAKE-UP XX Wake-Up Session, Timing page



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

TMPLT (F3)
Available for some options for **<Pt Input:>**. To configure ID templates.

Description of fields

Field	Option	Description
<Start Date:>	User input	Local date to start wake-up session.
<Start Time:>	User input	Local time to start wake-up session.There must be at least three minutes between consecutive wake-up sessions. No wake-up session can coincide with another session.
<Start Occupat:>	User input	Local time to start the point occupation (two minutes after **<Start Time:>**).
<Duration:>	From **3 mins** to **48 hrs**	Length of time the wake-up session should last for.
<End Time:>	Output	Time wake-up session will end calculated from the start time and duration.
<No. of Repeat:>	User input	Number of times the wake-up session should be repeated (max. 1000).
<Interval:>	From **10 mins** to **168 hrs**	Time interval between repeated wake-up sessions.

Next step
STORE (F1) returns to **WAKE-UP Wake-Up Sessions**.

Index

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733496-5.0.0en
Original text
Printed in Switzerland © 2006 Leica Geosystems AG, Heerbrugg, Switzerland

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- when it has to be **right**

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