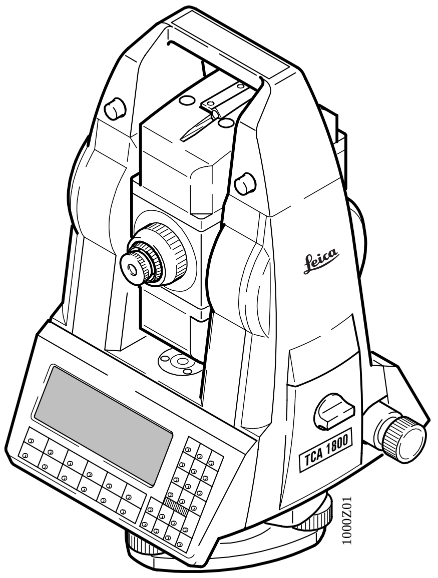
TPS - System 1000

Programs

Version 2.2
English



USER'S MANUAL

Congratulations on your purchase of your programs for a TPS - System 1000 !


In order to use the software correctly and reliably, you must follow the instructions given in the user manual or in the on-line help system. You must also adhere to the directions given in the user manual for the product with which you are using the software.
The rights and responsibilities accruing in respect to Leica as a result of acquisition of the software are set out in the **Leica Software License Agreement**.
To secure your rights with regard to the software acquired, it is essential that you follow the directions given on the **Leica Software - Support Registration Card**.

TPS - System 1000

Programs

Product identification

Enter your programs' version number in your manual and always refer to this **information** when you need to contact your **agency** or authorized **service workshop**.

Version number: ________________

Symbols used in this Manual

The symbols used in this User's Manual have the following meanings:

DANGER :
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING :
Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

CAUTION :
Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and / or appreciable material, financial and environmental damage.

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

View of chapters

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Introduction

IN

General

The electronic theodolites and total stations in the TPS System 1000 are equipped with programs for processing field data and control-point coordinates. The systems are therefore highly functional and classical survey tasks are simplified appreciably.

When delivered, the instruments are already equipped for the following standard applications:

- Orientation and height transfer
- Resection
- Tie distance
- Stakeout
- Free-station survey (Licence code required)

In addition, the following applications are delivered on diskette:

- Reference line / building alignment
- Remote height
- Hidden points
- Computation of area
- Sets of angles
- Traverse
- Local resection
- Roadline
- File Editor
- Road Plus
- COGO
- Monitoring

This list is extended continuously. Find actual information in file README.TXT on diskette.

The additional application programs can be loaded into the instrument, but can only be run as a demonstration version in which certain functions are disabled. Full functionality can be obtained with a licence code, available from your Leica agency, where you can also obtain information about the newest programs available in the ongoing applications-software development

project.
All installation programs and applications are supplied on normal 3 1/2" diskettes.

For optimal use of the programs and instruments read this manual carefully.

Installation in the PC

Hardware and software required

The hardware and software used to transfer the individual program packages must meet the following **requirements**:
- IBM-compatible PC, 386 or higher
- 4 MB RAM
- 3.5" floppy-disk drive
- RS 232 interface, including interface cable for Leica survey instruments (stock no. 563625)
- MS DOS 5.0 or higher
- MS Windows 3.1

Four diskettes are supplied with each instrument:
- disk 1 = SYSTEM FIRMWARE
- disk 2 = Programs and Languages
- disk 3 = TPS-WORKBENCH
- disk 4 = RCS 1000

More information can be found in the file README.TXT on each diskette.

Recommended installation procedure:

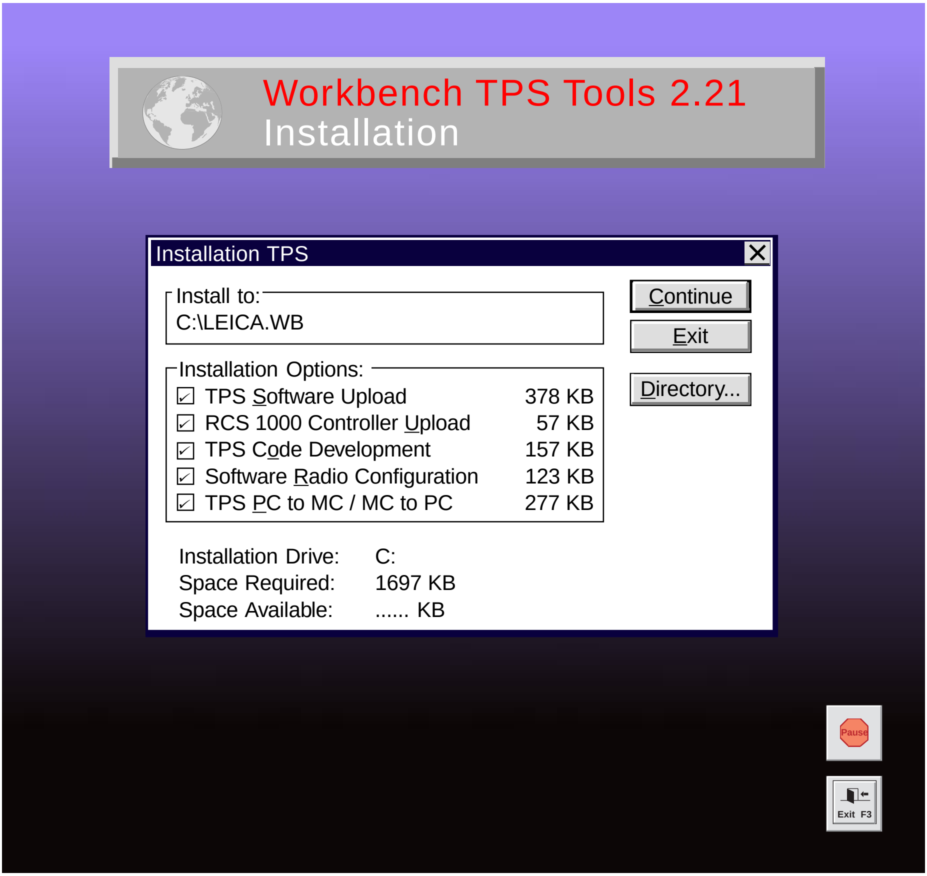
1. TPS-WORKBENCH (disk 3)
2. SYSTEM FIRMWARE (disk 1)
3. Programs and languages (disk 2)
4. RCS 1000 (disk 4)

IN

On the diskette bearing the label

TPS 1000/2000/5000
TPS-WORKBENCH

is the PC software needed to install applications or foreign-language texts on the TPS1000 instruments.



The "**WORKBENCH**" program is installed in the PC by running the program "SETUP.EXE" under WINDOWS on the diskette. For further details, refer to the handbook or to the HELP file of WINDOWS.

TPS-user just have to install the "TPS Softwae Upload".

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The diskette bearing the label

TPS 1000 SYSTEM FIRMWARE

contains the necessary system software for the TPS 1000 instrument:
- theodolite system software
- ATR system software
- EDM system software

The diskette bearing the label

TPS 2000/5000 SYSTEM FIRMWARE

contains the necessary system software for the TPS2000/5000 instrument:
- theodolite system software
- ATR system software
- EDM system software

The diskette bearing the label

TPS 1000/2000/5000 Programs and Languages

contains:
- all applications (both the standard ones and the additional ones),
- the appropriate text files for the languages available.

The text for the languages available are also included for the TPS1000 system software.

The diskette bearing the label

TPS 1000/2000/5000 RCS 1000

contains the remote control software:
- for RCS 1000 based on CR233/333
- for RCS 1000 based on GPC1

IN

Rules for naming files

The files are named in accordance with the following rules:

Application programs: ?????VVV.PRG

?????	Maximum of 5 characters for name of application
VVV	3 characters for version (release) number
PRG	Identification tag for loadable application

Text files: ?????VVV.LSS

?????	identical name of relevant application		
VVV	identical version (release) number of relevant application		
L	Identification tag for text file of application		
	SS Identification tag for language		
	SS =>	EN	English
		GE	German
		FR	French
		SP	Spanish

System texts:SYS?_VVV._SS

SYS?_	Seven text files (SYS1_ ... SYS7_)		
VVV	Version (release) number of system texts		
	Identification tag for text file of system		
SS	Identification tag for language		
	SS =>	GE	German
		FR	French
		SP	Spanish

After the installation is complete, you will find the following files in the subdirectory in your PC:

IN

Standard applications			
Application	**File name**	**Text file**	**Remarks**
All		prtxtVVV.LEN prtxtVVV.LGE prtxtVVV.LFR prtxtVVV.LSP	Texts common to all applications
Orientation and height transfer	ORI__VVV.PRG	ORI__VVV.LEN ORI__VVV.LGE ORI__VVV.LFR ORI__VVV.LSP	English German French Spanish
Tie distance	TIE__VVV.PRG	TIE_VVV.LENetc.	
Resection	RESECVVV.PRG	RESECVVV.LENetc.	
Stakeout	STAKEVVV.PRG	STAKEVVV.LENetc.	

Additional applications			
Application	**File name**	**Text file**	**Stock no.**
Free-station survey	FREE_VVV.PRG	FREE_VVV.LEN etc.	663156
Reference line / building alignment	REFL_VVV.PRG	REFL_VVV.LEN etc.	663198
Hidden points	HDNPTVVV.PR	HDNPTVVV.LEN etc.	663213
Remote height	REMHTVVV.PR	REMHTVVV.LEN etc.	663200
Traverse	TRAV_VVV.PRG	TRAV_VVV.LEN etc.	663197
Computation of area	AREA_VVV.PRG	AREA_VVV.LEN etc.	663196
Sets of angles	SETS_VVV.PRG	SETS_VVV.LEN etc.	663199
Local Resection	LRES_VVV.PRG	LRES_VVV.LEN etc.	663267
Road Line	ROADLVVV.PR	ROADLVVV.LEN etc.	663216
File Editor	FILEDVVV.PRG	FILEDVVV.LEN etc.	663217
Road Plus	RPLUSVVV.PRG	RPLUSVVV.LEN etc.	663218
COGO	COGO_VVV.PRG	COGO_VVV.LEN etc.	664401
Monitoring	MONIT222.PRG	MONIT222.LEN etc.	664411

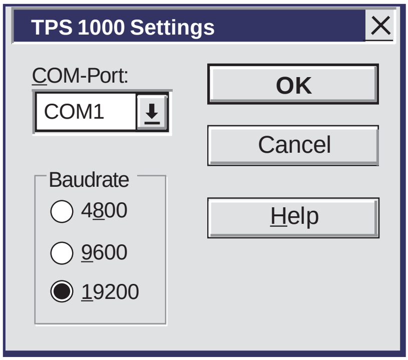
Loading files into the TPS1000 instruments

Applications, and system- and application texts, are loaded into the TPS1000 by means of the "TPS SOFTWARE UPLOAD" program.

Use the interface cable 563 625 to connect the TPS1000 to the serial interface COM1 or COM2 on the PC.

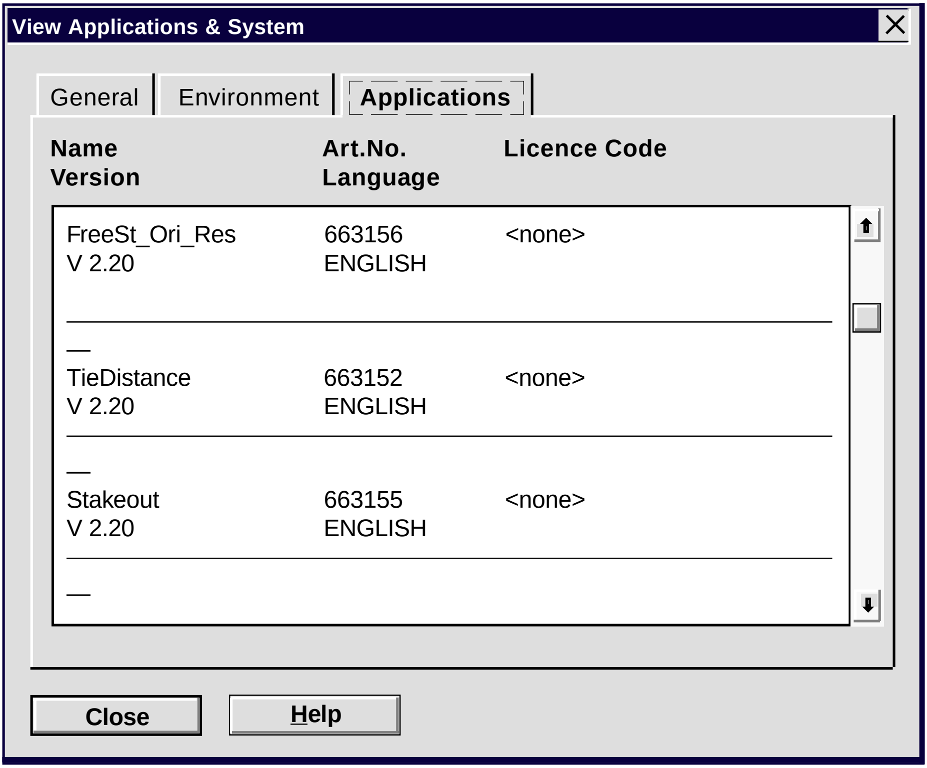
Start the "TPS SOFTWARE UPLOAD" program with a double-click from the WINDOWS program manager.

Select the command "Sensor/Settings" and inspect the interface selected and the baud rate. The baud rate should be set to the maximum. The baud rate for the TPS1000 instrument is set automatically.



IN

Switch the instrument off! Select the command "View Applications + System" to inspect the connection to the instrument. The instrument switches itself on again and establishes the connection. The display of the applications available on the instrument shows that the connection was successful. If it was not successful, read *section "Solving problems"*.

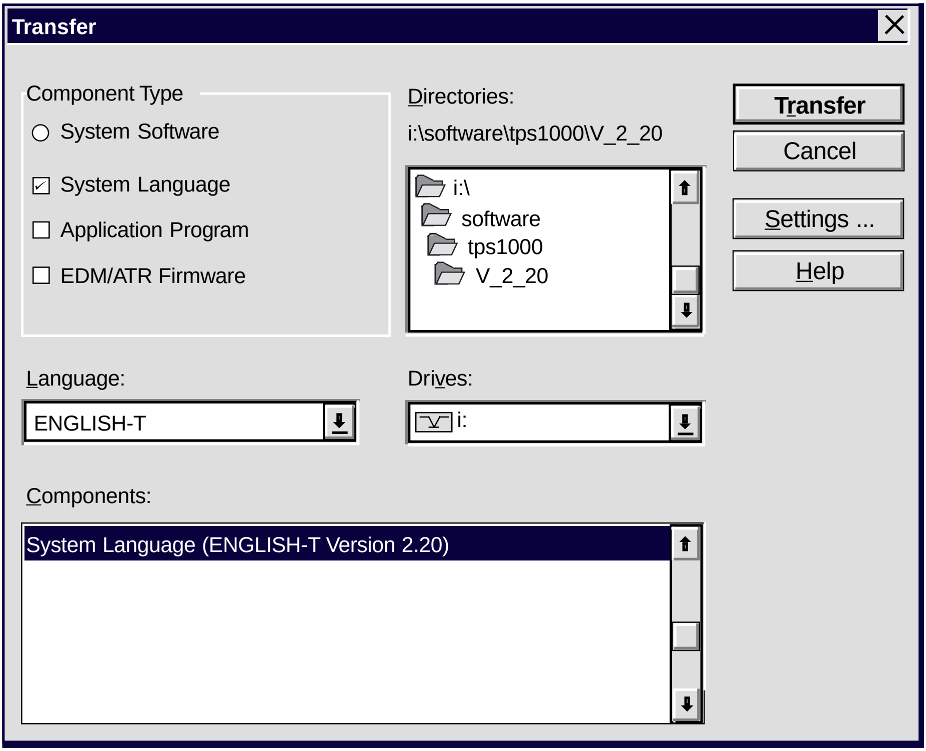


Loading system texts

- Select the command "Transfer files" in the "Utilities" menu ,
- Mark "System Language",
- select relevant drive under "Directories",
- select desired language under "Language" and
- mark relevant file under "Components".

Then press the **Transfer** key to start the transfer.

The progress of the transfer is shown in a bar diagram.



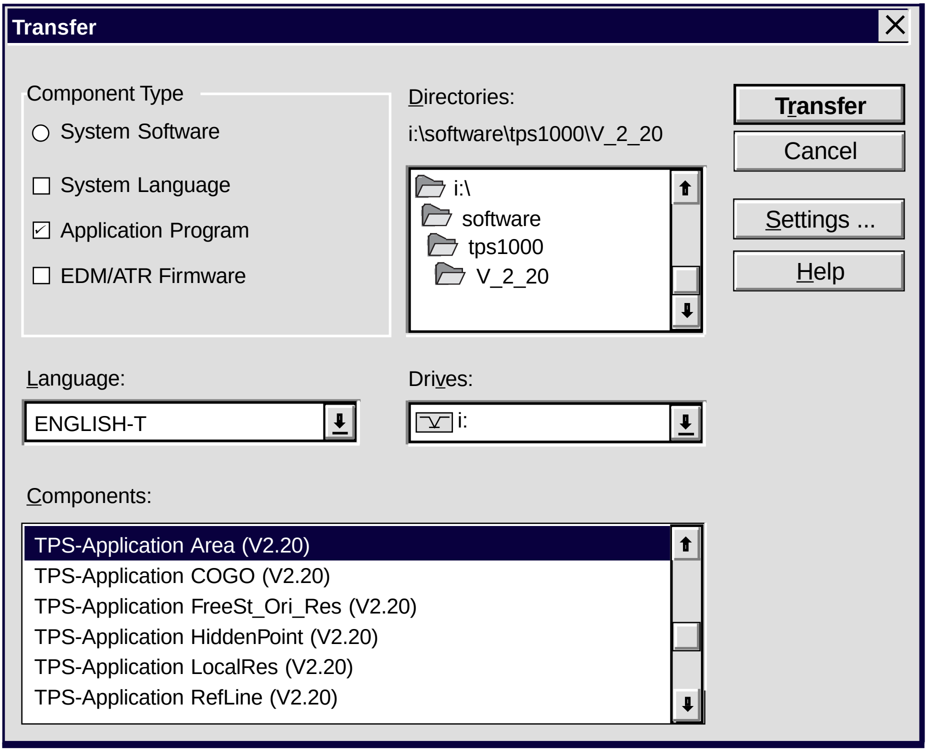
Afterwards, enter the language on the instrument *(see section "Configuration" of "System" - user manual).*

The English system texts are part of the system software and can be neither loaded nor erased.

Loading application programs

- Select the command "Transfer files" in the "Utilities" menu ,
- Mark "Application Program",
- select relevant drive under "Directories",
- select desired language under "Language" and
- mark desired program(s) under "Components".

Then press the **Transfer** key to start the transfer.
The progress of the transfer is shown in a bar diagram.



It is absolutely necessary that the program files (*.prg) are be in the same directory as the language files (*.LSS) and the Prtxt220.LSS file.

Licence code

When an additional application is first started up, a licence code is requested, so that the application will be fully functional. Without this licence code, you can run the applications as a demonstration version, but you will not be able to calculate and store the results.

IN

The licence code is available from your Leica agency, who will inform you about licence fees for additional applications. Details of the licence agreement are given in the registration card, which is a part of the "System" manual.
To expedite formalities, please fill in a copy of the form at the end of this section and fax it to your local Leica agency.

Solving problems

1. Instrument does not switch on when "Utilities/View Applications + System..." option is selected.
   Inspect the cable connections and that the serial interface COM1 or COM2 has been set correctly.

2. Instrument does not switch to "ON-LINE-MODE (GeoCOM)" mode when "Utilities/View Applications + System..." option is selected.
   Make sure that the instrument is switched off before the "Utilities/View Applications + System..." option is activated.

3. Instrument does not switch to "ON-LINE-MODE (GeoCOM)" mode when "Utilities/View Applications + System..." option is selected; "MEASURE & RECORD" menu or another autostart application is displayed instead.

IN

Carry out the following operations on the instrument:

Shift ESC or ESC — until main menu is displayed.

F3 — [CONF] Configuration

6 — [Autostart] Autoexec-application

F6 — [LIST] and select "MAIN MENU"

Switch off the instrument and start the data transfer process from the beginning.

Put crosses against the applications you require and send the form to your nearest Leica agency, which will process your order.

Address of customer *(please use Company stamp or write legibly)*	
Name	
Company	
Street	
Zip code / City	
Country	
Telephone	
Telefax	
Remarks	(Company stamp, signature)

Leica

Leica Geosystems AG
Geodesy
CH-9435 Heerbrugg
(Switzerland)
Software Management Dept.
Phone +41 71 727 36 81
Fax +41 71 727 47 05

Licence code for TPS 1000 applications			
Serial number TPS1000		Instrument type	
Name of application	**No. of application**	**Licence code**	**Remarks**
Free station survey	663156		
Computation of area	663196		
Traverse	663197		
Reference line/building alig.	663198		
Sets of angles	663199		
Remote height	663200		
Hidden points	663213		
Local resection	663267		
Road Line	663216		
File Editor	663217		
Road Plus	663218		
COGO	664401		
Monitoring	664411		

To be filled in by agency and forwarded to Leica Geosystems AG, Heerbrugg.	We confirm taking out a licence for the applications listed above, and we guarantee to pay the licence fees to Leica Geosystems AG. (Company stamp, signature)

General notes

Units in this manual

Specifications within this manual always apply to the following units:

Units of length:
- in m (meters)
- in addition, within brackets in ft (feet)

Units of angle:
- in ° ' "
- in addition, within brackets in gon

Units of temperature:
- in °C
- in addition, within brackets in °F

Preparation

All program sequences are based on a unified structure. The clearly-designed display with the function keys makes learning easy. Each program has a configuration dialog. In this dialog, the user can match program-specific parameters to changes in requirements and sequences. The various possibilities are described in the instructions for the individual programs.

Settings

To avoid temporarily-stored information being lost when the TPS1000 automatically switches off after long periods of disuse, you should set the "sleep mode" instead of the automatic switchoff. For more information, please refer to *section "Fixed keys" ("Power off, Sleep") of "System"* - user manual.

Each application takes over the settings (units, recording format, display format etc.) allocated to the appropriate user.

GN

If required, these user settings must be **defined in advance**. For more information, please refer to *section "User configuration" of "System"* - user manual.

GN

Data exchange

If the settings in an application are altered, these changed values will be taken over in the other applications also and in „Measure and record“. The settings affected are the station coordinates and the circle orientation, along with parameters such as the reflector constant, reflector height, and data for distance reduction. This data can be altered in every application.

The measurement data is stored in the file selected.

Using the program

Instrument field setup

F5

The setup is called up in the main menu.

To start with, the user profile and the file for storing measurement data can be selected in the start-up display.

```
SETUP\ START-UP DISPLAY 14:03
Select user template & files
User templ. :Polar(Standard) ▼
Rec. device :    Memory Card ▼
Meas. file  :1 √  FILE01.GSI ▼
Data file   :2 √  FILE02.GSI ▼

                  QSET STN LIST
```

Shift

```
HELP
```

F1 F2 F3 F4 F5 F6

CONT

The station number, the coordinates, the direction of the line of sight, and the instrument height, are all displayed

The dialog enables station coordinates to be set or imported and also permits a direction to a tie point to be set.

GN

```
SETUP\  STATION DATA          14:03
Station no. :     STATION 12  ▼     MC
Inst.Height :          1.634  m
Stat.Easting:       1010.567  m
Stat.Northg :     -34213.077  m
Stat.Elev.  :        345.655  m
Hz          :     390°35'58"
                 REC   Hz0  IMPOR  αNUM
```

Shift

```
HELP
```

```
F1    F2    F3    F4    F5    F6
```

Calling up the program

The applications are called up in the main menu.

Select the application required and

confirm

or

1 ... 4

alternatively type in the number which appears after the program name in the display.

```
 MAIN MENU: PROGRAMS          14:03
Orientation & Ht. Transfer 00
Resection                  01
Stakeout                   02
Tie Distance               03
Free Station               04

EXTRA   CAL  CONF  DATA  SETUP  MEAS
```

Shift

```
HELP
```

```
F1    F2    F3    F4    F5    F6
```

GN

Designation of keys

The effects of the fixed keys and of a few function keys are the same as their effects in "MEASURE AND RECORD". These keys are generally omitted from the descriptions of the applications and from the ON-LINE help.

CONT — Continues sequence after input, measurements etc. have been concluded. If the measurement dialog is concluded with CONT the measurement data will not be recorded.

CE — Erases incorrect alphanumeric input.

"REC" — Records in a pre-established format manually-entered coordinates, measurements or the results of calculations.

ESC — Quits current dialog and calls up previous dialog. Changes and inputs to dialog are rejected and are not stored.

Shift — Displays the second level of the function keys F1 - F6 .

Shift F1 — Calls ON-LINE help.

Shift ESC — Closes application.

CODE — Calls up code input or code function in measurement dialog.

Target eccentricity

If the reflector cannot be set up directly over the desired point, or if the point cannot be seen from the instrument, the function 'OFFS' may be used to make an offset measurement.

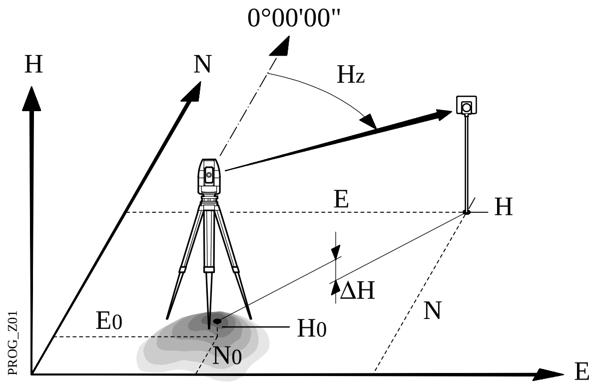
Previous to the input of the values for eccentricity, a distance must be measured to the reflector.

For more information, please refer to section *'Measurement & recording' of 'System'-user manual.*

Orientation and Height Transfer

Introduction

This manual describes the "Orientation and Height Transfer" program of the TPS SYSTEM 1000 theodolite series.



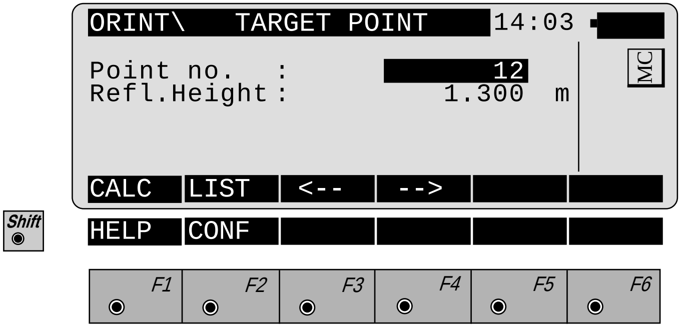
The instrument must be set up on a known point. The program "ORIENTATION" calculates an angular correction for the instruments horizontal circle, so that 0.0000 of the horizontal circle corresponds with grid north (Orientation correction), using reference points with known Easting and Northing.

For simultaneous determination of the station elevation, height of instrument and height of reflector must already have been input and the elevation of the target points must be known.

The program handles a maximum of 10 points.

Target Point

Enter the target point number and height of the reflector .



F1 Run the calculation. Note, the **F1** key will be assigned after the first measurement.

F2 Entry of target points into a list as well as selecting points for further use.

F3 Displays the previous point from the list of points entered. Note that this key will not be available until there is at least one point in the list.

F4 Displays the next point in the list of points entered. Note that this key will not be available until there is at least one point in the list.

CONT Retrieve the coordinates of the target point from the selected file. For further information, please refer to *dialog "IMPORT" described in the "System" - user manual*.

Shift **F2** Start the "CONFIGURATION"

Point List

Enter a maximum of 10 points. The same point can be retrieved several times.

```
ORINT\ POINT LIST        14:03
Point 1      :               1
Point 2      :               2
Point 3      :               3
Point 4      :               4
Point 5      :               5
Point 6      :               6

Point 7      :               7
Point 8      :               8
Point 9      :               9
Point10      :               0
```

Shift

```
HELP
```

F1	F2	F3	F4	F5	F6

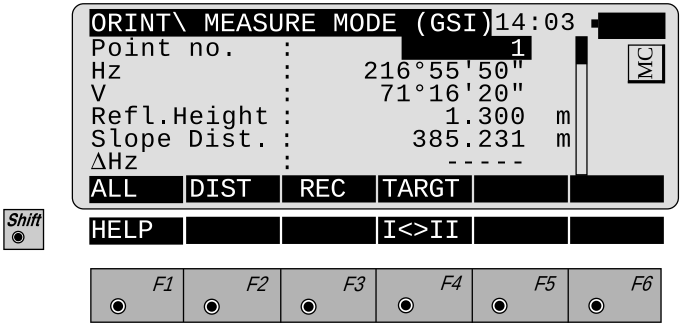
OH

CONT Return to the dialog "Target Point".

Measure Mode

This dialog is similar to the TPS 1000’s basic "Measure Mode" dialog. Once a measurement is taken, the program will return to the dialog "Target Point" to acquire the next point for measuring.
If the orientation correction can be calculated successfully from any of the first measurements, the ΔHz and ΔV values are displayed for further entered target point. Motorized theodolites will automatically drive the telescope to the target point.

OH



F1 Simultaneously measure and record data on the active recording device. Return to the dialog "Target Point".

F2 Measure a distance.

F3 Record the measurement on the active recording device. Return to the dialog "Target Point".

F4 Enter target data. For further information, please refer to *chapter "Measure & Record" described in the "System" - user manual*.

Shift **F4** Change the theodolite face.

CODE Call up the CODE function, as described in *chapter "Measure & Record" described in the "System" - user manual*.

Shift **ESC** Exit the program.

CONT Accept the measurement and return to the dialog "Target Point".

Calculation

Calculates the orientation, the elevation and the respective standard deviations.

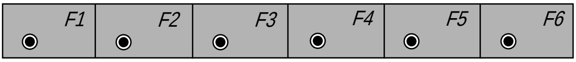
```
ORINT\ RESULTS <ROBUST>  14:03
Station no. :              10
No. of Pts. :               5
Inst.Height :           1.635  m
Easting     :        2134.234  m
Northing    :        4723.365  m
Elevation   :         521.643  m
S.ORI  S.HT   STORE  PLOT   MORE
Orientation :        2°12'34"
σElevation  :           0.010  m
σOrient     :        0°00'03"
```

MC

OH

Shift

```
HELP   LSQRS
```



Station no	:	Point number assigned to the station
No. of Pts	:	Number of points measured
Inst.Height	:	Instrument Height
Easting	:	Easting of the station entered.
Northing	:	Northing of the station entered.
Elevation	:	Calculated elevation of the station
Orientation	:	Oriented direction
σ Elevation	:	Standard deviation of the Elevation
σ Orient	:	Standard deviation of the Orientation

F1 — Set orientation on the instrument. **Note that once this key has been pressed it will not be possible to execute more measurements.**

F2 — Set station elevation on the instrument. **Note that once this key has been pressed it will not be possible to execute more measurements.**

F3 Record the following results into the active file:

WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last reflector height used
WI 88	Instrument Height

F4 Sketch of the station and the reference points used.

F5 Show the results of individual measurements on the screen (*see dialog "More Information")*.

ESC Measure more points. The program will recall the "TARGET POINT" dialog.

Shift F2 Select between the "Robust" method and the "Variation" method.

More Information

Display the residuals of individual measurements. You can also disable points from the calculation of orientation or height as well as delete erroneous measured points.

```
ORINT\ MORE INFORMATION  14:03
                          2/10      MC
Use for HT.  : YES Status:  ON
Point no.    :        Point01
Error flag   :           NONE
Δ Hz         :       0°00'03"
Δ Distance   :        0.050 m
RECLC  <--  -->  MEAS  DEL  NO
Δ Height     :        0.020 m
Refl.Height  :        1.555 m
Easting      :      991.427 m
Northing     :     1995.162 m
Elevation    :      402.466 m
```

Shift

```
HELP
F1  F2  F3  F4  F5  F6
```

2/10	:	Sequence number of the current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.
Use for Ht.	:	Use this measurement for height determination (YES/NO)
Status	:	Use this measurement for calculation (ON/OFF).
Point no	:	The target point number.
Error Flag	:	Identified erroneous measurements. Possible values are: NONE measurement is OK HZ horizontal angle error DIST distance error HT height difference error The flags may also be combined, i.e. DIST + HZ
Δ Hz.	:	Difference between calculated and measured horizontal angle
Δ Distance	:	Difference between calculated and measured distance
Δ Height	:	Difference between calculated and measured height
Refl. Ht.	:	Reflector height used for the target point

Easting, Northing, Elevation: Target coordinates used.

OH

F1 Recalculate the result.

F2 Scroll to the measurements of the previous point.

F3 Scroll to the measurements of the following point.

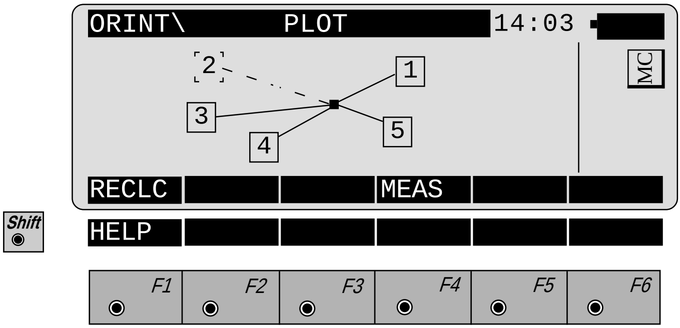
F4 Measure more points. Return to the dialog "Target Point".

F5 Delete a point from the set of measurements. You can now measure a new point in its place.

Shift ESC Exit the program.

Plot

Generates a plot showing the measurement configuration.
The station point is in the center and the top of the sketch shows the direction of grid north. The sketch is true in angular but not true in distances.
Points are numbered sequentially in the order in witch they were measured.
Points not used in the calculation are marked with a dotted line.



F1 Recalculate the result and return to the dialog "CALCULATION RESULTS".

F4 Measure more points. The program will recall the "TARGET POINT" dialog.

0 ... **9** Toggle any point ON or OFF by pressing the numeric key corresponding to the sequence number of the point. Note, that **0** represents point 10

Shift **ESC** Exit the program.

Configuration Editor

Shift F2

Start the "Configuration Editor" from the "TARGET-POINT" dialog.

OH

```
ORINT\  CONFIGURATION   14:03
Hz Ori Acc  :      0°00'32"
Ht Acc TP   :        0.0250  m   MC
Posn Acc TP :        0.0250  m
Two faces   :            NO
User Displ  :            NO
Log File    :           OFF
INFO                   DFLT  EDIT
Log FlName  :     ORIENT.LOG
```

Shift

```
HELP
```

F1	F2	F3	F4	F5	F6

The "Configuration Editor "sets parameters for further program operations:

Hz Ori Acc : Limit for the standard deviation of the orientation. The orientation is regarded as "error free", if the computed standard deviation of the orientation is within twice the entered value.

Ht Acc TP : Height accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The height is regarded as "error free", if the computed standard deviation is within twice the entered value.

Posn Acc TP : Position accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The position is regarded as "error free", if the computed standard deviation is within twice the entered value.

Two Faces : **YES** for dual-face measurement,
NO for single-face.

User Disp **:** **YES**; the measured value indication is used from application "Measure and record".
NO; the default indication is used for "Orientation and Height Transfer".

Log File : **ON**, records measurements in a Log-File.The format is described on *page 37*.

Log FlName **:** Enter the Log File Name.

F1 Displays date and version.

F5 Set the values to default. Default values are shown in *dialog on page 35*.

Shift ESC Exit the program.

CONT Store the current configuration and proceed to the dialog "TARGET POINT".

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

Log file

If **"Log File"** is set to **"ON"** the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header	The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

OH

Record

For each measurement, a record will be stored containing :

- Station coordinates
- station height,
- orientation correction
- standard deviations for
  height and
  orientation correction

The residuals for:

- horizontal angles,
- heights and
- measured distances

are also listed.

Leica VIP Orientation + Ht. Transfer V 2.10

Instrument	: TCM1100, Serial 412160, (not named)
User templ.	: User 1
Meas. file	: FILE12.GSI
Program Start	: 09/04/1996 at 12:57
Station no.	: 2000
	E= -0.0006m N= -0.0002m ELV= 398.3961m hi= 1.6000m

Using Robust Solution

Station Elev.	: 398.3929m
Ori.Corr.	: 40'36"
S.Dev. Elev.	: 0.0035m
S.Dev. Orient.	: 0°00'04"

3 point(s) measured :

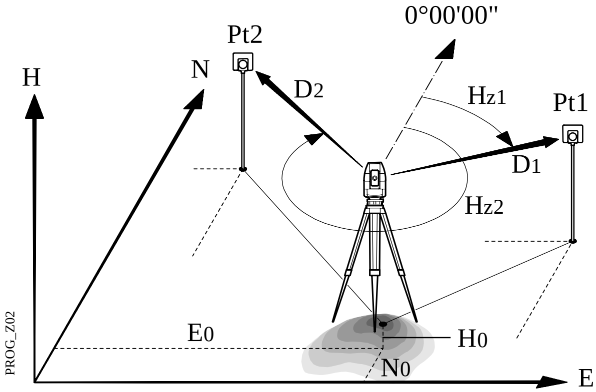
##	Point no.	Δ Hz	Δ Height	Δ Distance	Error Flag
1	500	-0°00'55"	0.0026m	0.0020m	NONE
2	501	-0°00'48"	0.0044m	0.0016m	NONE
3	502	0°00'52"	-0.0070m	-0.0000m	NONE

Typical log file entry in the "Orientation and Height Transfer" program

Resection

Introduction

This manual describes the "Resection" program of the TPS SYSTEM 1000 theodolite series.



The program can be used to deduce the three-dimensional coordinates for the instrument station and the orientation of the horizontal circle from measurements to 2 target points with know Easting and Northing. To compute the position coordinates, at least the distances and the directions for both points are necessary.

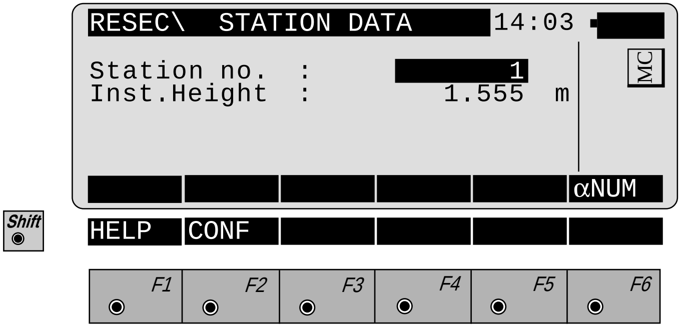
For simultaneous determination of the station elevation, height of instrument and height of reflector must already have been input and the elevation of the target points must be known.

The program allows measurement in single or dual-face mode.

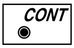
RE

Station Data

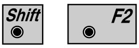
Enter station point number and height of the instrument.



RE



Proceed to the dialog "Target Point"

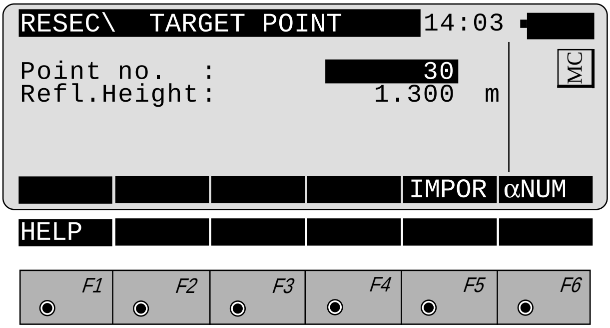


Start the "Configuration"

Target Point

Enter the target point number and height of the reflector.

Shift



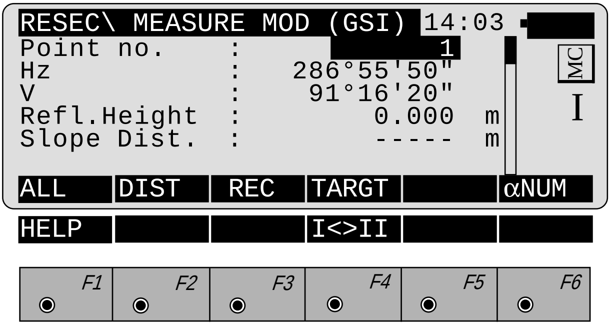
RE

CONT

Retrieve the coordinates of the point entered from the active file. For further information, please refer to *dialog "Import"* described in the *"System" - user manual*.

Measure Mode

This dialog is similar to the TPS System1000's basic "Measure Mode" dialog. Once a measurement is taken, the program will return to the dialog "Target Point" to acquire the next point for measuring.



RE

F1 — Simultaneously measure and record data on the active recording device. Return to the dialog "TARGET POINT".

F2 — Measure a distance.

F3 — Record the measurement on the active recording device. Return to the dialog "TARGET POINT".

F4 — Enter target data as described in *chapter "Measure & Record" of the "System" - user manual.*

F6 — Assigned with "**aNUM**" at point number input; assigned with "**EDIT**" at numerical input.

Shift F4 — Change the theodolite face.

CODE — Call up the CODE function, as described in *chapter "Measure & Record" of the "System" - user manual*.

Shift ESC — Exit the program.

CONT — Accept the measurement and return to the dialog "TARGET POINT".

Calculation

In this dialog the calculated station coordinates are shown with the orientation.

```
RESEC\CALCULATION RESULTS14:03
Station no. :               1
No. of Pts. :               2
Inst.Height :           1.635  m
Easting     :        2134.234  m
Northing    :        4231.365  m
Elevation   :         580.643  m
SET          STORE
Orientation :        2°12'34"
σEasting    :           0.003  m
σNorthing   :           0.005  m
σElevation  :           0.005  m
σOrient     :        0°00'03"

HELP
```

Shift

F1 F2 F3 F4 F5 F6

RE

Station no : Station point number

No. of Pts : Number of points measured

Inst.Height : Instrument Height

Easting : Calculated Easting (Y) for the station.

Northing : Calculated Northing (X) for the station.

Elevation : Calculated elevation for the station

Orientation : Oriented direction

σ Easting : Standard deviation of Easting

σ Northing : Standard deviation of Northing

σ Elevation : Standard deviation of the Elevation

σ Orient : Standard deviation of the Orientation

F1 Set orientation and station coordinates on the instrument. **Note that this key will end the program.**

F3 Record the following results on the active recording device:

WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last rflector height used
WI 88	Instrument Height

RE

Shift ESC Exit the program.

Configuration

Configuration Editor

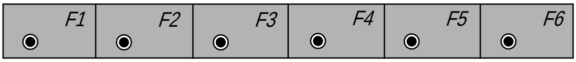
Shift F2

Start the "Configuration Editor" from the "**STATION DATA**" dialog.

```
RESEC\  CONFIGURATION     14:03
Hz Ori Acc   :      0°00'32"
Ht Acc TP    :         0.025  m
Posn Acc TP  :         0.025  m
Two Faces    :            NO
User Displ   :            NO
Log File     :           OFF
INFO                  DFLT  EDIT
Log FlName   :     RESECT.LOG
```

Shift

```
HELP
```



RE

The "Configuration Editor" sets parameters for further program operations:

Hz Ori Acc : Limit for the standard deviation of the orientation. The orientation is regarded as "error free", if the computed standard deviation of the orientation is within twice the entered value.

Ht Acc TP : Height accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The height is regarded as "error free", if the computed standard deviation is within twice the entered value.

Posn Acc TP : Position accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The position is regarded as "error free", if the computed standard deviation is within twice the entered value.

Two Faces : **YES** for dual-face measurement, **NO** for single-face.

Ben.Anzeige : **YES**; the measured value indication is used from application "Measure and record". **NO**; the default indication is used for the "Resection".

Log File : Set to **ON**, the program will record measurement data in a log file as described on *page 47*.

Log FlName : Enter the Log File Name.

F1 — Displays date and version.

F5 — Set the value to the default as described in *dialog on page 45*.

Shift ESC — Exit the program.

CONT — Store the current configuration and proceed to the dialog "STATION DATA".

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged.
These tolerances are used to avoid errors in target identification.
If exceeded an error message will be displayed.

Log File

If "Log File" is set to "ON" the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record For each measurement, a record will be stored containing :
Station coordinates and orientation correction, standard deviation for Easting, Northing, Height of station and orientation correction.
The residuals for horizontal angles, heights and measured distances are also listed.

RE

Leica VIP Resection V 2.10	
Instrument	: TCM1100, Serial 412160, (not named)
User templ.	: User 1
Meas. file	: FILE12.GSI
Program Start	: 09/04/1996 at 12:52

Using Least-Squares Solution

Station no.	: 2000
	E= -0.0011m N= -0.0006m ELV= 398.3951m hi= 1.6000m
Ori.Corr.	; 240°50'51"
S.Dev. East	: 0.0003m
S.Dev. North	: 0.0003m
S.Dev. Elev.	: 0.0047m
S.Dev. Orient.	: 0°00'49"

2 point(s) measured :

##	Point no.	Δ Hz	Δ Height	Δ Distance	Error Flag
1	500	-0°00'55"	0.0047m	0.0001m	NONE
2	501	-0°00'18"	-0.0047m	0.0002m	NONE

Typical log file entry in the "Resection" program

Tie Distance

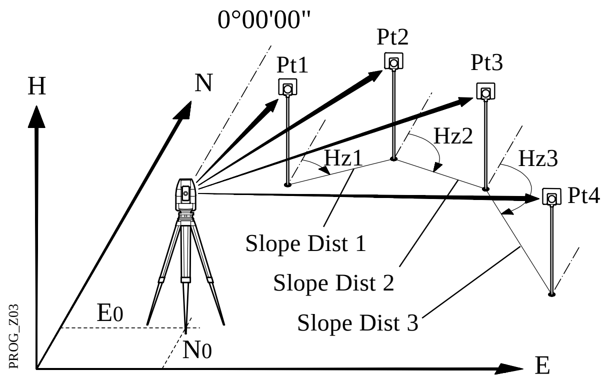
Introduction

This manual describes the "Tie Distance" program of the TPS SYSTEM 1000 theodolite series.
The program calculates the length and azimuth of a line connecting two points.
Polygonal or Radial methods can be used as shown in the illustrations.

The data for the points can either be measured or retrieved from the selected file. Measured points and points retrieved from the selected file can be used together in the calculations, if the station coordinates and orientation are set correctly.

TD

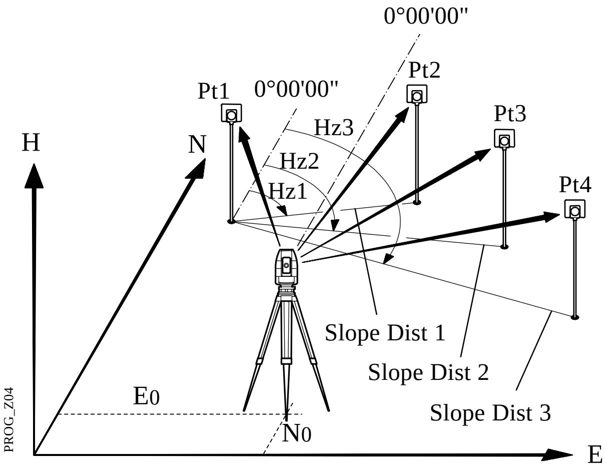
In Polygonal Mode, the program will calculate the distance between the last two points measured (eg. Pt3 - Pt4).



Polygonal Mode

TD

In Radial Mode, the program will calculate the distance between the last point measured (called a Radial Point) (Pt2, Pt3 ...) and a fixed Center Point (Pt1).



Radial Mode

Toggling between Polygonal and Radial Mode at any time while working is possible.

Measure Mode

This dialog is used in accordance with the settings of the system function "Measure & Record" or according to the dialog shown below.

```
TIED\  FIRST POINT          14:03
Point no.    :            546
Refl.Height  :          1.654  m
Hz           :      230°45'23"
V            :        4°52'35"
Slope Dist.  :          -----  m
Height diff  :          -----  m
 ALL |DIST | REC |TARGT|IMPOR|
Easting      :          -----  m
Northing     :          -----  m
Elevation    :          -----  m
```

Shift

```
HELP |CONF |     |I<>II|     |
```

F1 F2 F3 F4 F5 F6

The input for the start point is only possible after the program start or with the function F2 in the dialog "RADIAL MODE".
For all following points the program requests (NEXT POINT).
The dialog for the following points is identical with dialog above, except for the title.

F1

Simultaneously measure and record in the active file. Proceed with the dialog "NEXT POINT". If the second point has already been measured, the program will proceed to the "RESULT" dialog.

F2 F3

Measure a distance. Record the measurement in the active file and proceed with the dialog "NEXT POINT". If the second point has already been measured, the program will proceed to the "RESULT" dialog.

F2 CONT

Measure the distance. Accept the measurement without recording. If the second point has already been measured, the program will proceed with the "RESULT" dialog.

TD

F4 Enter the target data.
For further information refer to *chapter "Measure & Record" of "System" - user manual*.

F5 Import target coordinates.
For further information, please refer to *chapter "Setup" of "System" - user manual*.

Shift F2 Start the "Configuration Editor".

Shift F4 Change the theodolite face.

CODE Call up the CODE function, as described in *chapter "Measure & Record" of "System" - user manual*.

Shift ESC Exit the program

TD

Results

This dialog shows the results computed from the last two points, which can be measured or retrieved from the active file. The same results are calculated for both methods.

Using "Polygon Mode" the calculations are always based on the last two points, where as the "Radial Mode" always uses the first point as a reference point.

```
TIED\  RADIAL MODE      14:03
Center Pt.  :             12
Radial Pt.  :             13
Hori.Dist.  :          4.567  m
Azimuth     :     342°52'35"
Δ Height    :          2.543  m
Slope Dist. :          4.946  m
N.PKT | N.ZEN | STORE |       | POLYG |
ΔEasting    :         22.432  m
ΔNorthing   :         50.083  m
HELP  |       |       |       |       |
F1      F2      F3      F4      F5      F6
```

Shift

TD

Center Pt. : Point number of the center point

Radial Pt. : Point number of the radial point

Hori.Dist : Horizontal distance between the two points

Azimuth : Azimuth from point 1 to point 2

Δ Height : Height difference between point 1 and point 2 (**H_2 - H_1**).

Slope Dist : Slope distance between the two points

Δ Easting : Difference in Easting between point 1 and point 2 ($\mathbf{E_2 - E_1}$). The grid coordinates are only valid for oriented instruments set up on a known point.

Δ Northing : Difference Northing between point 1 and point 2 ($\mathbf{N_2 - N_1}$). Note, the grid coordinates are only relevant for oriented instruments set up on a known point.

F1 Return to the dialog "NEXT POINT" and measure the next point.

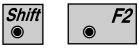
F2 Delete previous inputs. Proceed with the dialog "FIRST POINT" to enter a new reference point. This function is available for "RADIAL MODE" only.

F3 Record the following results in the active file:

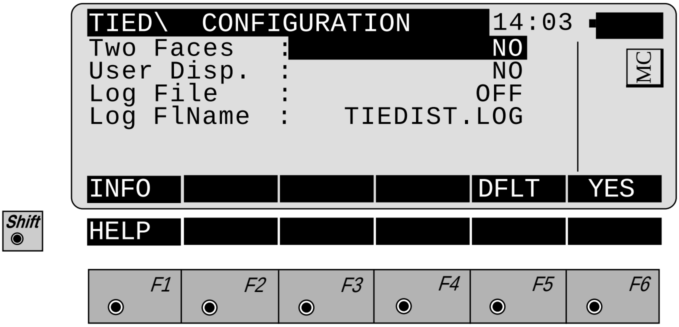
WI 11	Point number of point 2 or radial point number
WI 25	Azimuth from point1 to point 2
WI 35	Horizontal distance
WI 37	Height difference between point 1 and point 2
WI 39	Slope distance
WI 79	Point number of point 1 or center point number

F5 Toggle between Radial/Polygon Mode.

Configuration Editor



Start the "Configuration Editor" from the "FIRST POINT" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces : Set **YES** for dual-face measurement, **NO** for single-face.

User Disp. : **YES** to use the measurement display set in the application "Measure & Record".
Set **NO** to use the "Tie Distance" default display.

Log File : Set to **ON**, the program will record measurement data in the Log File according to the format described on *page 57*.

Log FlName : Enter the Log File Name.

F1 Displays date and version of the running application.

F5 Set the values to default. Default values are displayed *in dialog on page 55*.

Shift F4 Exit the program.

CONT Store the current configuration and proceed to the dialog "MEASURE MODE".

TD

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)**) and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

☞ Data will always be appended to the specified Log-file.

The Log-file contains the following information:

TD

Header The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record For each measurement, a record will be stored containing :
Point No 1, Point No. 2, Hori. Dist., Azimuth, ΔHeight, Slope Dist.

TD

Leica VIP Tie Distance V 2.10		
Instrument	:	TCM1100, Serial 412160, (not named)
User Templ.	:	User 1
Meas. File	:	FILE12.GSI
Program Start	:	09/04/1996 at 01:13
Station no.	:	1151
		E= 0.0000m N= 0.0000m ELV= 400.0000m hi= 0.0000m
Point No.1	:	1020
		E= -31.2368m N= -0.2083m ELV= 400.0626m
Point No.2	:	1030
		E= -30.5679m N= -17.8404m ELV= 403.1198m
Point no.1	:	1020
Point no.2	:	1030
Hori.Dist.	:	17.6448m
Azimuth	:	197°58'40"
ΔHeight	:	3.0572m
Slope dist.	:	17.9077m
Point No.2	:	1040
		E= -57.7040m N= -0.4265m H= 400.1028m
Point No. 1	:	1030
Point No.2	:	1040
Hori.Dist.	:	32.2430m
Azimuth	:	336°32'14"
ΔHeight	:	-3.0170m
Slope dist.	:	32.3839m

Typical log file entry in the "Tie Distance" program
(Polygonal Mode)

Stakeout

Introduction

This manual describes the "**STAKEOUT"** program of the TPS SYSTEM 1000 theodolite series. The program allows points with known coordinates to be placed in the field.

"**STAKEOUT"** requires the instrument to be set up on a known point with the instrument oriented. The station point can be determined also with the programs "**FREE STATION**" and "**RESECTION**".
The stakeout points can either be retrieved from the selected file or entered manually.
The program permits selection of either 2D or 3D stakeout modes.

SO

Search Point

The "SEARCH POINT" dialog informs about the active recording device, the active file for data storage and the present point/code.

```
STAKE\  SEARCH POINT     14:03
Define stakeout point                MC
Rec. device :    Memory Card
Search in   :     FILE01.GSI  ▼

Pkt/Code    :              4

INPUT |      |      |      | SEARC | αNUM
```

Shift

```
HELP  | CONF |      |      |       |
```

F1	F2	F3	F4	F5	F6

F1 — Manually enter the stakeout point. The TPS 1000 manual input dialog will appear.

F5 or CONT — Initiate a search of the point in the database.

Shift F2 — Allows program configuration.

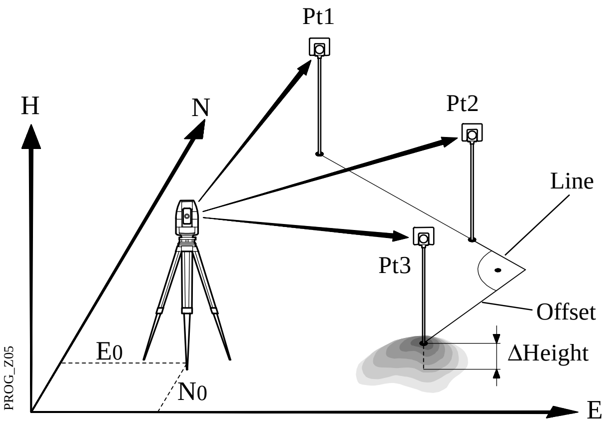
Coarse Positioning

Once the coordinates of the stakeout point have been acquired, the program proceeds to "Coarse Positioning". This option is available to direct the prism from the previous point placed to the next.
The "Coarse Positioning" calculates various displacements, depending on the method selected. Displacements are computed between the last point placed and the actual stakeout point selected. For more information refer to *chapter "Stakeout"*.

Line Offset

SO

The stakeout values of each point are computed in relation to the base formed by the last two points.
If the elevation is known for the point to be staked out, the height difference in relation to the last base point (Pt2), is displayed. In particular, this method is advantageous for long objects (traffic routes). **Values for positioning are only displayed after two stakeout points.**



Pt3 ... point to be staked

```
STAKE\  LINE OFFSET      14:03
Target no.     :        CURB
Azimuth        :    90°10'02"
Hz             :    98°34'45"
Line           :        4.105  m
Offset         :        1.250  m
ΔHeight        :        0.340  m
                         STAKE
```

Shift

F1	F2	F3	F4	F5	F6
HELP	METHD		PLOT		

Target no : Number of the point to be staked.

Azimuth : Azimuth from the station to the point to be staked.

Hz : Present theodolite direction. Note, if the instrument is oriented and the azimuth and Hz angle are corresponding, the instrument is pointing to the point to be staked.

Line : Distance along the line defined by the last two points staked

Offset : Orthogonal offset from the defined line

ΔHeight : Height difference from the last point staked.

CONT or F5 — Proceed to "STAKEOUT". Motorized theodolites can drive the telescope to the horizontal and vertical direction of the point to be placed.

Shift F2 — Change stakeout method. For more information refer to *chapter "Select Stakeout Method"*.

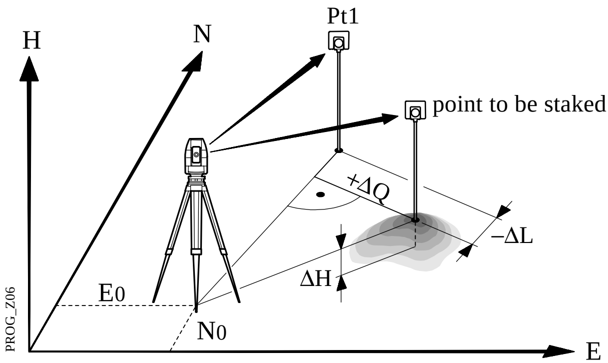
Shift F4 — Generate a plot of the stakeout data. For more information to *chapter "Plot"*.

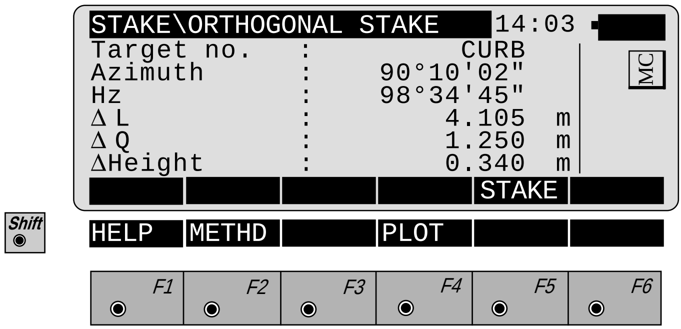
Shift ESC — Exit the program.

SO

Orthogonal

Setting out values are computed as orthogonal coordinates to the baseline between instrument station and prism. If the elevation is also known, ΔH is given in relation to the last prism - point measured.
Note, data will be displayed if there is at least one point measured.





Target no. : Number of the point to be staked.

Azimuth : Azimuth from the station to the point to be staked.

Hz Angle : Present theodolite direction. Note, if the instrument is oriented and the azimuth and Hz angle are corresponding, the instrument is pointing to the point to be staked.

ΔL and **ΔQ** in relation to the baseline: last stakeout point - instrument station.

Δ L : In-line distance **ΔL** is positive for points further than the last prism position measured.

Δ Q : Distance perpendicular to the baseline. **ΔQ** is positive for points on the right of the baseline.

ΔHeight : Height difference from the last point measured.

SO

CONT or F5 — Proceed to "STAKEOUT". Motorized theodolites can drive the telescope to the horizontal and vertical direction of the point to be placed.

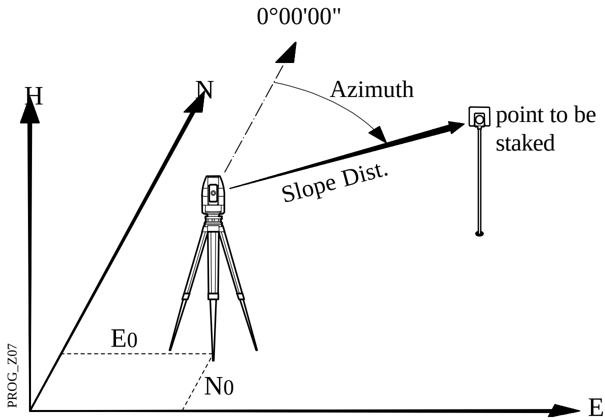
Shift F2 — Change stakeout method.
For more information refer to *chapter "Select Stakeout Method"*.

Shift F4 — Generate a plot of the stakeout data.
For more information to *chapter "Plot"*.

Shift ESC — Exit the program.

Azimuth and Distance

This method defines the point to be staked in terms of the azimuth and distance from the theodolite station to the point.




```
STAKE\AZIMUTH & DISTANCE 14:03
Target no.    :       CURB
Azimuth       :    90°10'02"
Hz            :    98°34'45"
Slope Dist.   :        4.105  m
Horiz.Dist.   :        4.021  m
ΔHeight       :        0.340  m
                              STAKE
Shift: HELP  METHD        PLOT
F1  F2  F3  F4  F5  F6
```

MC

Target No. : Number of the point to be staked.

Azimuth : Azimuth from the station to the point to be staked.

Hz : Present theodolite direction.
Note, if the instrument is oriented and the azimuth and Hz angle are corresponding, the instrument is pointing to the point to be staked.

SO

Slope Dist : Slope distance from the instrument station to the stakeout point.

Horiz. Dist : Horizontal distance from the instrument station to the stakeout point.

Δ Height : Height difference from the instrument station to the stakeout point.

CONT or F5 — Proceed to "STAKEOUT". Motorized theodolites can drive the telescope to the horizontal and vertical direction of the point to be placed.

SO

Shift F2 — Change stakeout method.
For more information refer to *chapter "Select Stakeout Method"*.

Shift F4 — Generate a plot of the stakeout data. For more information to *chapter "Plot"*.

Shift ESC — Exit the program.

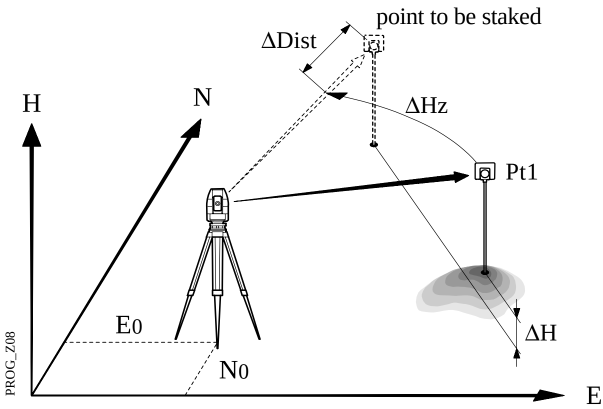
Stakeout

Points must have known coordinates. Various methods can be used, depending on the Stakeout Method set. Motorized instruments can drive the telescope to the horizontal and vertical direction of the point to be staked. For more information refer to *chapter "Select Stakeout Method"*.

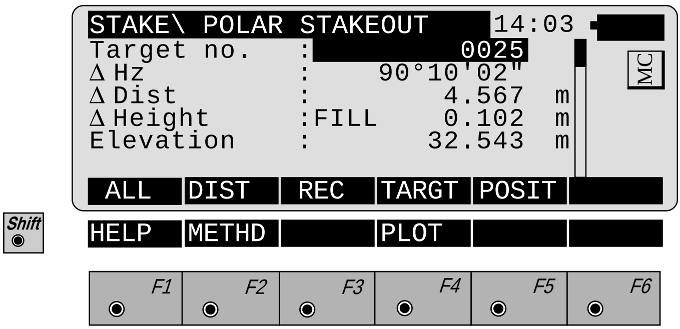
Polar Stakeout

After the first distance has been measured, the differences between calculated and measured direction and between calculated and measured horizontal distance are displayed. If the elevation of the point to be staked is available, the height difference between the last measured reflector and the point to be staked is shown together with the measured elevation of the reflector point.

SO



Values for ΔHz and ΔD will be updated each time a new distance is measured.



Target no. : Point number of the point to be staked.

Δ Hz : Difference in Hz circle reading between the actual horizontal direction and the calculated direction.

Δ Dist : Difference in horizontal distance between the measured and calculated distance.

Δ Height : Difference in height between the measured reflector point and the stakeout point, expressed both numerically and as CUT/FILL.

Elevation : Elevation of the measured target point.

SO

F1 — Simultaneously measure and record data on the active recording device.

F2 — Measure a distance.

F3 — Record the measurement on the active recording device.

F4 — Enter target data as described in *chapter "Measure & Record" of "System" - user manual.*

F5 — Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

Shift F2 — Change stakeout method. For more information refer to *chapter "Select Stakeout Method".*

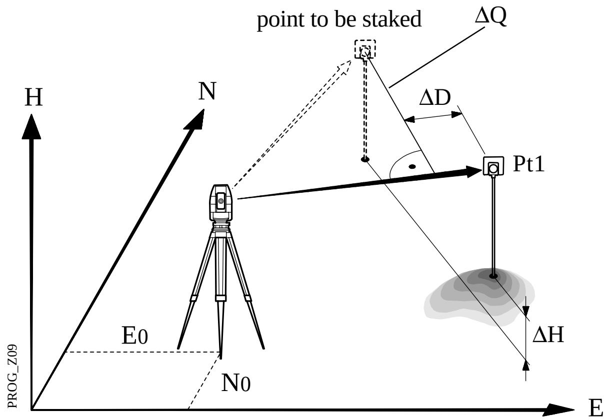
Shift F4 — Generate a plot of the stakeout data. For more information refer to *chapter "Plot".*

Shift ESC — Exit the program.

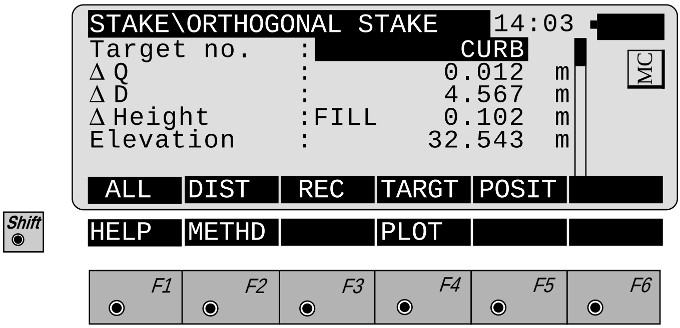
CONT — Acquire the next point to stake.

Orthogonal Stakeout

Orthogonal offsets are computed using the baseline between the last measured point and the instrument station.
After the first distance measurement, the transverse and longitudinal differences are displayed. If the elevation of the stakeout point is available, the height difference between the measured reflector and the point to be staked is shown, and also the measured elevation of the reflector point.



Values for ΔQ and ΔD will be updated each time a new distance is measured.



Target no. : Point number of the point to be staked.

Δ Q : Transversal displacement of the reflector. Positive in sign if point is right.

Δ D : Longitudinal displacement of the reflector. Positive in sign if stakeout point is further away from station.

Δ Height : Difference in height between measured reflector point and the stakeout point. Positive in sign if stakeout point is higher than the reflector position.

Elevation : Elevation of the measured reflector point.

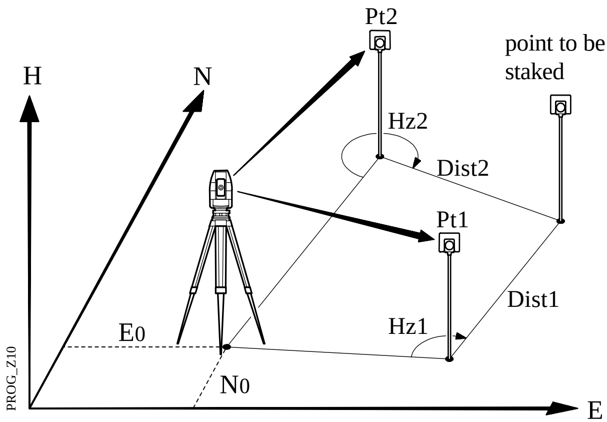
SO

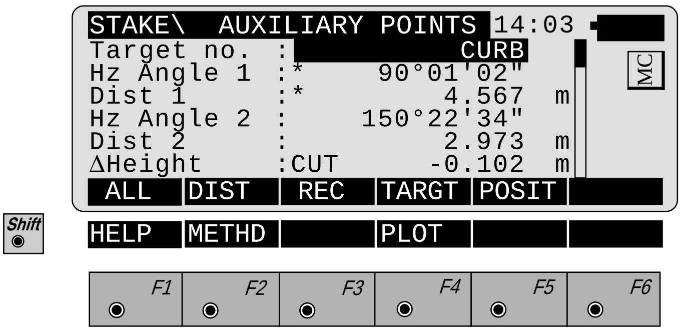
F1	Simultaneously measure and record data on the active recording device.
F2	Measure a distance.
F3	Record the measurement on the active recording device.
F4	Enter target data as described in *chapter "Measure & Record" of "System" - user manual.*
F5	Re-position the telescope on the target. Note, this function is only available for motorized theodolites.
Shift F2	Change stakeout method. For more information refer to *chapter "Select Stakeout Method".*
Shift F4	Generate a plot of the stakeout data. For more information refer to *chapter "Plot".*
Shift ESC	Exit the program.
CONT	Acquire the next point to stake.

Stakeout with auxiliary points

The stakeout method computes values for points which cannot be sighted directly.
Measure to the auxiliary point Pt1. The distance "Dist 1" and angle "Hz angle 1" to the stakeout point are computed. Likewise proceed for auxiliary point Pt2.
The stakeout point can be set out using the 2 calculated distances and/or angles from auxiliary points Pt1 and Pt2.
The program automatically updates both distance and angle values whenever a new point is measured. The previous point Pt2 becomes Pt1 and the new point Pt becomes Pt2.

Note, the auxiliary point to be measured will be marked with an asterisk (*).





Target no : Point number of the point to be staked.

Hz Angle 1 : Angle from the first auxiliary point to the stakeout point.

Dist 1 : Distance from the first auxiliary point to the stakeout point.

Hz Angle 2 : Angle from the second auxiliary point to the stakeout point.

Dist 2 : Distance from the second auxiliary point to the stakeout point.

Δ Height : Difference in height between the last measured reflector point and the stakeout point. Positive in sign if stakeout point is higher than the reflector position.

SO

F1 Simultaneously measure and record data on the active recording device.

F2 Measure a distance.

F3 Record the measurement on the active recording device.

F4 Enter target data as described in *chapter "Measure & Record" of "System" - user manual.*

F5 Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

Shift F2 Change stakeout method. For more information refer to *chapter "Select Stakeout Method".*

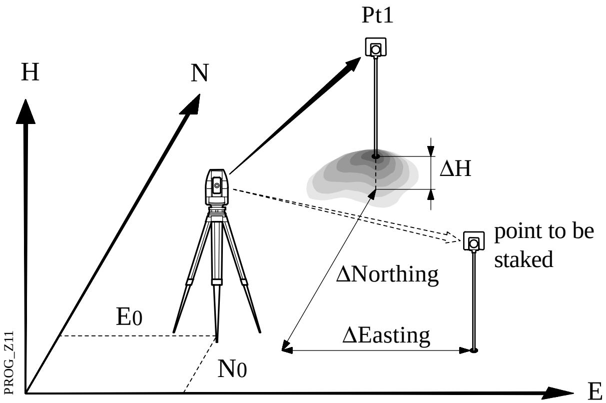
Shift F4 Generate a plot of the stakeout data. For more information refer to *chapter "Plot".*

Shift ESC Exit the program.

CONT Acquire the next point to stake.

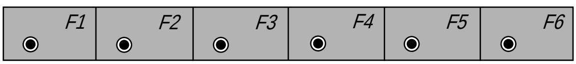
Stakeout from Coordinate Differences

After the first distance measurement, the displacements along the grid coordinate axes are displayed. If the elevation of the point to be staked is available, the height difference between the measured reflector and the stakeout point is shown as well as the measured elevation of the reflector point.



Values for ΔE and ΔN will be updated each time a new distance is measured.

```
STAKE\ GRID COORDINATES  14:03
Target no.  :          Ta0025      MC
Δ Easting   :           0.101  m
Δ Northing  :           0.567  m
Δ Height    : CUT      -0.102  m
Elevation   :          32.543  m

 ALL  | DIST  | REC  | TARGT | POSIT |
Shift
HELP  | METHD |      | PLOT  |       |
```



Target no. : Point number of the point to be staked.

Δ Easting : Displacement of the reflector along the East-coordinate axis.

Δ Northing : Displacement of the reflector along the North-coordinate axis.

SO

Δ Height	:	Difference in height between the measured reflector point and the stakeout point. Positive in sign if stakeout point is higher than the reflector position.
Elevation	:	Elevation of the measured reflector point.

SO

F1 Simultaneously measure and record data on the active recording device.

F2 Measure a distance.

F3 Record the measurement on the active recording device.

F4 Enter target data as described in *chapter "Measure & Record" of "System" - user manual.*

F5 Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

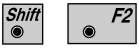
Shift F2 Change stakeout method. For more information refer to *chapter "Select Stakeout Method".*

Shift F4 Generate a plot of the stakeout data. For more information refer to *chapter "Plot".*

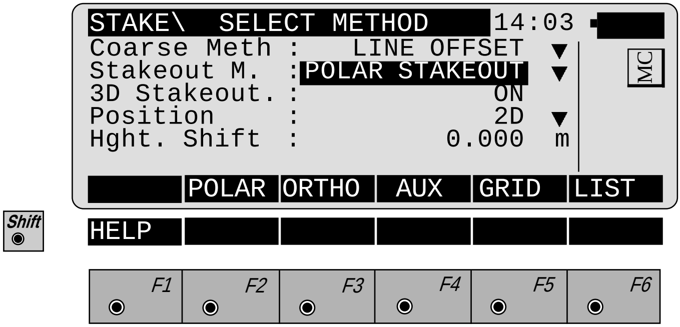
Shift ESC Exit the program.

CONT Acquire the next point to stake.

Select Stakeout Method



Select the stakeout method in any stakeout dialog.



SO

Coarse Meth :

Select the method for "COARSE POSITIONING":

NONE	no static method used
LINE OFFSET	*see chapter* "Line Offset"
ORTHOGONAL	*see chapter "Orthogonal"*
AZIMUTH & DISTAN	*see chapter "Azimuth and Distance"*

Choosing **NONE**, the program will automatically proceed to the selected "STAKEOUT METHOD" and bypass the "COARSE POSITIONING" method after you selected a new stakeout point.

Stakeout M. :

Select the method for "STAKEOUT":

POLAR STAKEOUT	*see chapter "Polar Stakeout"*
ORTHOGONAL STAKE	*see chapter "Orthogonal Stakeout"*
AUXILIARY POINTS	*see chapter "Stakeout with auxiliary points"*
GRID COORDINATES	*see chapter "Stakeout from Coordinate Differences"*

3D Stakeout : **ON** for 3D stakeout,
OFF for 2D stakeout.

Position : Select positioning method. (Motorized instruments only):

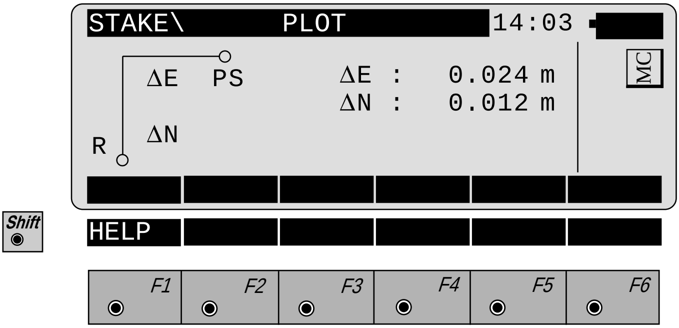
- **Off** Automatic positioning off
- **2D** Positioning of the horizontal drive
- **3D** Positioning vertical and horizontal drive

Hght. Shift : All heights are changed by this amount. The value can be changed only when you are in this dialog.

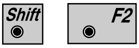
Plot

A plot is generated of the stakeout situation with a list of the numeric values, corresponding to the "STAKEOUT METHOD".

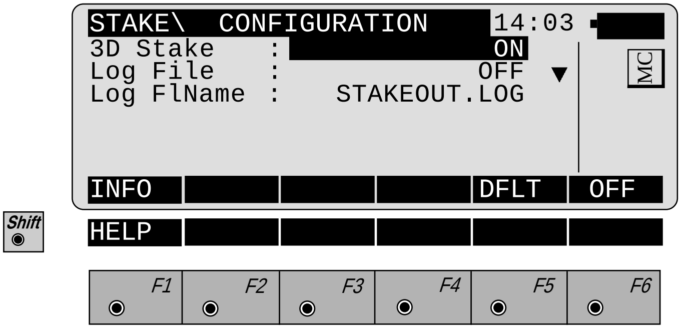
Note, below a typical plot is shown using the coordinate "STAKEOUT METHOD".



Configuration



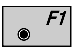
Start the "Configuration Editor" from the "**SEARCH POINT**" dialog.



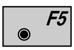
The "Configuration Editor" sets parameters for further program operations:

3D Stake : **ON** for 3-dimensional stakeout. Note the program will not perform 3D stakeout if no elevation is available for the point to be staked.
OFF for 2-dimensional stakeout. Note that there will be no difference in height displayed.

Log File : **OFF** no recording in a Log file
SHORT reduce recording in a Log file
LONG detailed recording in a Log file



Display software-version



Set the value to default. (3D stake = **ON**) .

SO

Shift **ESC** Exit the program.

CONT Store the current configuration and proceed to the dialog "SEARCH POINT".

Log File

If "Log File" is set to "ON" the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header	The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.
Record	**SHORT** recording of design coordinates, setout height and height difference in the log file.
	LONG recording of design coordinates, setout coordinates und differences of coordinates in the log file.

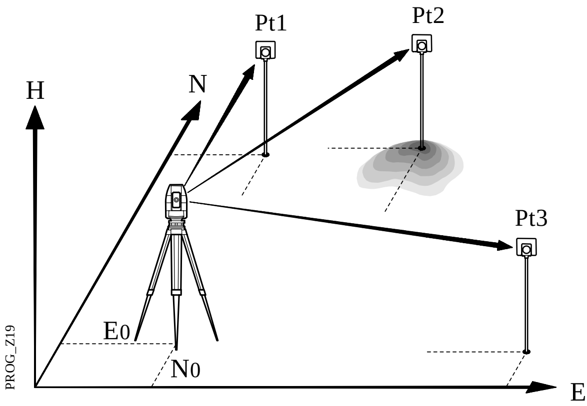
Leica VIP Stakeout V 2.10		
Instrument	:	TCM1100, Serial 412160, (not named)
User templ.	:	User 1
Meas. file	:	FILE12.GSI
Program Start	:	09/04/1996 at 01:18
Station no.	:	3000
		E= 21.016m N= 64.666m ELV= 420.467m hi= 1.700m
Point no.	:	1152, Hght. Shift = 0.000m
Design	:	E= 21.602m N= 62.184m ELV= 420.115m
Staked	:	E= 21.606m N= 62.166m ELV= 420.355m hr= 1.500m
Deltas	:	dO= -0.004m dN= 0.018m dELV= -0.240m

Typical log file entry in the "STAKEOUT" program

Free Station

Introduction

This manual describes the "FREE STATION" program of the TPS SYSTEM 1000 theodolite series.



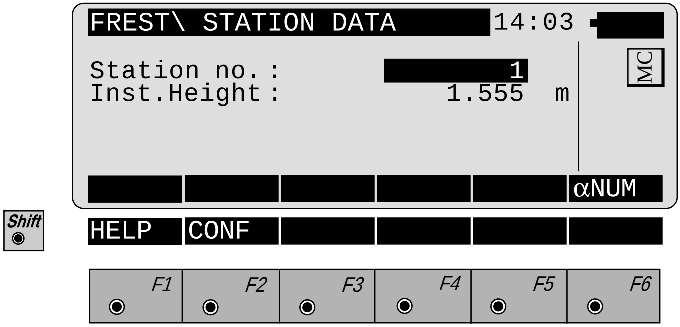
FS

This program can be used to deduce the three-dimensional coordinates for the instrument station and the horizontal orientation of the from measurements to a maximum of 10 target points.
For simultaneous determination of the station elevation, height of instrument and height of reflector must already have been input and the elevation of the target points must be known.

The program allows measurement in single or dual-face mode.
Directions to target points can be determined, as can any combination of direction and distance. To compute the position coordinates, at least three elements (2 directions and 1 distance) are necessary.

Station Data

Enter station point number and height of the instrument.



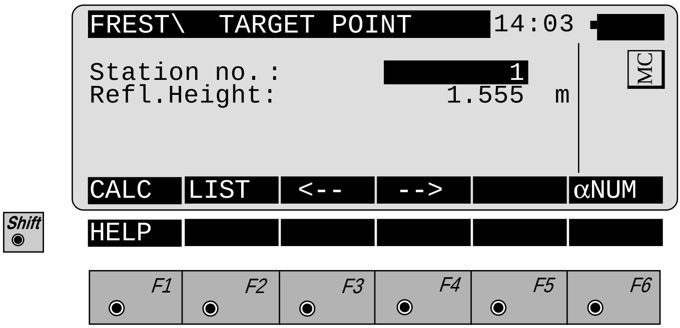
CONT — Proceed to define the target points.

Shift F4 — Start the "CONFIGURATION"

F6 — Alpha-numerical/numerical input.

Target Point

Enter the target point number and height of the reflector.



F1 — Run the calculation. Note, the F1 key will be assigned after sufficient measurements were taken to calculate a position.

F2 — Entry of target points into a list as well as selecting points for further use.

F3 — Displays the previous point from the list of points you entered. Note that this key will not be available until there is at least one point in the list.

F4 — Displays the next point in the list of points you entered. Note that this key will not be available until there is at least one point in the list.

CONT — Retrieve the coordinates of the target point from the active file. For further information, please *refer to dialog "IMPORT" described in the "SYSTEM" - user manual*.

F6 — Alpha-numerical/numerical input.

Point List

Enter a maximum of 10 points. The same point can be retrieved several times.
The same point number can be used several times without new input.

```
FREST\  POINT LIST        14:03
Point 1               TAR01     MC
Point 2               TAR02
Point 3               TAR03
Point 4               TAR04
Point 5               TAR05
Point 6               TAR06

Point 7               TAR07
Point 8               TAR08
Point 9               TAR09
Point10               TAR10
```

Shift

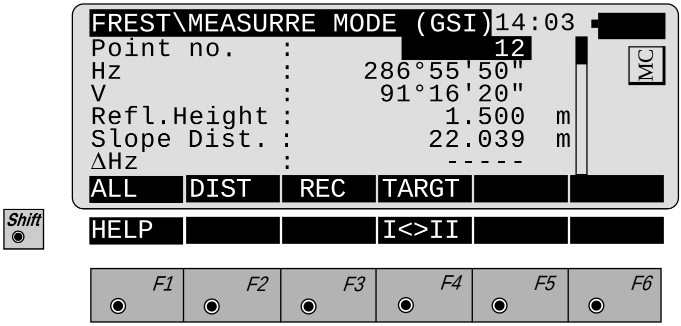
```
HELP
F1  F2  F3  F4  F5  F6
```

CONT — Return to the dialog "Target Point".

Measure Mode

This dialog is similar to the TPS System 1000's basic "MEASURE MODE" dialog. Once a measurement is taken, the program will return to the dialog "DEFINE POINT" to acquire the next point for measuring.
If the station coordinates can be calculated successfully from the first few measurements, the Δ Hz and ΔV values are displayed for further entered target points.
Motorized theodolites will automatically drive the telescope to the target point.

FS



F1 Simultaneously measure and record data on the active recording device. Return to the dialog "TARGET POINT".

F2 Measure a distance.

F3 Record the measurement on the active recording device. Return to the dialog "TARGET POINT".

F4 Enter target data. For further information, please refer to *chapter "Measure & Record" described in the "System" - user manual*.

Shift F4 Change the theodolite face.

CODE Call up the CODE function, as described in *chapter "Measure & Record" described in the "System" - user manual*.

Shift ESC Exit the program.

CONT Accept the measurement and return to the dialog "TARGET POINT".

Calculation

Calculates the 3D station coordinates and orientation as well as the standard deviation of the results.

```
FREST\ RESULTS <L.SQRS>  14:03
Station no. :           1
No. of Pts  :           6
Inst.Height :       1.635  m
Easting     :    2134.234  m
Northing    :    4231.365  m
Elevation   :     580.643  m
 SET  |     |STORE|PLOT |MORE |
Orientation :    2°12'34"
σEasting    :       0.003  m
σNorthing   :       0.005  m
σElevation  :       0.005  m
σOrient     :    0°00'03"
Calc Scale  :         YES
Scale       :    0.999956
```

Shift

```
HELP |ROBST|     |     |     |
 F1  | F2  | F3  | F4  | F5  | F6
```

FS

Station no : Point number assigned to the station

No. of Pts : Number of points measured

Inst.Height : Instrument Height

Easting : Calculated Easting for the station

Northing : Calculated Northing for the station

Elevation : Calculated Elevation for the station

Orientation : Oriented direction

σ Easting : Standard deviation of Easting

σ Northing : Standard deviation of Northing

σ Elevation : Standard deviation of the Elevation

σ Orient : Standard deviation of the Orientation

Calc Scale : **YES** scale factor is calculated, **NO** scale factor is not calculated

Scale : The scale factor of the free station calculation. **Note that the scale is not shown if set to NO.**

F1 — Set orientation and station coordinates on the instrument. **Note that this key will end the program.**

F3 — Record the following results on the active recording device:

FS

WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last reflector height used
WI 88	Instrument Height

F4 — Sketch of the station and the reference points used.

F5 — Show the results of individual measurements on the screen *(see dialog "More Information").*

ESC — Measure more points. The program will recall the "TARGET POINT" dialog.

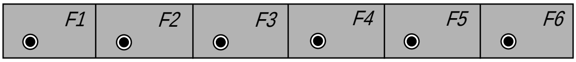
Shift F2 — Select between the "Robust" method and the "Variation" method

Shift ESC — Exit the program.

More Information

Display the residuals of individual measurements. You can also disable points from the calculation of position or height as well as delete erroneous measured points.

```
FREST\MEHR INFORMATIONEN 14:03
                           9/10
Use for Ht   :YES Status:  ON
Point no.    :             12
Error Flag   :           NONE
Δ Hz         :       0°00'03"
Δ Distance   :        0.050 m
RECLC  <--   -->   MEAS  DEL  NO
Δ Height     :        0.020 m
Refl.Height  :        1.555 m
Easting      :      991.427 m
Northing     :     1995.162 m
Elevation    :      402.466 m

HELP
```



FS

9/10 : Sequence number of the current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Use for Ht. : Use this measurement for height determination (YES/NO)

Status : Use this measurement for calculation (ON/OFF).

Point no : The target point number.

Error Flag : Identified erroneous measurements. Possible values are:

NONE	measurement is OK
HZ	horizontal angle error
DIST	distance error
HT	height difference error

The flags may also be combined, i.e. DIST + HZ

Δ Hz. : Difference between calculated and measured Hz. angle

Δ Distance : Difference between calculated and measured distance

Δ Height : Difference between calculated and measured height

Refl. Ht. : Reflector height used for that target point

Easting, Northing, Elevation : Target coordinates used.

FS

F1 Recalculate the result.

F2 Scroll to the measurements of the previous point.

F3 Scroll to the measurements of the following point.

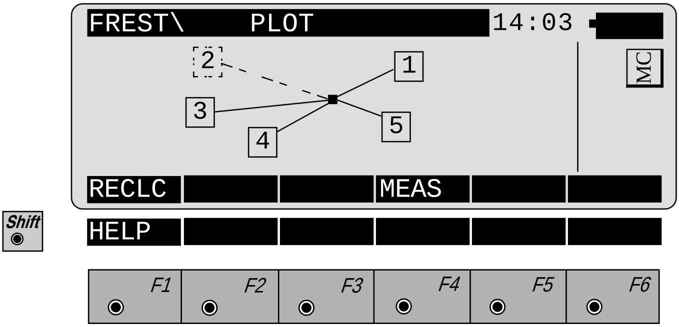
F4 Measure more point. Return to dialog "TARGET POINT".

F5 Delete a point from the set of measurements . You can now measure a new point in its place.

Shift ESC Exit the program.

Plot

Generates a plot showing the measurement configuration. The station point is in the center and the top of the sketch shows the direction of Grid north. The sketch is true in angular but not true in distances. Points are numbered sequentially in the order in which they were measured. Points not used in the calculation are marked with a dotted line.



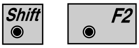
FS

Recalculate the solution and return to the dialog "CALCULATION RESULTS" *(see page 83).*

Measure more points. The program will recall the "TARGET POINT" dialog. *(see page 80).*

Toggle any point ON or OFF by pressing the numeric key corresponding to the sequence number of the point. Note, that 0 represents point 10.

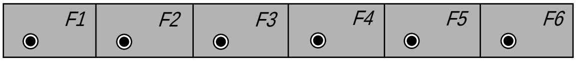
Configuration Editor



Start the "Configuration Editor" from the "**STATION DATA**" dialog.

```
FREST\  CONFIGURATION  14:03
Hz Ori Acc  :      0°00'32"
Ht Acc TP   :        0.0250  m
Posn Acc TP :        0.0250  m
Two Faces   :            NO
User Displ. :            NO
Log File    :           OFF
INFO                  DFLT  EDIT
Log FlName  :   FREE_STA.LOG
```


```
HELP            I<>II
```



The "Configuration Editor" sets parameters for further program operations:

Hz Ori Acc : Limit for the standard deviation of the orientation. The orientation is regarded as "error free", if the computed standard deviation of the orientation is within twice the entered value.

Ht Acc TP : Height accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The height is regarded as "error free", if the computed standard deviation is within twice the entered value.

FS

Posn Acc TP : Position accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The position is regarded as "error free", if the computed standard deviation is within twice the entered value.

Two Faces : **YES** for dual-face measurement, **NO** for single-face.

User Disp : **YES**; the measured value indication is used from application "Measure and record".
NO; the default indication is used for the "Free Station".

Log File : ON, records measurements in a Log-File.The format is described on *page 90*.

Log FlName : Enter the Log File Name

FS

F1 Display software-version

F5 Set the values to default. Default values are shown in the *previous dialog*.

Shift ESC Exit the program.

CONT Store the current configuration and proceed to the dialog "STATION DATA".

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

FS

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header

The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record

For each measurement, a record will be stored containing :
- Station coordinates and
- orientation correction,
- standard deviations for
  Easting,
  Northing,
  Height of station
  and orientation correction.

The residuals for

- horizontal angles,
- heights and
- measured distances

are also listed.

```
Leica VIP Free Station V 2.10
Instrument        :  TCM1800, Serial 410000, (not named)
User templ.       :  User 1
Meas. file        :  FILE01.GSI
Program Start     :  02/05/1996 at 11:23

Using Least-Squares Solution

Station no.       :  200
                     E= -3.5461m   N= -0.7683m   ELV= -0.6518m    hi= 0.0000m

Ori.Corr.         :  0°00'20"
S.Dev. East       :  0.0003m
S.Dev. North      :  0.0003m
S.Dev. Elev.      :  0.0015m
S.Dev. Orient.    :  0"00'02"

4 point(s) measured :

## Point no.          d Hz      d Height    d Distance    Error Flag
1  109            0°01'21"     0.0012m      -0.0000m    NONE
2  110           -0°00'00"    -0.0045m      -0.0002m    NONE
3  112           -0°00'25"     0.0018m       0.0010m    NONE
4  113            0°00'48"     0.0014m      -0.0002m    NONE
```

Continued next page

FS

Using Robust Solution

Station no.	:	200
		E= -3.5461m N= -0.7683m ELV= -0.6518m hi= 0.0000m
Ori.Corr.	:	0°00'20"
S.Dev. East	:	0.0003m
S.Dev. North	:	0.0003m
S.Dev. Elev.	:	0.0015m
S.Dev. Orient.	:	0°00'02"

4 point(s) measured :

##	Point no.	d Hz	d Height	d Distance	Error Flag
1	109	0°01'21"	0.0012m	-0.0000m	NONE
2	110	-0°00'00"	-0.0045m	-0.0002m	NONE
3	112	-0°00'25"	0.0018m	0.0010m	NONE
4	113	0°00'48"	0.0014m	-0.0002m	NONE

FS

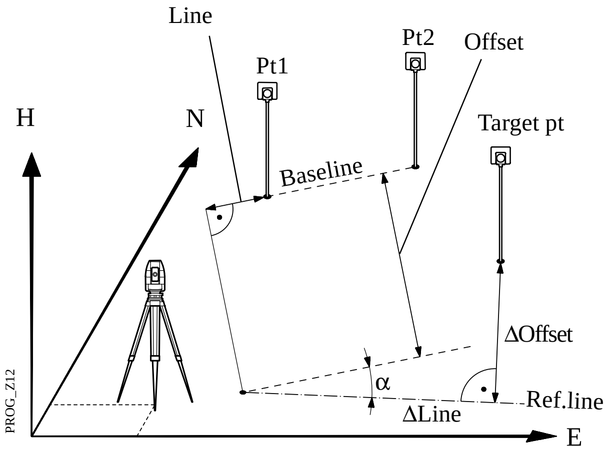
Typical log file entry in the "FREE STATION" program

Reference Line

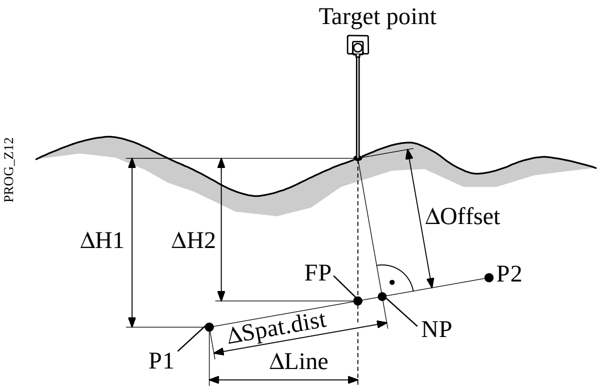
Introduction

This manual describes the "REFERENCE LINE" program of the TPS SYSTEM 1000 theodolite series. The distance and the angle between two points is calculated by the program.

"REFERENCE LINE" is a specialized form of stakeout used for construction and building alignment. It permits positioning of a point referred to a line. Points for use in the program can be measured, entered manually, or read from the database.
The program records individual measurements in the database. In addition, the program generates a log file containing all data for a given measurement session.



The program also allows to determine various values of height determination as shown in the figure below.



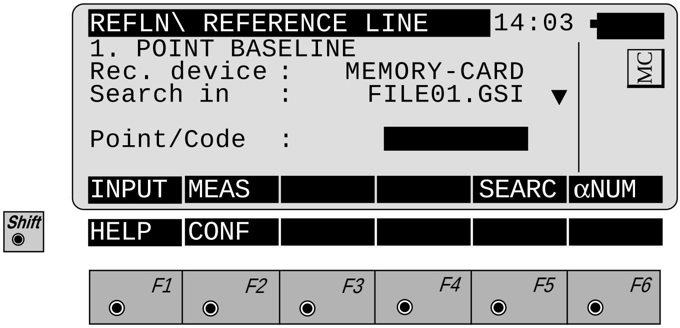
RL

FP	Point of intersection of vertical with line P1-P2
NP	Point of intersection with line P1- P2 of perpendicular to P1- P2
ΔH1	Height difference to start of line P1
ΔH2	Height differencein relation to the interpolated height FP of reference line P1-P2.
ΔLine	Horizontal distance from P1 to FP (abscissa)
ΔSpat.dist	Spatial distance from P1 to NP
ΔPerp.l	Length of perpendicular from Target point to Reference line

Baseline Points

Determine Base Points

This dialog defines the two points of the baseline. You can either manually enter, measure or search for the point in the database.



F1 Manually enter the first base point. The TPS 1000 manual input dialog will appear.

F2 Proceed to determine the base point by a measurement.

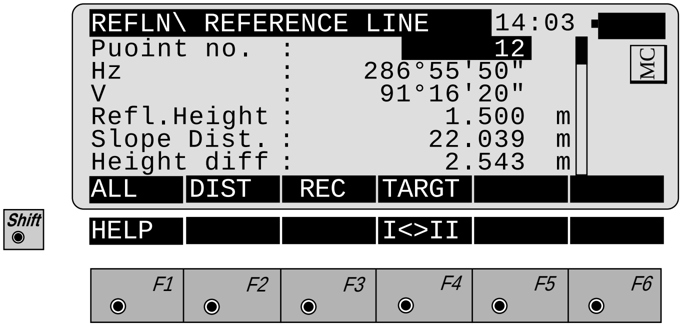
F5 or **CONT** Initiate a search of the point in the database.

Shift **F2** Start the "Configuration Editor".

Shift **ESC** Exit the program.

Measure a Base Point

This dialog is used in accordance with the settings of the system function "Measure & Record" or according to the dialog shown below.



RL

F1

Simultaneously measure and record in the active file. Proceed with the dialog "1 POINT BASELINE" *(page 95)*. If the second point has already been measured, the program will proceed to the "DEFINE REF LINE" dialog.

F2 F3

Measure a distance.
Record the measurement in the active file and proceed with the dialog "1 POINT BASELINE" *(page 95)*. If the second point has already been measured, the program will proceed to the "DEFINE REF LINE" dialog.

F2 CONT

Measure the distance. Accept the measurement without recording. If the second point has already been measured, the program will proceed with the "DEFINE REF LINE" dialog.

F4

Enter the target data. For further information refer to chapter *"Measure & Record" of "SYSTEM" - user manual.*

Shift F4 Change the theodolite face.

CODE Call up the CODE function, as described in chapter *"Measure & Record" of "SYSTEM" - user manual*.

Shift ESC Exit the program.

RL

Define Reference Line

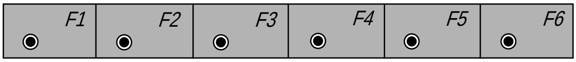
The reference line can be defined by entering a distance value, a line offset value and an angle value for the base line. Heights can be changed by a constant rate (eg, 1m) by entering a H offset value.

```
REFLN\ DEFINE REF LINE   14:03
1.BasePoint :               12
2.BasePoint :               13
Offset      :            1.000  m
Line        :            1.558  m
Alpha       :         2°03'39"
H Offset    :            0.500  m
       NEWL         MEAS
```

MC

Shift

HELP



RL

1.BasePoint : The first base point that defines the base line.

2.BasePoint : The second base point that defines the base line.

Offset : Establishes the displacement parallel to the base line.

Line : Establishes the distance from the first reference point to the starting point of the new reference line.

Alpha : Establishes the angle between the base line and the new reference line.

H Offset : Displaces the base line parallel in height.

F2 — Define a new base line.

F4 or CONT — Accept parameters as displayed and proceed to the "RESULT REF LINE" dialog.

Results Reference Line

The "RESULTS REF LINE" dialog displays the data of the measured point refering to the reference line, as shown in dialog below:

```
REFLN\RESLUTS REF LINE     14:03
Point no.       :             12
Δ Offset        :          0.020  m
Δ Line          :          1.468  m
Δ H             :         -0.558  m
ΔPerp.lngth     :          0.039  m
ΔSpat. dist     :          3.020  m
ALL  DIST  REC  TAGT
Elevation       :        103.020  m
```

Shift

```
HELP
```

F1 F2 F3 F4 F5 F6

RL

Point No. : The point number of the stakeout point.

Δ Offset : The delta value of line Offset in reference to the stakeout point. (ordinate)

Δ Line : The delta value of Line in reference to the stakeout point. (abscissa)

Δ H : Height difference between the stakeout point as measured and the height reference point.

ΔPerp.lngth. : Length of perpendicular

ΔSpat.dist. : Spatial distance

Elevation : Height of target point.

If "ΔOffset" is brought to "0" by turning the instrument, a distance measurement must always be carried out for control purpose.

F1 Simultaneously execute distance measurement and record the measurement.

F2 Measure a distance.

F3 Record the measurement in the database.
Depending on the setting in the "Configuration" dialog a measurement block containing delta values is recorded:

WI 11	Point Number of target
WI 35	ΔOffset
WI 37	ΔH
WI 39	ΔLine

or

WI 11	Point Number of target
WI 35	ΔOffset
WI 37	ΔPerpendicular
WI 39	ΔSpatial distance

Depending on the setting in the "Configuration" dialog a record is written in the log file.
When finished, the program will proceed the "DEFINE REF LINE" dialog.

RL

F4 Enter target data as described in the Measure & Record of the System Manual.

Shift ESC Exit the program.

CONT Proceed with dialog "DEFINE REF LINE".

CODE Call up the CODE function, as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

Configuration

Configuration Editor

Shift F2

Start the "Configuration Editor" from the "**1. POINT BASELINE**" dialog.

```
REFLN\ CONFIGURATION      14:03
Offset       :             ON
Line / α     :            OFF
H.Offset.    :            OFF
Rec Diff     :           NONE ▼
User Disp    :             NO
Height       :            Ref ▼
INFO                 DFLT  OFF
Log File     :            OFF
Log FlName   :    REFLINE.LOG
```

Shift

```
HELP
```

F1 F2 F3 F4 F5 F6

The "Configuration Editor" lets you change and set the following parameters that determine program operation:

Offset : Set to **ON**, the program will allow the input of an offset from the reference line.

Line / α : Set to **ON**, the program will allow the input of a distance from the first base point to the starting point of the new reference line, and also an angle between the base line and the new reference line .

H Offset : Set to **ON**, the program will allow the input of a height offset.

RL

Rec Diff	:	Set to **NONE**, no additional measurement is recorded. Set to **O** the program will record Δ Offset values only. Set to **O/ L**, the program will record both Δ Offset and Δ Line values. Set to **O/L/H**, the program will record Δ Offset, D Line and ΔHeight of target values. If the option "**Height**" is set to "**Inter**" you can in addition calculate the values: Set to **O/S** the program will record both Δ Offset and Δ Spatial distance values. Set to **O/S/P**, the program will record Δ Offset, Δ Spatial distance and ΔPerp.length of the perpendicular line. *(Refer to figure page 94)*
User Disp	:	Set to **YES**, the display defined in the MEAS application will be used. If set to **NO**, the "REFERENCE LINE" default display applies.
Height	:	Set to **Ref**, Δ Height (1) will be calculated from the first base point and the reflector. Set to **Inter**, the program will calculate Δ Height (2) from the interpolated height of the base line at Δ Line of the reflector position and the reflector position itself. If set to **Inter**, the **Line / a option** is set to **NO** automatically.
Log File	:	Set to **ON**, the program will record measurement data in a log file in the format described on *page 103*.
Log FlName	:	Enter the Log File Name.

F1 Displays date and version of the running application.

F5 Press to reset configuration parameters to their default values. Default settings are shown in the previous dialog.

CONT Store the current configuration and proceed with dialog "1. POINT BASELINE".

F6 Key to choose the different functions.

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

RL

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header	The header line will contain the program used, information about the instrument, the name of the data file as well as dateand time.
Configuration	each modification of baseline and reference line is stored.
Record	For each measurement, a record will be stored containing: Point No., as-staked Easting, Northing, and Elevation and their delta values.

Leica VIP Reference Line V 2.10		
Instrument	:	TCM1100, Serial 430000, Joe’s theodolite
User Templ.	:	User 1
Meas. File	:	FILE01.GSI
Program Start	:	02/23/1995 at 13:00
Station no.	:	Stationpointnumber
		E=1000.000m N=2000.000m H=400.000m hi=1.1150m
1.BasePoint	:	Baselinepointnumber
		E=1050.000m N=2050.000m H=410.000m
2.BasePoint	:	Baselinepointnumber
		E=1060.000m N=2060.000m H=420.000m
Offset.	:	1.0000m
Line	:	2.6700m
Alpha	:	72°45'66"
H Offset	:	1.0000m
Height	:	REF
Point no.	:	1025
		E=1055.000m N=2055.000m H=415.000m hr=1.1150m
Deltas	:	dP= 4.3403m
	:	dL= 3.0907m
	:	dH= -1.5027m

RL

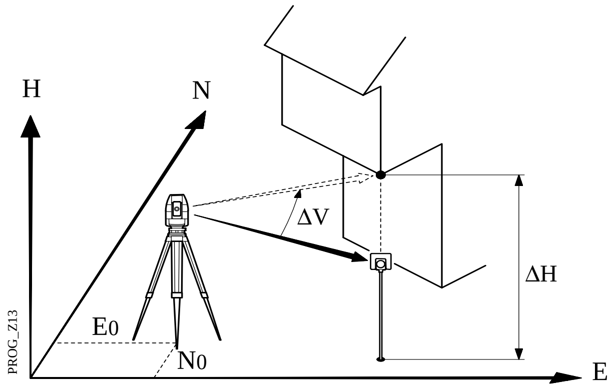
Typical log file entry in the "REFERENCE LINE" program

Remote Height

Introduction

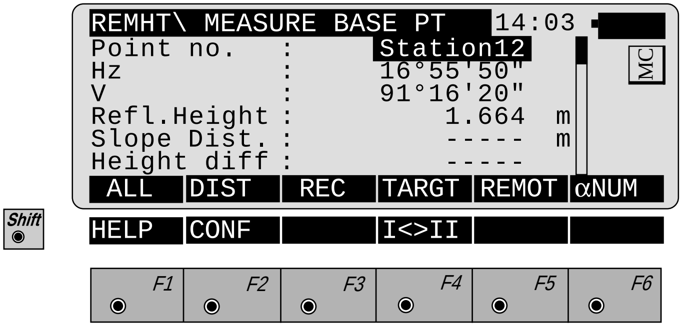
This manual describes the "Remote Height" program of the TPS System 1000 theodolite series. The distance and the angle between two points is calculated by the program.

The elevation of a remote height point is calculated from the zenith angle to the target and from the measured distance to a reflector situated vertically below or above that target.
To ensure correct results, the target and the reflector must be lined up vertically. In practice it is not generally possible to maintain an exactly-vertical line, and so you must decide what lateral deviation can be tolerated. The horizontal distance to the inaccessible target must however coincide with the horizontal distance to the reflector.
When the instrument is aligned and the station coordinates have been set, the position coordinates of the remote height can be calculated and stored in the data file.



Measure Base Point

This dialog is used in accordance with the settings of the system function "Measure & Record" or according to the dialog shown below.



Point No. : The point number of the base point.

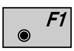
Hz : Horizontal direction from the remote point to the base point.

V : Vertical angle to the remote point.

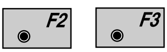
Refl.Height : Reflector height used for the target point.

Slope dist. : Slope distance from the instrument station to the base point.

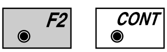
Height diff : Height difference between the base point ground and the instrument ground.



Simultaneously measure and record in the active file. Proceed with the "REMOTE POINT" dialog.



Measure a distance. Record the measurement in the active file and proceed with the "REMOTE POINT" dialog.



Measure the distance. Accept the measurement without recording. Proceed with the "REMOTE POINT" dialog.

RH

F4 Enter the target data. . For further information refer to chapter *"Measure & Record" of the "SYSTEM" - user manual.*

F5 Proceed with "REMOTE POINT" dialog.

Shift **F2** Start the "Configuration Editor".

Shift **F4** Change the theodolite face.

CODE Call up the CODE function, as described in chapter *"Measure & Record" of the "SYSTEM" - user manual.*

Shift **ESC** Exit the program.

F6 Alpha-numerical/numerical input.

Measure Remote Point

Once the base point has been measured, this dialog shows the position of the point - above or below the base point - aimed with the telescope. The data are immediately updated while turning the instrument.

```
REMHT\ MEASURRE REMOTE PT 14:03
Point no.       :    Station12
Hz              :    16°55'50"
V               :    91°16'20"
Slope Dist.     :       23.345  m
ΔHgt diff       :        6.435  m
Easting         :     3453.998  m
            STORE  TARGT  BASE
Northing        :      124.003  m
Elevation       :      768.005  m

Shift
HELP                  I<>II

F1     F2     F3     F4     F5     F6
```

RH

Point No. : The point number of the remote point.

Hz : Horizontal direction from the instrument to the remote point.

V : Vertical angle to the remote point.

Slope dist. : Slope distance from the instrument station to the remote point. (calculated)

Δ Hgt diff : Height difference between the remote point and the base point ground.

Easting : Calculated Easting (Y) for the remote point.

Northing : Calculated Northing (X) for the remote point.

Elevation : Calculated Elevation for the remote point.

F3 Record the measurement in the database.

F4 Enter the target data. . For further information refer to chapter *"Measure & Record" of the "SYSTEM" - user manual.*

F5 Return to the "MEASURE BASE POINT" dialog.

CODE Call up the CODE function, as described in chapter *"Measure & Record" of the "SYSTEM" - user manual.*

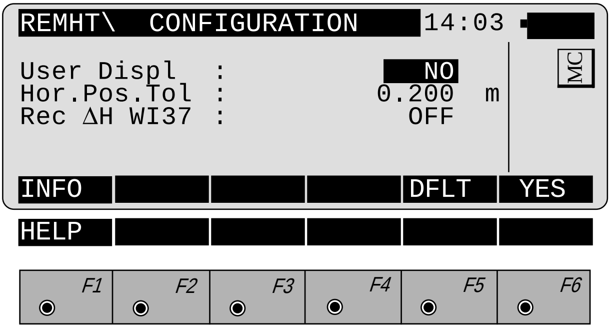
CONT Return to the "MEASURE BASE POINT" dialog.

Shift ESC Exit the program.

RH

Shift F2

Start the "Configuration Editor" from the "MEASURE REMOTE POINT" dialog.



Shift

The "Configuration Editor" sets parameters for further program operations:

RH

User Disp : Set to **YES**, the display defined in the "MEAS" application will be used. If set to **NO**, the "REMOTE HEIGHT" default display applies.

Hor.Pos.Tol : Horizontal distance tolerance that valid point measurements cannot exceed.

Rec ΔH WI37:Set to **ON**, the program will store Δ height difference as record WI37 in the database.

F1

Displays date and version of the running application.

F5

Reset configuration parameters to their default values. Default settings are shown in dialog above.

CONT

Accept the current configuration and proceed to the dialog "MEASURE BASE PT".

Hidden Point

Introduction

This manual describes the "HIDDEN POINT" program of the TPS SYSTEM 1000 instruments.

The program allows measurements to a point that is not directly visible using a special hidden-point rod. The data for the hidden point are calculated from measurements to the prisms mounted on the pole with a known spacing and a known length of pole. The pole still may be kept slope.
"Measurements" are calculated as if the hidden point was observed directly. These "calculated measurements" can also be recorded.

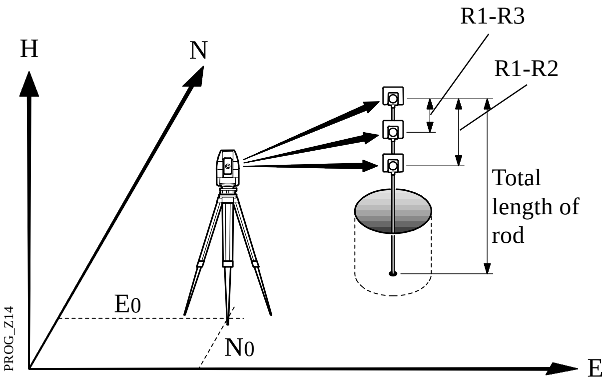
The hidden-point rod can have either **two** or **three** reflectors. The rod you are using is defined in the "CONFIGURATION" of the program. Here, you enter the length of the rod, spacing between reflectors, and the prism constant. Refer to Figure *on page 112*, which illustrates a hidden-point rod with three reflectors.

HP

If the hidden-point rod you are using has three reflectors, the program calculates coordinates for the hidden point from three combinations:

Reflector 1 + Reflector 2
Reflector 3 + Reflector 2
Reflector 1 + Reflector 3

In the case of motorized theodolites, you can configure the program in such a way, that it points the telescope at the third reflector automatically after the first two reflectors have been measured.



Configuration

Shift F2

Start the "Configuration Editor" from the "MEASURE" dialog.

```
HDNPT\  CONFIGURATION     14:03
User Displ    :            NO
Meas. Tol.    :         0.020  m     MC
Add. const.   :         0.000  m
No. of Refl   :             3  ▼
Auto Pos.     :            ON
Rod Length    :         5.000  m
INFO                      DFLT   YES
Space R1-R2   :         1.000  m
Space R1-R3   :         0.500  m
```

Shift

```
HELP
```

F1	F2	F3	F4	F5	F6

The "Configuration" let you set the following parameters that determine program operation and define the hidden-point rod you are using:

User Displl : **YES** use the display defined in "MEASURE & RECORD".
Set **NO** use the default display of the program "HIDDEN POINT".

Meas. Tol	:	Limit for the difference between the given and measured spacing of the reflectors. If the tolerance value is exceeded, the program will issue a warning. In case of measurements with 3 prism the values are also used as limit for the max. deviation of the 3 measurements.
Add. const.	:	Input of prism constant for the prisms of the pole. The prism constant set in the system is disregarded.
No. of Refl.	:	Number of the reflectors on the rod you are using. Move the input cursor to this line, then toggle to either 2 or 3.
Auto pos.	:	**On** the program will automatically point the telescope of a motorized theodolite at the third reflector once the first two reflectors have been measured. The exact pointing must be made manually.
Rod Length	:	Total length of hidden-point rod.
Space R1-R2	:	Spacing between the centers of reflector R1 and reflector R2.
Space R1-R3	:	Spacing between the centers of reflector R1 and reflector R3. Enter only for rods with three reflectors. Reflector 3 must be situated between reflector 1 and 2.

F1

Displays date and version of the running application.

F5

Set values to default. Default values are displayed *on page 112*.

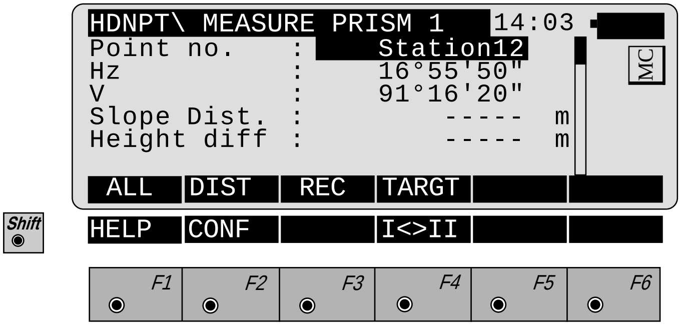
CONT

Accept the current configuration and proceed to "MEASURE ROD"

Note that all parameters for the rod you are using must be defined before you can proceed. If any of the parameters have not been defined, the program will issue an error message to this effect. Press OK to clear the message, then make any necessary settings in the "CONFIGURATION".

Measure Rod

The program will display the TPS 1000 "Measure & Record"dialog or the dialog shown below.
If the difference of the given and measured spacing between the reflectors exceeds the "Meas. Tol. limit" a message is displayed.
You may accept the measurement or re-measure the reflector.



F1

Simultaneously measure and record in the active file. Proceed with the same dialog for the next reflector. If the last point has already been measured, the program will proceed to the "RESULT" dialog.

F2 F3

Measure a distance. Record the measurement in the active file and proceed with the same dialog for the next reflector. If the last point has already been measured, the program will proceed to the "RESULT" dialog.

F2 CONT

Measure the distance. Accept the measurement without recording. Proceed with the same dialog for the next reflector. If the last point has already been measured, the program will proceed to the "RESULT" dialog.

The prism constant used in the program is shown in the distance measurement display during the distance measurement. The prism name also shown in this display has nothing to do with the prism constant and can be ignored.

HP

F4 Enter the target data. For further information refer to *chapter "Measure & Record" of "SYSTEM" - user manual.*

Choosing another reflector and therefore another prism constant via this function is **NOT** recommended because the actually selected prism constant is only used for the current measurement. After confirming/ storing a measurement with **CONT** / "REC" or "ALL" the prism constant set in the program configuration is automatically used again. This could result in errors. Therefore always set the prism constant of the pole in the configuration of the program. *Refer to pages 112 and 113.*

Shift **F4** Change the theodolite face.

CODE Call up the CODE function, input of a code block.

Results

Once all reflectors have been measured, the program will display the results of the hidden-point calculation. If 3 reflectors are used, the hidden point position obtained from the median value of the 3 combinations is displayed.

```
HDNPT\    RESULTS        14:03
Point no.    :     Station12        MC
Hz           :     16°55'50"
V            :     91°16'20"
Slope Dist.  :         3.345  m
Height diff  :        -0.435  m
Easting      :      2253.635  m
 NEW        REC   TARGT

Northing     :     12145.281  m
Elevation    :       306.005  m
```

Shift

```
HELP
```

F1	F2	F3	F4	F5	F6

Point no. : The Point number.

Hz : Horizontal direction to the hidden point.

V	:	Vertical angle to the hidden point.
Slope. Dist.	:	Slope distance to the hidden point.
Height Diff	:	Height difference from instrument station to the hidden point.
Easting	:	Calculated Easting (E) for the hidden point.
Northing	:	Calculated Northing (N) for the hidden point.
Elevation	:	Calculated Elevation for the hidden point.

F1 Take a new hidden-point measurement.

F3 Store the point calculation on the recording device.

HP

If the prism constant is also stored (depending on the REC mask) during storing of the calculated data of the hidden point this value can be ignored because it is not relevant for the calculation.

F4 Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

CODE Call up the CODE function, as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

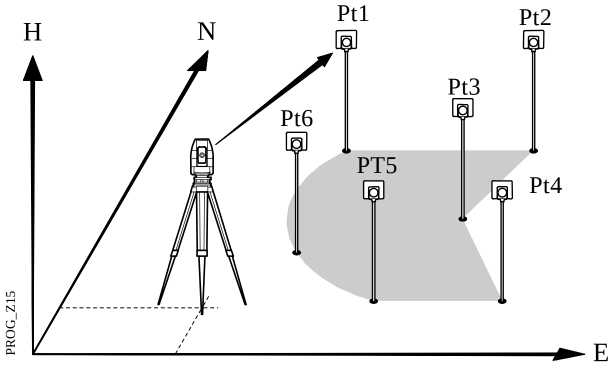
CONT Proceed to measure a new hidden point.

Shift ESC Exit the program.

Area (Computation of Area)

Introduction

This manual describes the "AREA" program of the TPS SYSTEM 1000 theodolite series.



An area can be defined by a series of straight lines and arcs. Arcs are defined by 3 radial points or 2 radial points and radius.

AR

Straight line

```
AREA\  MEASURE POINT 14:03
Segs Meas.   :            0
Point no.    :            1
Refl.Height  :        0.000  m
Hz           :    95°55'50"
V            :    91°16'20"
Slope Dist.  :        -----  m
 ALL  DIST  REC  TARGT IMPOR
Height diff  :        -----  m
Easting      :        -----  m
Northing     :        -----  m
Elevation    :     206.7963  m
Azimuth      :   182°25'05"
Seg. Len.    :        0.203  m
```

Shift

```
HELP  CONF  DEL  CALC  ARC  NEW
 F1    F2    F3   F4    F5   F6
```

Segs Meas. : Counts the number of segments. With a new area the segment counter will be set to zero.

Seg. Len. : Length of the last straight line segment measured.

AR

F1 — Simultaneously measure and record data on the active recording device. Return to dialog "MEASURE POINT"

F2 F3 — Measure a distance and record data on the active recording device.

F2 CONT — Measure a distance without recording.

F4 — Enter the target data. For further information refer to *chapter "Measure & Record" of "SYSTEM" - user manual.*

F5 — Import target coordinates. For further information, please refer to *chapter "Setup" of "SYSTEM" - user manual.*

Shift F2	Start the "Configuration editor".
Shift F3	Deletes last completed segment. Resume at the start of a new segment.
Shift F4	Close the area polygon to the start point and calculates area and length of perimeter. The display of the results is shown in *chapter "CALCULATION"*.
Shift F5	Select arc as the next segment.
Shift F6	Resets the segment counter to zero. Results of the last area computation will be erased.
CODE	Call up the CODE function.

AR

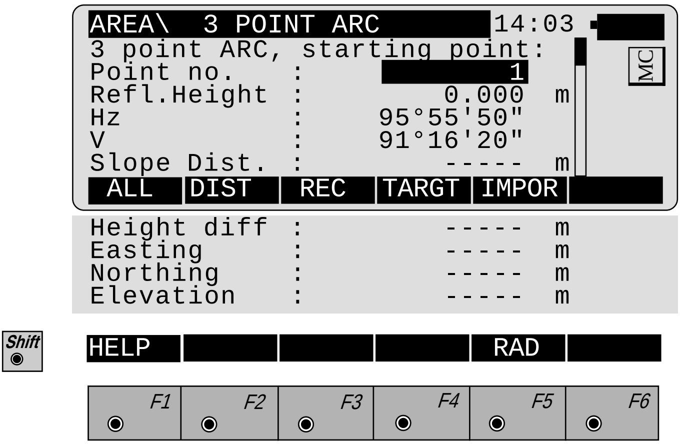
Arcs

During measurement, you can choose the ARC function to measure an arc defined by 3 radial points or 2 points and radius.
Select the correct options before proceeding with the first point of the segment.

Ensure the central angle of any arc is always smaller than 180° (200 gon).

- **Three Points**

Determine the three points of an arc sequentially. Completing the third point the program continues with Dialog "Measure point" *(page 118)*.



F1

Simultaneously measure and record data on the active recording device.

F2 F3

Measure a distance and record data on the active recording device.

F2 CONT

Measure a distance without recording.

AR

F4 — Enter the target data. For further information refer to *chapter "Measure & Record" of "SYSTEM" - user manual.*

F5 — Import target coordinates. For further information, please refer to *chapter "Setup" of "SYSTEM" - user manual.*

Shift F5 — Select arc defined by 2 points and radius.

Shift ESC — Call up the CODE function, as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

CODE — Exit the program.

- **Radius Arc**

Determine the two points of an arc sequentially. After the second point the "Measure point" dialog *(page 118)* prompts to input the radius.

AR

```
AREA\  RADIUS ARC        14:03
Radius ARC, starting point:
Point no.     :            1
Refl.Height   :        0.000  m
Hz            :     95°55'50"
V             :     91°16'20"
Slope Dist.   :        -----  m
 ALL  | DIST | REC  |TARGT |IMPOR |
Height diff   :        -----  m
Easting       :        -----  m
Northing      :        -----  m
Elevation     :        -----  m
```

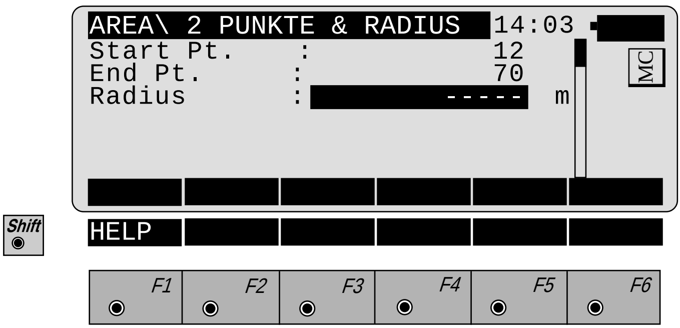
Shift

```
HELP |      |      |      | 3 PT |
```

F1	F2	F3	F4	F5	F6

F1	Simultaneously measure and record data on the active recording device.
F2 F3	Measure a distance and record data on the active recording device.
F2 CONT	Measure a distance without recording.
F4	Enter the target data. For further information refer to *chapter "Measure & Record" of "SYSTEM" - user manual.*
F5	Import target coordinates. For further information, please refer to *chapter "Setup" of "SYSTEM" - user manual.*
Shift F5	Press 3 Pt. to switch to the 3-Point Arc method .
Shift ESC	Call up the CODE function, as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*
CODE	Exit the program.

For arcs to the left enter the radius negative and for arcs to the right enter the radius positive.



CONT	Accept the input. Continue with dialog "MEASURE POINT" *(page118).*

Calculation

Displays number of segments, computed area and length of perimeter.

```
AREA\    RESULTS          14:03
No. Segs.     :             10
Area          :        892.888 m²
Hectares      :          0.089
Perimeter     :        295.563  m
 NEW         STORE        PLOT
HELP
```

Shift

F1 F2 F3 F4 F5 F6

No. Segs. : Number of segments used.

Area : Computed area in units of measure.

Hectares/ Acres : Computed area in hectares or acres[1] . 1 acre = 43560 ft².

Perimeter : Length of perimeter of the current unit of measure.

[1] depending on the setting of the distance unit metre or feet.

AR

F1

Start a new area. Resets the segment counter to zero. Results of the last area computation will be erased.

F3

The following format will be used to record calculated area results:

WI 41: Code block identification (default = 36)
WI 42: Number of segments used.
WI 43: Area in the current measurement units, always with one decimal place.
WI 44: Length of perimeter in the current units of measure with one decimal place.

Area results recording format

Code (default = 36)	no. of segments =4	area polygon 4500.3 m2	length polygon perimeter 392.2 m
41001+00000036	42...+00000004	43...+00045003	44...+00003922
WI 41	WI 42	WI 43	WI 44

F5 Generate a plot of the area.

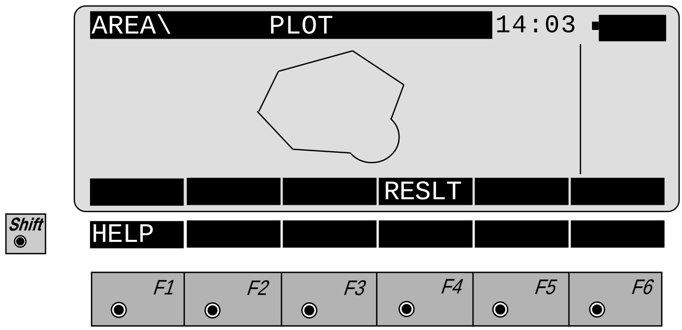
CONT Continue with dialog "MEASURE POINT".

Shift ESC Exit the program.

Plot

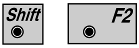
AR

Shows a plot of the present area.

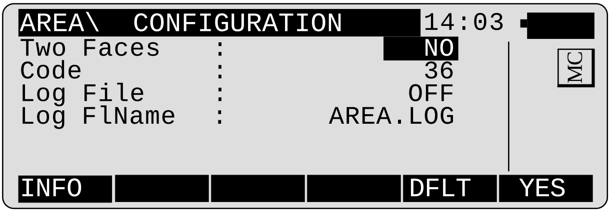


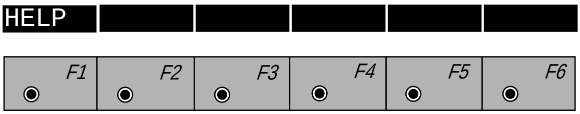
F4 Return to the dialog "RESULTS".

Configuration Editor



Start the "Configuration Editor" from the "MEASURE POINT" dialog.





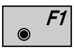
The "Configuration Editor" sets parameters for further program operations:

Two Faces : Set **YES** for dual-face measurement, **NO** for single-face.

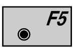
Code : Enter the block identification code for recording the area results (max. eight alpha numeric characters)

Log File : Set to **ON**, the program will record measurement data in a log file in the format described on *page 128*.

Log FlName : Enter the Log File Name.



Display date and version of the running application



Set the values to default. Default values are displayed in dialog above.

CONT

Store the current configuration and proceed to the dialog "MEASURE POINT". Points can be added to the current area or a new area can be started.

Shift ESC

Exit the program.

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

AR

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

☞ Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header	The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.
Record	For each section of the area, start point and end point, horizontal distance and azimuth are stored. For arcs with 2 points and radius the azimuth of arc, radius and length of arc are also stored. For 3 point arcs the direction of arc, radius and length of arc are also stored.

Leica VIP Area V 2.10		
Instrument	:	TCM1100, Serial 430000, Joe’s theodolite
User templ.	:	User 1
Meas. file	:	FILE01.GSI
Program Start	:	02/23/1995 at 13:00
Segment Number	:	1
Start Point	:	1
End Point	:	2
H Distance	:	5.5555m
Azimuth	:	140°11'17"
Segment Number	:	2
Start Point	:	2
End Point	:	4
Curve Right		
Radius	:	4.9089m
ARC Length	:	2.326m
Segment Number	:	3
Start Point	:	4
Second Point	:	5
End Point	:	6
Curve Right		
Radius	:	5.362m
ARC Length	:	2.254m
Number of Segments : 3		
Area	:	9.8496m2
Hectares	:	0.0010
Perimeter	:	13.8396m

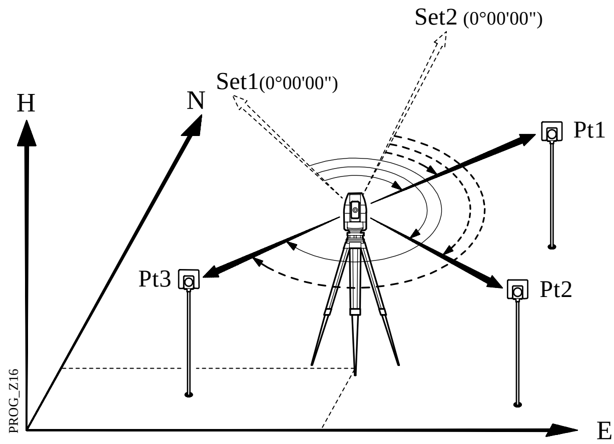
AR

Typical log file entry in the "AREA" program

Sets of Angles

Introduction

This manual describes the "Sets of Angles" program of the TPS SYSTEM 1000 theodolite series.



The program permits direction measurements to targets of which coordinates are not necessarily known. The average direction of all sets, the standard deviation for one observed direction and the standard deviation for the average of all directions is computed for each target. To calculate a result, a minimum of two full sets must be observed. Measurements in two faces must exist for each target .

Once the program has "learned" the targets and their respective sequence during the first set in face I, the observer is guided throughout the following measuring sequence.

A maximum of 250 measurements per instrument station (in 2 faces) can be handled in one calculation.

SA

Sets menu - view

The point numbers and sequence of the targets are stored in the program during the observation of the first half set in face I. This is designated as the "Learning Phase". The observer is thereafter guided throughout the observation sequence, i.e. the targets are proposed as per "learned" sequence using the selected observation method. To locate the targets easily, the horizontal and vertical differences in direction are displayed. Turning these differences to "zero", the relevant target is visible. Motorized theodolites will automatically drive the telescope to the specified target point, if the first half set was measured successfully.
Complete directions must be observed for all targets within the first set. A **complete direction** is defined as a direction observed in both faces.
During observation the program tests, if the correct face is used. As soon as the last "learned" target has been observed, the program changes automatically to face II.

SA

```
SETS\     SETS MENU         14:03
Measure First Set              0
Measure Further Set            1     MC
Calculate Horizontal Sets      2
Calculate Vertical Sets        3
End Program                    4
```

Shift

```
HELP  CONF
```

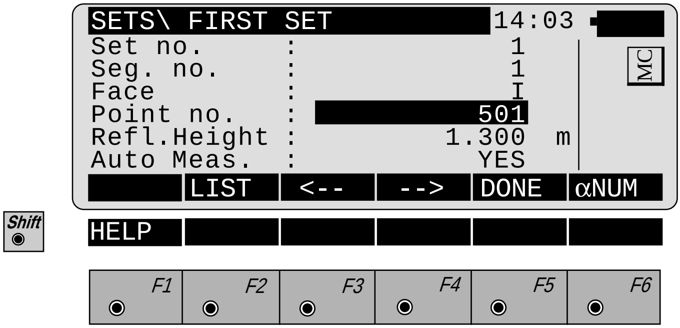
F1 F2 F3 F4 F5 F6

Shift F2 Start the "CONFIGURATION".

Measure Mode

- **Measure First Set**

This option starts the first set and the "Learning Phase" of a new instrument station. The point number for the targets must be entered in Dialog "FIRST SET".



Set no.	**:**	Displays the active set.
Seq. no.	**:**	Displays the sequence number of the selected target out of the total number of target used.
Face	**:**	Displays the face.
Point no.	**:**	Target point number.
Refl.Height	**:**	Reflector height of target point.
Auto Meas.	:	Automatic measurement ON/OFF

F2 Entry of target points into a list as well as selecting points for multiple use.

F3 Displays the previous point from the list of points you entered. **Note that this key will not be available until there is at least one point in the list.**

F4 Displays the next point in the list of points you entered. **Note that this key will not be available until there is at least one point in the list.**

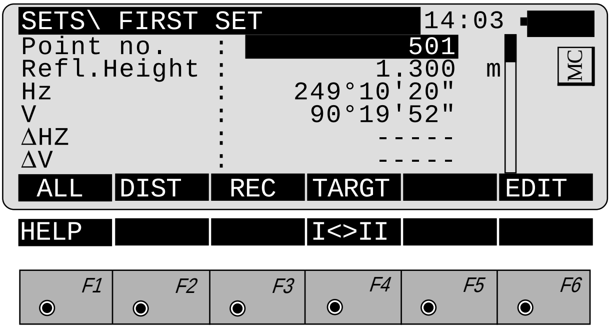
F5 Ends the 1. half set and returns to the dialog "SETS MENU".

F6 — Select alpha-numeric/numeric input.

Shift ESC — Exit the program.

CONT — Proceed to the "MEASURE" dialog (displayed below).

This "MEASURE" dialog is shown during the measurement to targets. The program return to the dialog "FIRST SET" (*page 131*) on completion of a measurement or to the "FURTHER SET" dialog (*page 133*).



ΔHz / ΔV : Are not activ during the first set. The differences are shown for all further sets relative to the measurements of the first half set.

SA

F1 — Simultaneously measure and record data on the active recording device. Return to the dialog "FIRST SET".

F2 F3 — Measure and record a distance.[1]

F2 CONT — Measure without recording the measurement on the active recording device.

F4 — Enter the target data. For further information refer to chapter *"Measure & Record" of the "SYSTEM" - user manual.*

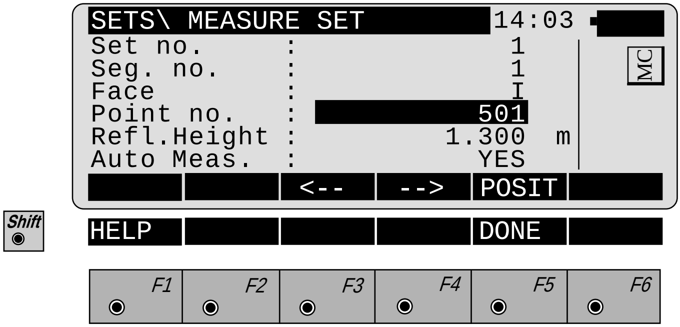
Shift F4 — Change the theodolite face.

CONT — Proceed to "FIRST SET".

[1] Distance measurement is optional.

- **Measure Further Set**

To measure the sets, the user is guided the measurement sequences. The following dialog selects points used within the 1. half set. The measurement sequence requires no special target selection due to the pre-defined configuration.



Set no. **:** Displays the active set.

Seg. no **:** Internal ordinal number from 1st half set.

Face **:** Displays the face.

F3 Selects the previous point from a list of points.

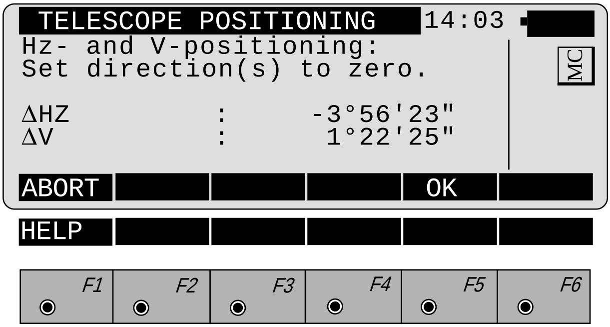
F4 Selects the next point from a list of points.

F5 Turn the telescope to the selected point.

Shift F5 Returns to the "Sets Menu"

To detect the targets easily, the horizontal and vertical angle differences are shown in a special display. If these are "turned to zero", the selected target is visible within the field of view.
Motorized instruments sight the target automatically after the successful measurements of the first half set.

Shift



ΔHz	:	Difference in horizontal direction.
ΔV	:	Difference in vertical direction

F1 — Ends the telescope positioning.

SA

CONT or F5 — Ends the telescope positioning. Are activated if the present telescope position is within 27' (0.5 gon) of the expected position. This is confirmed accustically.

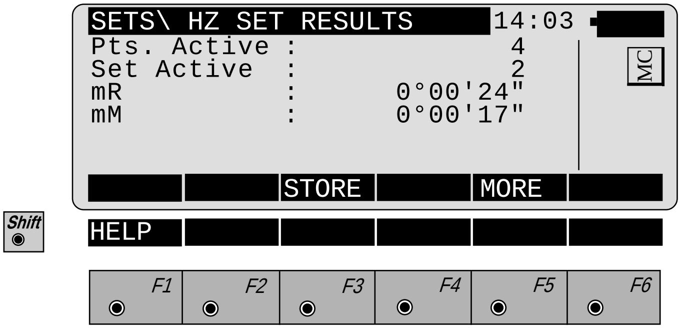
Further measurements follow the same rules as described in *chapter "Measure first set"*.

Calculate Mode

- **Calculate Horizontal and Vertical Sets**

The display-format is the same for horizontal and vertical directions. The data displayed, refer to the selected calculation.
Standard deviations of a single direction in both faces (mR) and the standard deviation for an averaged direction from all sets (mM) are calculated.

Computations of standard deviations require, that all targets and sets are observed in two faces. Exceptions may exist, in which case the standard deviation should be seen as an approximation to be used as a field control. The correct standard deviations a posteriori can be calculated using the recorded data and a suitable computation method.



SA

Pts. Active : Number of observed points used in the calculation.

Sets Active : Number of observed sets used in the calculation.

mR : Standard deviation of one observed horizontal or vertical direction.

mM : Standard deviation of an average direction from all sets.

F3 Results of sets of angles are recorded in the activ file for measurements. (For details *see dialog "FORMATS AND MORE INFORMATION")*

F5 Show the results of individual measurements on the screen. *(For details see dialog "MORE INFORMATION"*)

Shift ESC Exit the program

- **Formats and Data Recording**

The following format is used to record results in the activ file for measurements.

Number of measurements and accuracies.

WI 41	Code "HZ-RESLT" or "V0-RESLT"
WI 42	Number of targets.
WI 43	Number of observed sets.
WI 44	Standard deviation of a horizontal or vertical direction.
WI 45	Standard deviation of a horizontal or a vertical direction averaged from all sets.

HZ-RESLT: (Number of observations and accuracies)

SA

Code	**Number of targets =4**	**Number of sets =3**	**mR = 52"**	**mM = 37"**
410039+HZ-RESLT	42....+00000004	43....+00000003	44....+00000520	45....+00000370
WI 41	WI 42	WI 43	WI 44	WI 45

Directions averaged from all valid sets.

WI 41: Code "HZ-MEAN0" or "V0-MEAN0".
WI 42: Point number
WI 43: Averaged direction from all sets.

HZ-MEAN0: (Average from all valid sets)

Code	Target number	Average of all sets
410040+HZ-MEAN0	42....+00000001	43....+00000000
410041+HZ-MEAN0	42....+00000002	43....+00641040
410042+HZ-MEAN0	42....+00000003	43....+01354568
410043+HZ-MEAN0	42....+00000004	43....+01944557
WI 41	WI 42	WI 43

Differences or residuals for the points observed.

WI 41: Code "HZ-DIFF0" oder "V0-DIFF0".
WI 42: Point number.
WI 43 - WI 48: Difference or residual

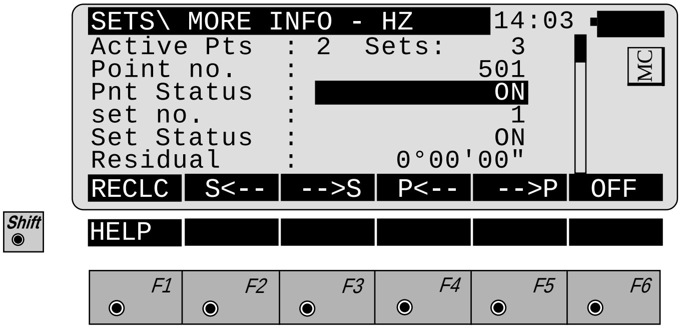
HZ-DIFF0: (Difference (**r**) for Hz-directions and residuals (**v**) for vertical directions).

Code	Target numbers	Differences or residuals	
410044+HZ-DIFF0	42....+00000001	43....+10000000......	.....48....+60000000
410045+HZ-DIFF0	42....+00000002	43....+10000216......	.....48....-60000216
410046+HZ-DIFF0	42....+00000003	43....-10000168......	.....48....+60000168
410047+HZ-DIFF0	42....+00000004	43....-10000041......	.....48....+60000141
WI 41	WI 42	WI 43........ until	........WI 48

SA

- **More Information**

Further information is given relating to the differences of the measurements. Single points or full sets can be deactivated prior to the calculation.



Active Pts : Number of points used in the calculation.

Sets : Number of sets used in the calculation.

Point no. : Target point.

Pnt. Status : Point used for computation (**ON/ OFF**).

Set no. : Present displayed set.

Set Status : Point used for computation (**ON/ OFF**).

Residual : Difference in horizontal direction, using the direction of the active set and the averaged direction of all sets. For the vertical directions, the residual is used to compute the standard deviations.

F1 Re-calculate the results and return to the dialog showing the results.

F2 Display previous set.

F3 Display the next set.

F4 Display the previous point.

F5 Display the next point.

Shift ESC Exit the program.

SA

Examples and used formulae

A typical example of a Hz - measurement is shown in the following list:

The example shows a survey with 3 sets and 4 targets with directions in ° ' ".

The calculations are carried out according to the following table.

PtNr	Face I	Face II	Average face I+II (a)	Reduced average of set (b)	Average (d)	r= d - b	v= r+q	v^2
1	0°00'20"	180°00'17"	0°00'19"	0°00'00"	0°00'00"	0	+1	1
2	24°43'34"	204°43'31"	24°43'33"	24°43'14"	24°43'10"	-4	-3	9
3	84°47'15"	264°47'11"	84°47'13"	84°46'54"	84°46'53"	-1	0	0
4	306°41'52"	126°41'42"	306°41'47"	306°41'28"	306°41'28"	0	+1	1
					q= -(Σ r)/N q =	-(5")/4 +1	Σv=-1	
1	45°00'13"	225°00'16"	45°00'15"	0°00'00"		0	0	0
2	69°43'24"	249°43'23"	69°43'24"	24°43'09"		+1	+1	1
3	129°47'06"	249°47'08"	129°47'07"	84°46'52"		+1	+1	1
4	351°41'45"	171°41'44"	351°41'45"	306°41'30"		-2	-2	4
					q= -(Σ r)/N q =	-(0)/4 0	Σ v=0	
1	90°00'19"	270°00'19"	90°00'19"	0°00'00"		0	-1	1
2	114°43'28"	294°43'26"	114°43'27"	24°43'08"		+2	+1	1
3	174°47'10"	354°47'15"	174°47'13"	84°46'54"		-1	-2	4
4	36°41'47"	216°41'45"	36°41'46"	306°41'27"		+1	0	0
					q= -(Σ r)/N q =	-(2)/4 -1	Σv=-2	
							Σ v² =	23

$$mR = \sqrt{\frac{\Sigma v^2}{(N-1)(s-1)}} = \sqrt{\frac{23''}{(4-1)(3-1)}} = \pm 2''$$

$$mM = \frac{mR}{\sqrt{s}} = \frac{2''}{\sqrt{3}} = \pm 1''$$

SA

A typical example of a V - measurement is shown in the following list:

The example shows a survey with 3 sets and 4 targets and directions in ° ' ".

The calculations are carried out according to the following table.

PtNr	Face I	Face II	Average face I+II (a)	Average (d)	v = d - a	v^2
1	87°13'58"	272°46'24"	87°13'47"	87°13'46"	-1	1
2	88°42'12"	271°18'18"	88°41'57"	88°41'55"	-2	4
3	89°44'22"	270°16'00"	89°44'11"	89°44'11"	0	0
4	91°06'47"	268°53'38"	91°06'34"	91°06'33"	-1	1
1	87°14'01"	272°46'22"	87°14'49"		-3	9
2	88°42'09"	271°18'20"	88°41'54"		+1	1
3	89°44'27"	270°16'00"	89°44'13"		-2	4
4	91°06'47"	268°53'40"	91°06'33"		0	0
1	87°14'01"	272°46'34"	87°13'43"		+3	9
2	88°42'09"	271°18'20"	88°41'54"		+1	1
3	89°44'23"	270°16'04"	89°44'09"		+2	4
4	91°06'49"	268°53'42"	91°06'33"		0	0
					Σ V= -2	
					Σv^2 =	**34**

SA

$$mR= \sqrt{\frac{\Sigma v^2}{N*s-1}} = \sqrt{\frac{34"}{4*3-1}} = \pm 2"$$

$$mM = \frac{mR}{\sqrt{s}} = \frac{2"}{\sqrt{3}} = \pm 1"$$

Used formulae and designations

a = In both faces observed and averaged direction.
b = In both faces averaged and reduced direction of a set
d = Final averaged direction from all sets.
r = Difference between a final direction averaged from all sets and a single direction of a set.
q = Average of the differences (r).
v = Residuals.
s = Number of sets
N = Number of targets.

r = d - b
v = r + q   for horizontal directions
v = d - a   for vertical directions

Average of the differences for horizontal directions.

$$q = -\frac{\Sigma r}{N}$$

Standard deviation of one horizontal direction observed in two faces.

SA

$$mR = \sqrt{\frac{\Sigma v^2}{(N-1)(s-1)}}$$

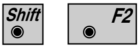
Standard deviation of one vertical direction observed in two faces.

$$mR = \sqrt{\frac{\Sigma v^2}{N*s-1}}$$

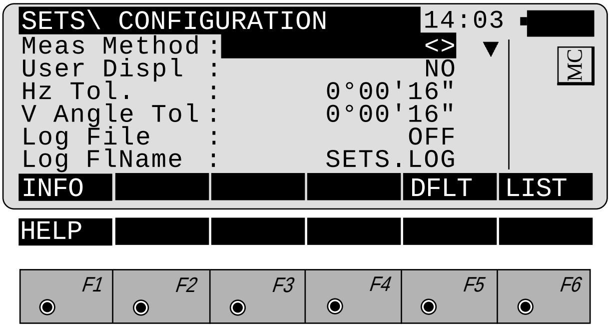
Standard deviation of an averaged direction from all sets.

$$mM = \frac{mR}{\sqrt{s}}$$

Configuration Editor



Start the "Configuration Editor" from the "SETS MENU" dialog.



The "Configuration Editor" sets parameters for further program operations:

Meas Method : > <All targets have to be observed for face II in **opposite** order to the observations in face I.

> >All targets have to be observed in face II using the **same** sequence as for the observations in face I.

◊ Each target has to be observed in face II immediately after its measurement for face I has been completed.

User Displ : Set to **YES**, the display defined in the "MEAS" application will be used. **NO** uses the "SETS OF ANGLES" default display.

Hz Tol. : Input the tolerance for Hz-directions. This defines the limit for the difference between the actual direction and the direction observed within the first half set. A change in the horizontal circle orientation is always accounted for, after observing the first target within a new set. If the tolerance is exceeded, a warning is given.

V Angle Tol : Input the tolerance for vertical directions. This defines the limit for the difference in the vertical directions between the actual observations and the directions observed within the first half set. If the tolerance is exceeded, a warning is given.

Log File : **ON**, records measurements in a Log-File.The format is described on *page 146*.

Log FlName : Enter the Log File Name.

SA

F1 Displays date and version.

F5 Set default values. Default values are displayed in dialog "CONFIGURATION" *(page 143)*.

Shift ESC Exit the program

CONT Store the current configuration and proceed to the dialog "SETS MENU".

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

☞ Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record The average horizontal and vertical angles of all sets, the standard deviation for one measurement and the standard deviation of an angle averaged from all sets, are stored in the Log-File.

SA

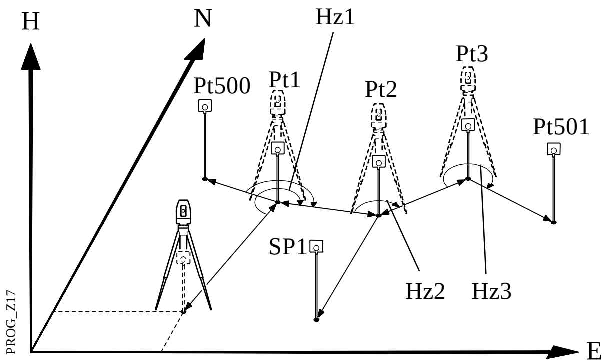
```
Leica VIP Sets of Angles V 2.10
Instrument          :  TCM1100, Serial 430000, Joe’s theodolite
User Templ.         :  User 1
Meas. File          :  FILE01.GSI
Program Start       :  01/05/1996 at 13:00

Station no.         :                     132
                    E=725362.235m  N=263587.236m  ELV= 569.587m  hi= 1.2000m

Horizontal set results:
5 Sets measured with 3 points each.

Standard deviation of any measurement:  0°00'02"
Standard deviation of mean from all measurements:  0°00'01"
1.  Point no.: 1    mean direction:    0°00'00"     Refl.Height:   0.0000m
2.  Point no.: 2    mean direction:   83°25'53"     Refl.Height:   0.0000m
3.  Point no.: 3    mean direction:  179°56'28"     Refl.Height:   0.0000m

Results of single sets:

1.    Point no.: 1
      Set  1 :      Residual :   0°00'00"         average :      0°00'00"
      Set  2 :      Residual :   0°00'00"         average :      0°00'00"
      Set  3 :      Residual :   0°00'00"         average :      0°00'00"
2.    Point no.: 2
      Set  1 :      Residual :   0°00'33"         average :     83°25'50"
      Set  2 :      Residual :  -0°00'01"         average :     83°25'44"
      Set  3 :      Residual :  -0°00'32"         average :     83°25'15"
3.    Point no.: 3
      Set  1 :      Residual :  -0°00'50"         average :    179°56'28"
      Set  2 :      Residual :   0°00'57"         average :    179°56'30"
      Set  3 :      Residual :  -0°00'47"         average :    179°56'55"

Vertical set results:
5 Sets measured with 3 points each.

Standard deviation of any measurement: 0°00'05"
Standard deviation of mean from all measurements: 0°00'03"
1.    Point no.:1   mean direction:100°53'56"     Refl.Height:   0.0000m
2.    Point no.:2   mean direction:94°15'47"      Refl.Height:   0.0000m
3.    Point no.:3   mean direction:85°57'56"      Refl.Height:   0.0000m

Results of single sets:
1.    Point no.: 1
      Set  1 :      Residual :  -0°00'45"         average :    100°53'21"
      Set  2 :      Residual :   0°00'27"         average :    100°53'49"
      Set  3 :      Residual :  -0°00'52"         average :    100°53'59"
2.    Point no.: 2
      Set  1 :      Residual :   0°00'55"         average :     94°15'52"
      Set  2 :      Residual :   0°00'08"         average :     94°15'39"
      Set  3 :      Residual :  -0°00'53"         average :     94°15'10"
3.    Point no.: 3
      Set  1 :      Residual :   0°00'54"         average :     85°57'12"
      Set  2 :      Residual :   0°00'38"         average :     85°57'37"
      Set  3 :      Residual :  -0°00'52"         average :     85°57'38"
```

Typical Log-File for "SETS OF ANGLES"

Traverse

Introduction

This manual describes the "Traverse" program of the TPS-System 1000 instruments.



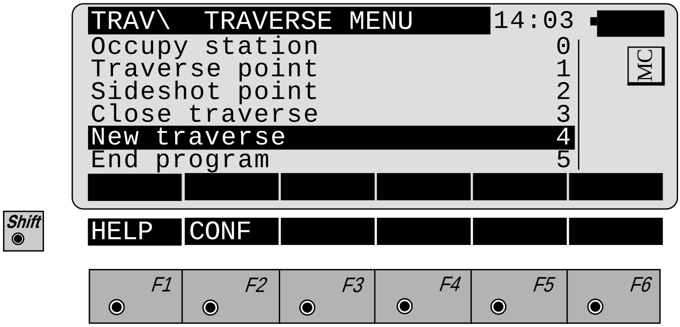
Using data about direction and distance, the program continuously computes the coordinates of the station (in the example shown above, the instrument "moves" from one station to the next, previously measured point) and aligns the horizontal circle.
For a point the coordinates of which are known, the deviation from the coordinates determined by measurement can be computed and displayed.
There is no adjustment of these differences in coordinates and direction. Subsequently, however, the measurements stored on the PCMCIA can be processed with the assistance of an appropriate software program.
Individual stations can be calculated as "sideshots" (SP). The coordinates and directions of these points are also determined in the course of this program.
If the program is terminated (e.g. to record a detail point), the values remain stored. The measurement procedure can be resumed after calling up the program again.

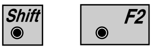
TR

Traverse Menu

Traverse menu

In this display, the individual functions of the program can be called. After a function has been performed, the user returns to this display.





Start the "CONFIGURATION".

TR

New traverse

Any data of a previous traverse in the memory will be erased at the start of a new traverse. To avoid unintentional erasing, a confirmation must be made. The first dialog requests the entry of the station point number, height of instrument, station coordinates and the setting of a spezified Hz-angle.

```
TRAV\ NEW TRAV STATION     14:03
Station no. :     Station100
Inst.Height :          1.635  m
Stat.Eastng :      23541.025  m
Stat.Northg :      55231.177  m
Stat.Elev.  :        521.358  m
Hz          :     233°15'25"
            REC   Hz0  IMPOR  αNUM
Shift:
HELP
F1    F2    F3    F4    F5    F6
```

F3 Records manually entered station data on the active recording device. The program proceeds to the "MEASURE MODE" dialog.

F4 Set horizontal-circle direction. For further information, please refer to *chapter "Measure & Record" of "SY-STEM" - user manual.*

F5 Import station coordinates. For further information, please refer to *chapter "Setup" of "SYSTEM" - user manual.*

F6 Alpha-numeric or numeric input.

Shift ESC Exit the program.

CONT Proceed to the "DEFINE BACKSIGHT POINT MODE" dialog.

TR

- **Select method of orientation**

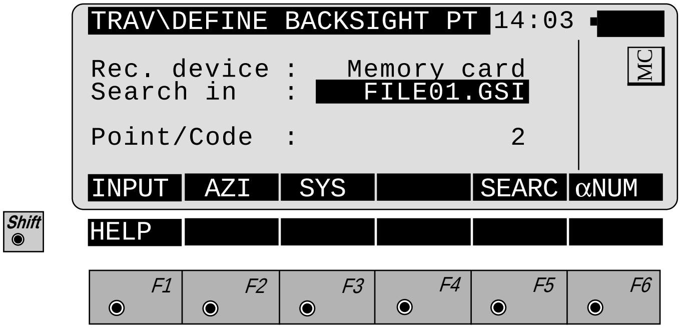
Three different methods of the orientations are available

1. Confirm the orientation already set in the system.[1] No measurements are performed (SYS).

2. Calculation of an azimuth from coordinates to one tie point. A following measurement to a tie point orientates the Hz-circle (INPUT). *See page 151*.

3. Manual input of the azimut to one tie point. A measurement to the tie point is required (AZI). *See page 152*.

[1] If the orientation was determined with the "ORIENTATION" program, for example.



TR

F1 — Manual entry of coordinates for tie points. The standard input dialog of TPS 1000 is used. Continue with the "MEAS" dialog.

F2 — Select the "MEAS" dialog and enter the azimuth.

F3 — Confirms the present orientation. Continues with the dialog "TRAVERSE MENU".

F5 or CONT — Search coordinates in the active file.

Shift ESC — Exit the program.

- **Calculate Azimuth**

This dialog corresponds to the TPS-System 1000 basic dialog. On completion of a measurement, the program continues either with "MULTIPLE MEAS" or with the "TRAVERSE MENU" according to the settings in the configuration.

```
TRAV\  NEW TRAVERSE         14:03
Measure Backsight Point
Point no.    :          500
Refl.Height  :        1.300   m      MC
Hz           :     249°10'20"
V            :      90°19'52"
Sloe Dist.   :        -----   m
 ALL  |DIST | REC |TARGT|     |
Height diff  :        -----   m
Easting      :        -----   m
Northing     :        -----   m
elevation    :        -----   m

Shift
HELP |     |     |I<>II|     |
 F1  | F2  | F3  | F4  | F5  | F6
```

F1 — Simultaneously measure and record data on the active recording device.

F2 **F3** — Measure a distance[1] and record data on the active recording device.

F2 **CONT** — Measure a distance without recording.

F4 — Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

Shift **F4** — Change the theodolite face.

CONT — Proceed to the dialog "TRAVERSE MENU".

CODE — Call up the CODE function.

[1] Distance measurement is optional.

TR

- **Enter Backsight Azimuth**

This dialog corresponds to the TPS-System 1000 basic dialog with the additional entry of the backsight azimuth.
On completion of the first measurement, the program continues either with "MULTIPLE MEAS" or with the "TRAVERSE MENU" according to the settings in the configuration.

```
TRAV\ NEW TRAVERSE        14:03
Measure Backsight Ponit
BS Azimuth  :        -----
Point no.   :          500
Refl.Height :        1.300  m
Hz          :    249°10'20"
V           :     90°19'52"
 ALL  DIST  REC  TARGT

Slope Dist. :        -----  m
Height diff :        -----  m
Easting     :        -----  m
Northing    :        -----  m
Elevation   :        -----  m

Shift
HELP             I<>II
F1  F2  F3  F4  F5  F6
```

BS Azimuth : Enter the backsight azimuth for the orientation.

TR

F1 — Simultaneously measure and record data on the active recording device.

F2 F3 — Measure a distance[1] and record data on the active recording device.

F2 CONT — Measure a distance without recording.

F4 — Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

Shift F4 — Change the theodolite face.

CODE — Call up the CODE function.

[1] Distance measurement is optional.

Occupy station

The instrument is set up for a new traverse point or sideshot. The angle measurement (distance measurement is optional) is made to a tie point or to the last traverse point. This dialog corresponds to the TPS-System 1000 basic dialog. After the function has been performed, the station coordinates and orientation are set in the instrument.

```
TRAV\  OCCUPY TRAVERSE PT 14:03
Station no.  :               2
Backsight    :               1
Inst.Height  :           1.300
Refl.Height  :           1.300  m
Hz           :      249°10'20"
V            :       90°19'52"
 ALL  | DIST | REC | TARGT | SS |

Slope Dist.  :           -----  m
Height diff  :           -----  m
Easting      :           -----  m
Northing     :           -----  m
Elevation    :           -----  m

Shift
HELP |      |      | I<>II |      |
F1     F2     F3     F4      F5     F6
```

Station no. : Station point number.

Backsight : Backsight to tie point.

TR

F1 — Simultaneously measure and record data on the active recording device.

F2 F3 — Measure a distance[1] and record data on the active recording device.

F2 CONT — Measure a distance without recording.

F4 — Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

[1] Distance measurement is optional.

F5 — Selects the last measured sideshot or the last traverse point as the new station.[2]

Shift F4 — Change the theodolite face.

CONT — Proceed to the dialog "TRAVERSE MENU".

CODE — Call up the CODE function.

[2] Only active if a sideshot point was measured.

TR

Traverse Point / Sideshot Point

A distance measurement is carried out to the respective tie point. Both functions use the same dialog. This corresponds to the TPS-System 1000 "MEASURE" dialog. On completion of the measurement, the program continues either with "MULTIPLE MEAS" or with the "TRAVERSE MENU" according to the settings in the configuration.

```
TRAV\MEAS TRAVERSE PT      14:03
Point no.    :            2
Refl.Height  :        1.300  m     MC
Hz           :     249°10'20"
V            :      90°19'52"
Slope Dist.  :        -----  m
Height diff  :        -----  m
 ALL  DIST   REC   TARGT
Easting      :        -----  m
Northing     :        -----  m
Elevation    :        -----  m
```

Shift

```
HELP              I<>II
```

F1 F2 F3 F4 F5 F6

F1 — Simultaneously measure and record data on the active recording device.

F2 F3 — Measure a distance and record data on the active recording device.

F2 CONT — Measure a distance without recording.

F4 — Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

Shift F4 — Change the theodolite face.

Shift ESC — Exit the program.

Close traverse

The program requires a closing point for comparison with the last traverse point measured. The default point number is the starting point of the travers.

```
TRAV\  DEFINE CLOSING PT 14:03
                                  MC
Rec. device  :   Memory-Card
Search in    :    FILE02.GSI

Point/Code   :           123

INPUT      ST PT      SEARC
```

Shift

```
HELP
F1   F2   F3   F4   F5   F6
```

F1 — Enter coordinates using the standard input dialog.

F3 — Confirms the coordinates of the starting point.

F5 or CONT — Search coordinates in the database.

Shift ESC — Exit the program.

TR

```
TRAV\   CLOSURE RESULTS 14:03
No. of Pts.   :          3       MC
Length        :   1676.367  m
Crd. miscl.   :      0.040  m
Hgt. miscl.   :      0.262  m
ΔEasting      :     -0.016  m
ΔNorthing     :     -0.037  m
           STORE PLOT  MENU
AziCrdMiscl   :   90°19'52"
H Precision   :      83569  m
V Precision   :       6528  m
```

Shift

```
HELP
F1   F2   F3   F4   F5   F6
```

No. of Pts. : Number of traverse points

Length : Length of traverse

Crd. miscl. : Coordinate misclosure

Hgt.miscl. : Height misclosure

Δ Easting : Misclosure in easting

Δ Northing : Misclosure in northing

AziCrdMisc1 : Azimuth of coordinate misclosure

H Precision : Position precision =

$$= \frac{\text{traverse length}}{\text{Crd. misclosure}}$$

V Precision : Vertical precision =

$$= \frac{\text{height difference}}{\text{Hgt. misclosure}}$$

F3 The results of the traverse are recorded in the file for measurements on the active recording device.

F4 Plot of the traverse.

F5 Continue with the "TRAVERSE MENU".

Shift ESC Exit the program.

CONT Continue with the "TRAVERSE MENU".

TR

Examples

Codeblock with results of the traverse closure :

WI 41: Code 38
WI 42: Number of traverse points.
WI 43: Length of traverse (sum of legs).
WI 44: Azimuth of misclosure

```
410010+00000038 42....+00000005 43....+01013515 44....+01928220
```

WI 41 Code 39
WI 42 Misclosure
WI 43: Misclosure easting
WI 44: Misclosure northing
WI 45: Misclosure in height

```
410011+00000039 42....+00000123 43....+00000045 44....+00000114 45....+00000087
```

WI 41 Code 40
WI 42 Position precision (traverse length / misclosure)
WI 43: Vertical precision (height difference / misclosure)

TR

```
410012+00000040 42....+00008239 43....+00010000
```

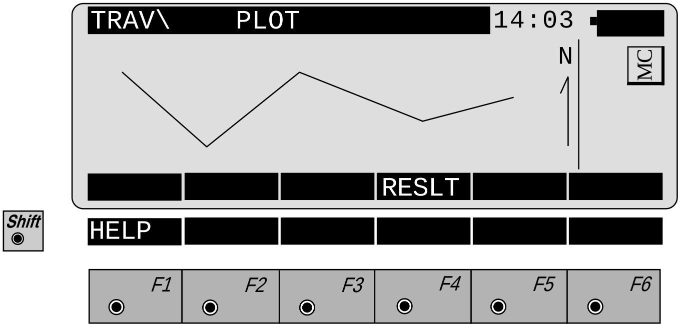
Measurementblock with the traverse Station Coordinates of station points

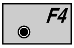
WI 11: Point number
WI 25: ΔHz (correction of orientation)
WI 84: E_0 easting coordinate
WI 85: N_0 northing coordinate
WI 86: Height
WI 88: Instrument height

```
110015+00123456 25.143+14611200 84..40+00001215 85..40-00003153
86..40+00403285 88..10+00001555
```

Plot

Generates a plot showing the measurement configuration.





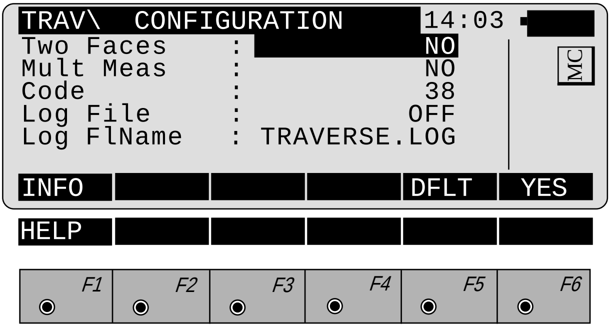
Return to the dialog "CLOSURE RESULTS".

TR

Configuration

Configuration Editor

Start the "Configuration Editor" from the "TRAVERSE MENU" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces	:	Set **YES** for dual-face measurement, **NO** for single-face.
Mult Meas	:	Set **YES** for the multiple measurement, **NO** for the single measurement.
Code	:	Input of code number for recording results (maximum 8 characters)
Log File	:	Set to ON, the program will record measurement data in the Log File according to the format described on *page 163*.
Log FlName	:	Enter the Log File Name.

Displays date and version.

TR

F5 — Set all values to default. Default values are shown in dialog *on page 160*.

F6 — Select (NO/YES, alpha-numeric/numeric input, ON/OFF).

CONT — Confirm displayed parameter and continues with the "TRAVERSE MENU".

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

Multiple Measurement

The measurement to a point can be repeated as often as desired to achieve a higher accuracy or reliability. The mean value of the measurements and the respective standard deviation is displayed.


```
TRAV\ MULTIPLE MEAS          14:03
Point no.       :              500     MC
No. of Meas     :                1
σHZ             :        0°00'30"
σV              :        0°00'22"
σSlope Dist     :           0.001  m
ØHz             :       45°00'52"
MEAS  CLEAR  REC  TARGT  ACCEP
ØV              :      103°45'25"
ØSlope Dist     :          50.125  m
```

Shift

```
HELP
```

F1 F2 F3 F4 F5 F6

Point no.	**:**	The target point number.
No. of Meas	**:**	Counter of the measurements.
σHz	**:**	Standard deviation of the horizontal direction for a single measurement.
σV	**:**	Standard deviation of the vertical angle for a single measurement.
σSlope Dist	**:**	Standard deviation of the slope distance for a single measurement.
ØHz	**:**	Mean value of the HZ-measurements.
ØV	**:**	Mean value of the HZ-measurements.
ØSlope Dist	:	Mean value of the slope distances.

F1 Further measurements.

F2 Delete all measurements of the current point and start again.

F3 Record the mean value of the measurements on the active recording device. Return to the "TRAVERSE MENU" dialog.

F4 Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

F5 Accept the mean values and return to the "TRAVERSE MENU".

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header The header line will contain the name of this program, information about the instrument, the name of the data file and date and time.

Record Computed coordinates of traverse points are continously stored. The option Close traverse in the "TRAVERSE MENU" *(Dialog page 148)* displays and stores at any time the coordinate - differences of traverse points of which the coordinates are known.

TR

Leica VIP Traverse V 2.10					
Instrument	:	TCM1100, Serial 430000, Joe’s theodolite			
User Templ	:	User 1			
Meas. File	:	FILE01.GSI			
Program Start	:	02/23/1995 at 10:25			
Backsight	:	500			
Station	:	Pt.1			
		E= -0.679m	N= 9.545m	H= 400.062m	hi= 1.530m
Station	:	Pt.2			
		E=-13.462m	N=10.528m	H= 400.170m	hi= 1.650m
Station	:	Pt.3			
		E=26.513m	N=16.821m	H= 401.260m	hi= 1.610m
Last Trav.Pt.	:	501			
		E= -77.949m	N= 25.037m	H= 399.923m	
Closing Pt.	:	501			
		E= -78.016m	N= 24.996m	H= 400.181m	
No. of Pts.	:	4			
Length	:	82.788m			
Hor. miscl.	:	0.047m			
Vert. miscl.	:	0.268m			
DEasting	:	-0.017m			
DNorthing	:	-0.031m			
Azi H.miscl	:	226°51'25"			
H Precision	:	2036			
V Precision	:	2356			

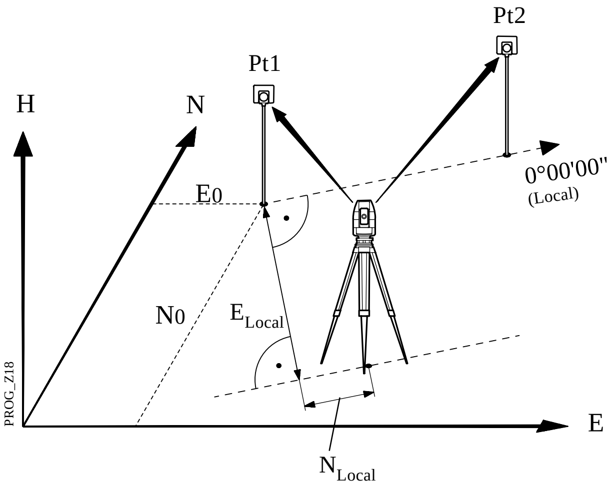
TR

Typical log file entry in the "TRAVERSE"

Local Resection

Introduction

This manual describes the "LOCAL RESECTION" program of the TPS SYSTEM 1000 theodolite series.



Two points are measured from any instrument station. The first point measured forms the centre of a local coordinate system (N=0; E=0; H=0). The second point measured determines the direction of the positive N - axis.
The distance between the two points must be at least 50 mm
The program can be used to deduce the three-dimensional local coordinates for the instrument station and the orientation of the horizontal circle from measurements to 2 target points. To compute the position coordinates, at least 4 elements (2 distances and 2 directions) are necessary.

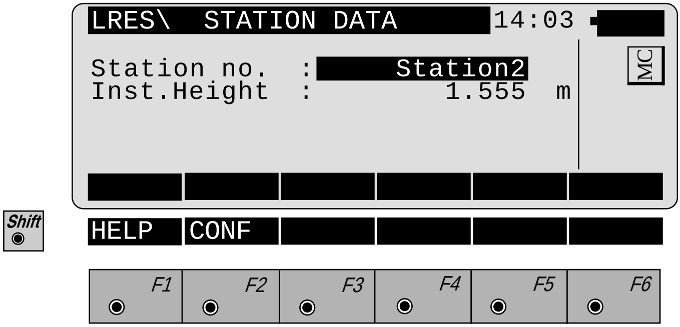
For simultaneous determination of the local station elevation, height of instrumentand height of reflector must already have been input.

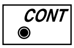
The program allows measurement in single or dual-face mode.

LR

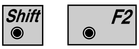
Station Data

Enter station point number and height of the instrument.

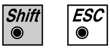




Proceed to the dialog "MEASURE POINT 1".



Start the "CONFIGURATION"



Quit program .

LR

Target Points

This dialog is similar to the TPS System 1000's basic "MEASURE MODE" dialog. Once the measurement to the first and to the second point is taken, the program will proceed to the dialog "RESULTS".

```
LRES\  MEASURE POINT 1   14:03
Point no.    :            12
Remark 1     :         -----
Refl.Height  :         1.300  m
Hz           :      2°10'20"
V            :     90°19'52"
Horiz.Dist.  :         -----  m
 ALL  DIST   REC  TARGT
Height diff  :         1.002  m
Easting      :       231.463  m
Northing     :        56.785  m
Elevation    :        72.235  m
```

Shift

```
HELP              I<>II
```

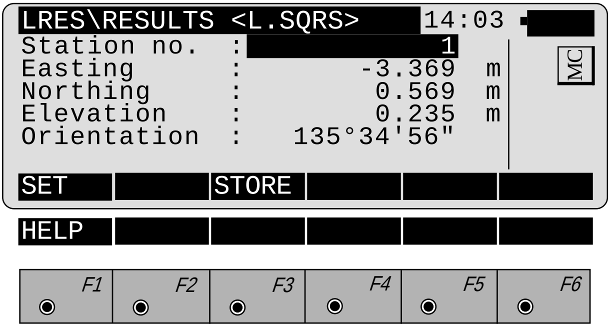
F1 F2 F3 F4 F5 F6

- **F1**: Simultaneously measure and record data on the active recording device.
- **F2**: Measure a distance.
- **F3**: Record the measurement on the active recording device.
- **F4**: Enter target data as described in *chapter "Measure & Record" of "SYSTEM" - user manual.*
- **Shift F4**: Change the theodolite face.
- **CONT**: Accept the measurement.
- **CODE**: Call up the CODE function, input of a code block.

LR

Calculation

In this dialog the calculated station coordinates are shown with orientation.



Station no : Station point number

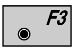
Easting : Calculated E (local) for the station

Northing : Calculated N (local) for the station

Elevation : Calculated Elevation (local) for the station

Orientation : Angular correction needed to orient the instrument

Set orientation and station coordinates on the instrument. Note that this key will end the program.



Record the following results on the active recording device:

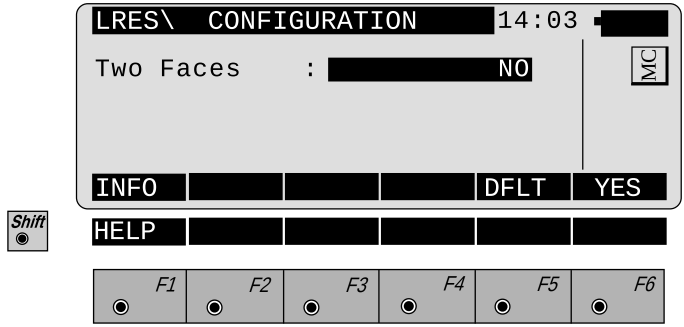
WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last reflector height used
WI 88	Instrument Height

Exit the program.

Configuration

Configuration Editor

Shift F2 — Start the "Configuration Editor" from the "STATION DATA" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces : **YES** for dual-face measurement, **NO** for single-face.

F1 — Displays date and version of the running application.

F5 — Set the value to the default. (Two Faces = NO, see display above)

CONT — Store the current configuration and proceed to the dialog "STATION DATA".

LR

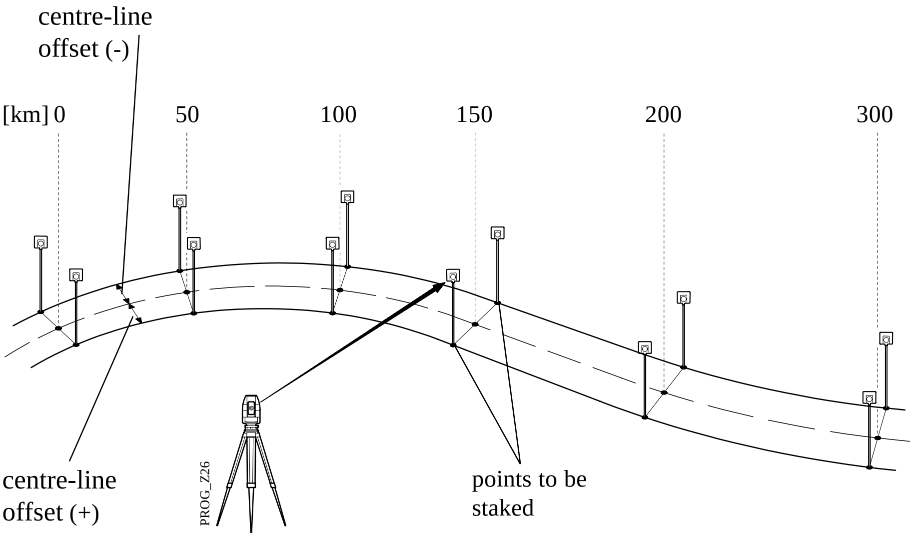
Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

Road line

Introduction

The manual describes the program "ROAD LINE" for the Leica TPS 1000 series.



The program is suitable for setting out points which are determined by chainage and centre-line offset along a calculated alignment. If V-alignments and cross-sections are defined for the alignment, the points can be calculated and set out spatially ("ROAD STAKEOUT").
Conversely, if a point in the vicinity of the alignment has been determined by measurement, the chainage and centre-line offset can be determined ("X-SECTION CHECK").
This version of "ROAD LINE" is only valid for a GSI configuration.

The program reads the geometrical elements of an alignment from files expressed in GSI format. The data for the alignment are grouped in accordance with the three components of an alignment. The file names must comply with certain rules:

1. Hz-alignment
   File name: **ALN?????.GSI**

2. V-alignment
   File name: **PRF?????.GSI**

3. Cross section
   File name: **CRS?????.GSI**

You can insert a permitted character for a DOS file name in place of a ? .

1. Permitted elements in the Hz-alignment

- **Straight** defined by chainage and coordinates of tarting point
- **Curve** defined by chainage and coordinates of starting point Radius of arc (- = left-hand curve + = right-hand curve)
- **Spiral** defined by chainage and coordinates of starting point parameter A[1] of spiral (negative parameter = spiral into left-hand curve)
- **End of project** (EOP) chainage and coordinates of end-point

RO

[1] $A^2 = L \times R$ where L = length of spiral; R = radius of curve

2. Permitted elements in V-alignments

- **Straight** defined by chainage and height of starting point
- **Curve** defined by chainage and height of starting point radius of arc (- = crest + = dip)
- **Parabola** defined by chainage and height of starting point parameters of parabola[1] (- = crest + = dip)
- **End of project** (EOP) chainage and height of end-point of gradient

3. Permitted elements in cross sections

- Chainage
- Offset
- Height difference relative to axis

To enter the data, you can use a PC and the program ROADDATA.EXE supplied, or you can use the program FILE EDITOR on the TPS 1000.

RO

[1] $2p \times (H - H_0) = (S - S_0)^2$ S_0, H_0 station and height of vertex

Program concept

The "**ALIGNMENT CALCULATION**" program only permits measurements in one face.

Before the program is started, the following procedures are carried out:

1. Setting user profile and name of the data file.

2. Determining the instrument station and the orientation

"ROAD STAKEOUT" requires the following input:

1. Chainage for the point to be set out

2. Offset and height displacement of the point to be set out, or zero point of cross section relative to axis (optional)

3. Selection of a point on the cross section (optional)

On the basis of this input, the coordinates of the point to be set out are determined and are transferred to the program "SETTING OUT" for post-processing.

The **"X-SECTION CHECK"** requires the following input:

1. Measurement to ground point

RO

The parameters calculated and displayed are respectively the chainage, the offset, and the height difference of the point measured with respect to the centre-line.

Selection of files

The files with the definitions for the Hz-alignment, the V-alignment and the cross sections are selected. The names of the files must be in accordance with the guidelines laid down in *section "Introduction"*.
The Hz-alignment must always be selected. The choice of a V-alignment and of transverse sections is optional. **If no V-alignment is selected, points can only be set out or inspected in two dimensions. Without V-alignments, no transverse sections can be selected.**

```
ROADL\ SELECT ALN FILES  14:03
Horiz.Aln.   :     ALNTEMP ▼
Vert. Aln.   :     PRFTEMP ▼      MC
Cross Secs   :     CRSTEMP ▼
Log FlName   :    ROAD.LOG
```

Shift

```
HELP  CONF
```

F1	F2	F3	F4	F5	F6

Horiz.Aln : Selects definition of Hz-alignment.

Vert. Aln : Selects definition of gradient (optional)

Cross Secs : Selects definition of cross section. (optional)

Log FlName : Name of the log file in use.

RO

Shift F2 Start the "Configuration".

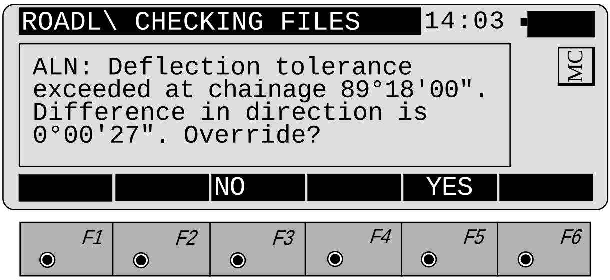
CONT Continues with dialog "CHECKING FILES".

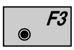
Checking files

The files selected are inspected for **formal** input errors and for **geometrical** deviations.

The job identification for the three input files is inspected, as are possible errors in the data format e.g. missing or incorrect word index (WI). Errors are indicated by appropriate messages. The inspection can be continued or interrupted. **If serious formal errors are found, the inspection is aborted.**

Geometrical deviations include the tangent directions of adjacent elements and the chord lengths of elements. Deviations which exceed the permitted tolerance are displayed. The inspection of the files can be continued or interrupted.





After inspection, the program returns to Dialog 2. The input values can be corrected, either on a PC using the program "ROADDATA.EXE" or on the TPS1000 using the programm "FILE EDITOR".

RO

F5

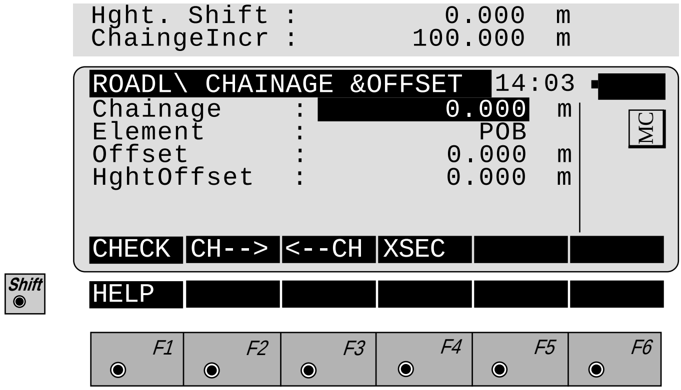
Exceeding the permitted tolerance is accepted and the inspection is continued. Longitudinal errors are distributed proportionally by changing the scale. Because of the variable curvature, deviations in the tangential direction are not taken into account.

When the program is called up again, the permitted tolerance is inspected only if the data have been changed or if the tolerance limits have been changed.

RO

Chainage and centre-line offset

The dialog is used to enter the longitudinal and cross section data for a point to be set out, or to call the function "X-SECTION CHECK".



Chainage : The present chainage for "STAKEOUT". After setting-out is completed, the chainage is automatically changed to the next value divisible by ChaingeIncr. The chainage of the main points (change of elements) is displayed independently of ChaingeIncr. Any desired chainage can be keyed in. For the function "X-SECTION CHECK" the values displayed and data from the cross section do not influence the calculation in the "X-SECTION CHECK".

RO

Element : The element type on which the chainage displayed is located.
The elements are output in full. Both adjacent elements are displayed in the main points.

Offset : Horizontal displacement (offset) of the point to be set out in relation to the centre line.

HghtOffset : Height displacement of the point to be set out in relation to the centre line. (The amount of the vertical displacement is also taken into account.)

Hght. Shift : All heights in the alignment are changed by this amount. The value can only be changed in the dialog "CONFIGURATION".

ChaingeIncr : The chainage difference when setting out. The chainage is automatically incremented by this amount.

F1 Calls the function "X-SECTION CHECK".

F2 Displays the next chainage up which is divisible by ChaingeIncr. If the end of the alignment is overshot, a warning is given once. After the end of the alignment, the calculation is based on the tangent of the last element.

F3 Displays the next chainage down which is divisible by ChaingeIncr. If there is a shortfall at the beginning of the alignment, a warning is given once. Before the beginning of the alignment, the calculation is based on the tangent of the first element.

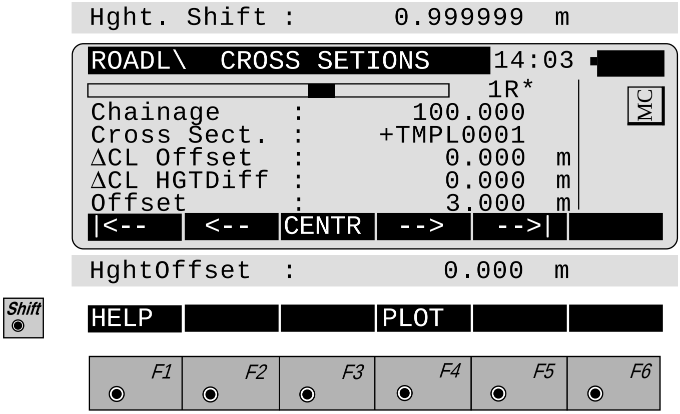
F4 Calls the dialog "CROSS SECTIONS".

CONT Calls the dialog "POINT COORDINATES" in order to display the coordinates of the point to be set out. From there, calls the program "STAKEOUT".

RO

- **Selecting points in the cross section**

For setting out, points on the defined cross section can be selected.



1R : Numbering the profile points from the centre line outwards: 1L, 2L, 3L, etc. for points to the left; 1R, 2R, 3R etc. for points to the right. The centre of the cross-sectional profile is numbered 0C. Points already set out are marked * . The display bar displays in graphical form the position of the point in the profile.

Chainage : Chainage currently valid.

Cross Sect. : Name of the valid cross section. A different profile can be searched for.

ΔCL Offset : Horizontal distance from the centre of the profile to the current profile point.

ΔCL Hgt Diff : Vertical distance from the centre of the profile to the current profile point.

RO

Offset : Horizontal displacement (centre-line offset) of the centre of the X-section by this amount.

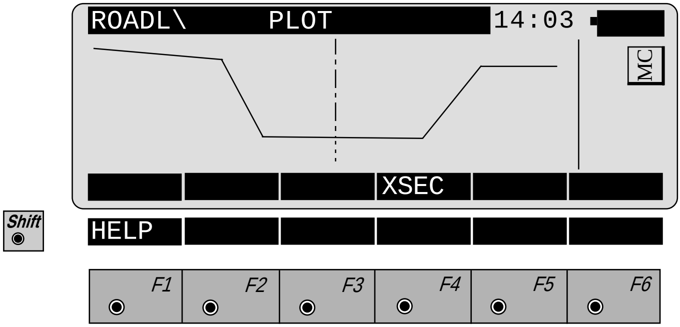
HghtOffset : Height displacement of the centre of the X-section
(The value of the HghtOffset is also taken into account.)

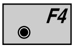
Hght. Shift : All heights in the alignment are changed by this amount. The value can only be altered in this dialog.

F1	Displays far-left profile point.
F2	Displays profile point one place further to the left.
F3	Displays centre of profile.
F4	Displays profile point one place further to the right.
F5	Displays far-right profile point.
Shift F4	Displays diagram of cross section.
CONT	Calls dialog "POINT COORDS" to display coordinates of point to be set out. From there, calls program "STAKEOUT".

- **Plot**

A simple diagram of the cross section is displayed. The vertical scale is exaggerated three times.



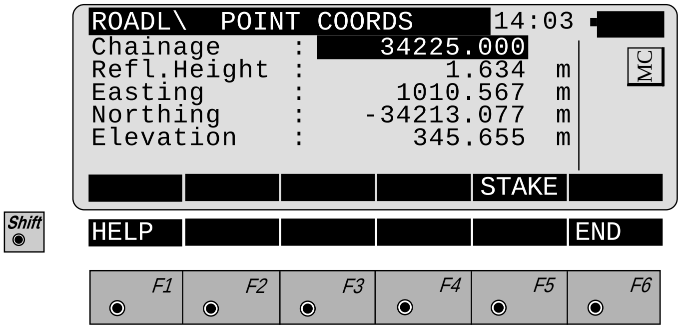


Returns to dialog "CROSS SECTION".

RO

Stakeout

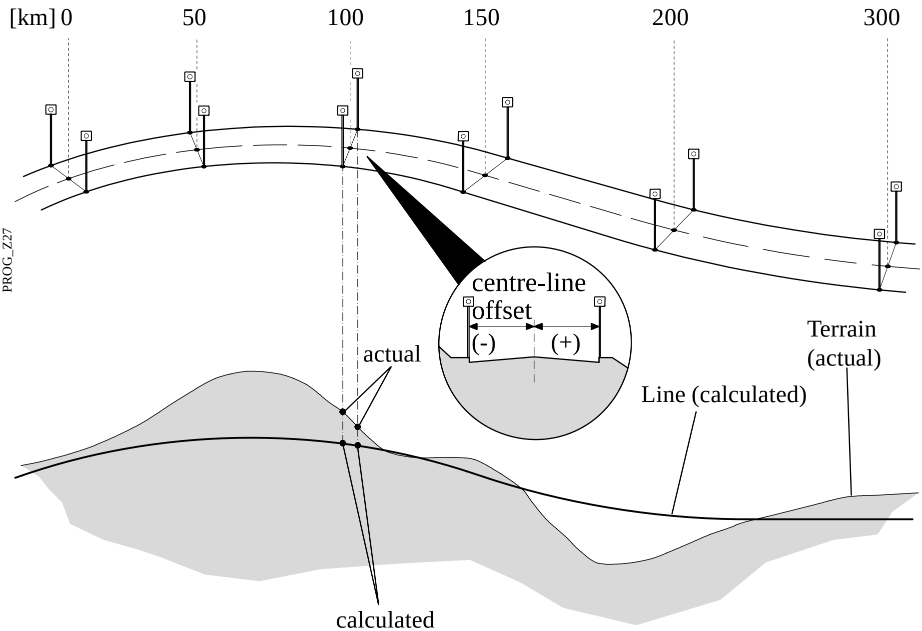
The coordinates of a stakeout point are displayed and passed to the program "STAKEOUT".



The coordinates calculated from the input values of the dialog "CHAINAGE & OFFSET" or "CROSS SECTION" are displayed.

F5 or CONT

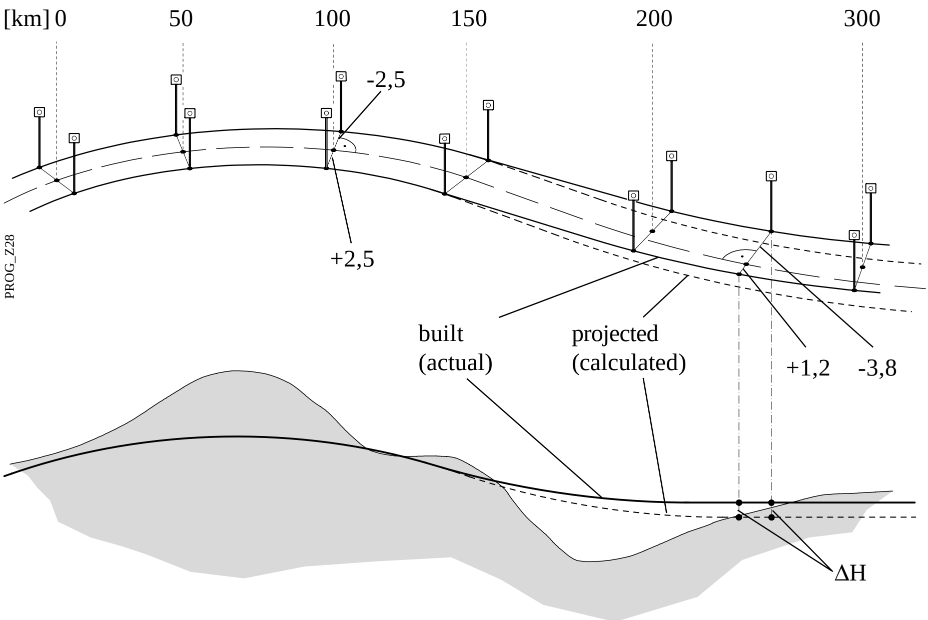
Calls program "STAKEOUT". The coordinates displayed are transferred.

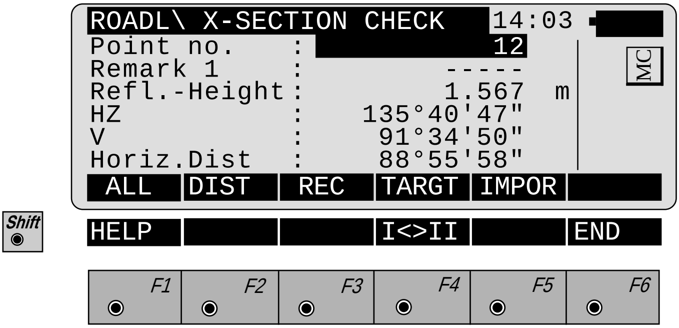


RO

The function "X-SECTION CHECK" is called in the dialog "CHAINAGE & OFFSET".
Any desired point in the topography is measured.
The program calculates
- the chainage,
- the offset and
- the height difference

of the point in relation to the defined centre line.





This displays the defined standard measuring dialog, which may be different from the one depicted above.

F1 — Measures and records in the active file and goes on to display the chainage and the offset relative to the centre-line definition.

F2 F3 — Measures the distance. Stores the measurement in the active file and goes on to display the chainage and the offset of the point.

F2 CONT — Measures the distance. Does not store the measurement. Goes on to display the chainage and the offset relative to the centre-line definition.

F4 — Enters the target-point data. This function is described in *chapter "Measure & Record" of "SYSTEM" - user manual.*

RO

F5 — For manually entering the coordinates of a point, or for reading in the active coordinate file. Displays the chainage and the offset of the point.

CODE — Calls the code function.

Display of results

Displayed are
- chainage,
- offset and
- height offset

in relation to the **centre line**.

```
Hght. Shift :        0.000  m
ChaingeIncr :      100.000  m

ROADL\ CHAINAGE &OFFSET 14:03
Chainage      :      23.456  m
Element       :Straight line
Offset        :      -3.553  m
HghtOffset    :       0.254  m

CHECK  CH-->  <--CH  XSEC
Shift
HELP          STORE
F1     F2     F3     F4     F5     F6
```

Chainage : The chainage of the point measured is displayed.

Element : The type of element on which the point measured is located. The names of the elements are displayed without abbreviation. In the main points, the two adjacent elements are displayed.

Offset : Horizontal displacement (offset) of the point measured in relation to the centre line. If several results are available (eg, at tight corners) the point with the shortest distance to the centre line is indicated. By changing the calculation limits in the configuration, the calculation range can be limited and as a result, the found stationing can be influenced.

RO

HghtOffset : Height displacement of the point measured in relation to the centre line. (The amount of the vertical displacement is also taken into account.)

Hght. Shift : All heights in the alignment are changed by this amount. The value can only be changed in the dialog "CONFIGURATION".

ChaingeIncr : The chainage difference when setting out. The chainage is automatically incremented by this amount.

F1 — Re-calls the function "X-SECTION CHECK".

F2 — *See section "Chainage and centre-line offset".*

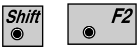
F3 — *See section "Chainage and centre-line offset".*

Shift F3 — The result of the road station and offset is stored.

F4 — *See section "Chainage and centre-line offset".*

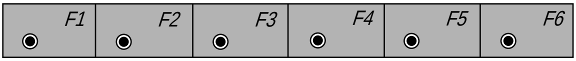
CONT — *See section "Chainage and centre-line offset".*

Configuration Editor



Start the "Configuration Editor" from the "**SELECT ALN FILES**" dialog.

```
ROADL\  CONFIGURATION     14:03
BaseChainge :          0.000
End Chainge :          0.000
ChaingeIncr :        100.000  m
Hght. Shift :          0.000  m
Deflct.Tol. :      0°00'16''
ChaingeTol. :             10  m
INFO                    DFLT EDIT
3D Stake    :             ON
Log File    :            OFF
Log FlName  :       ROAD.LOG
HELP
```



The parameters defining the further course of the program are determined in the "Configuration Editor":

BaseChainge : Setting the starting point for calculation when in the "X-SECTION CHECK" function.

EndChainage : Setting the end point for calculation in the "X-SECTION CHECK" function.

ChaingeIncr : Difference in chainage when setting out. The chainage is automatically incremented by this amount.

Hght. Shift : All heights in the alignment are changed by this amount. The value can be changed only when you are in this dialog.

RO

Deflct.Tol. : Permissible deviation of the tangent directions for adjacent elements. A message appears if this value is exceeded. The input is always in milligon.

ChaingeTol. : Permissible deviation of the (chord) length of an element and of the distance calculated from the end-point coordinates, expressed in the length units set. A message appears if this value is exceeded.

3D Stake : ON for setting out positions and heights. The height can be set out only if the V-alignment has been defined. OFF for setting out only positions. Neither a V-alignment nor a typical cross-section can be set out.

Log File : Set to ON, the program will record measurement data in a log file in the format described on *page 190*.

Log FlName : Enter the log file name.

F1 Displays date and version of the program.

F5 Sets standard values . The values are displayed in dialog *on page 188*.

CONT Accepts and stores parameters displayed. Continues to display "SELECT ALN FILES".

RO

Log File

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header includes:
- the program used,
- information about the instrument,
- the file to store the measurement data,
- the date and the time.

Configuration the name of the input files for:
- the Hz-alignment,
- the V-alignment and
- the transverse section.

Measurement
- Instrument station with coordinates and instrument height.
- Stakeout point with chainage,
- offset[1] and height displacement[2] relative to centre line,
- comparison values from planning, and associated differences.

For the alignment inspection,
- the coordinates of the point measured are stored along with
- the associated station,
- the offset and
- the height difference.

[1] This value results from
- the displacement of the zero point of the profile and
- the displacement taken from the transverse profile.

[2] This value results from
- the displacement of the zero point of the profile and
- the displacement taken from the transverse profile
- the height displacement in the configuration.

```
Leica VIP Road line V 2.10
Instrument       :  TCM1800, Serial 410000, TCM1800
User templ.      :  User 1
Meas. file       :  FILE01.GSI
Program Start    :  02/07/1996 at 10:43

Hz-alignment     :  ALNMSPLZ.GSI
V-alignment      :  PRFMSPLZ.GSI
Cross Sect.      :  CRSMSPLZ.GSI

Station no.      :  TRASSE
                    E= -10.0000m    N= 25.0000m    ELV= 400.0000m    hi= 0.0000m

Point no.        :  3386
Chainage         :  49.2812, Offset= -4.9130m,     HghtOffset=  0.2473m
As Measured      :  E= -11.6393m,   N=  27.8821m,  ELV= 400.8301m

Point no.        :  3386
Chainage         :  49.2812, Offset= -4.9130m,     HghtOffset= 0.2473m
Design           :  E= -11.6391m,   N= 27.8823m,   ELV= 400.8301m
Staked           :  E= -11.6394m,   N= 27.8830m,   ELV= 400.8266m
Deltas           :  dE=  0.0004m,   dN= -0.0007m,  dELV= 0.0035m
```

Example of a log file for the program "ROAD LINE"

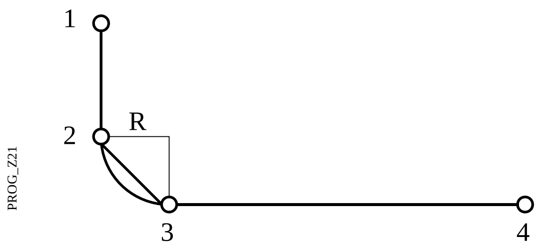
RO

Data format

This section describes the input-data format for the Hz-alignment, the V-alignment and the cross section. To enter the data, you can use a PC and the program "ROADDATA.EXE" supplied, or you can use the program "FILE EDITOR" on the TPS 1000.

Hz-alignment

The definition of the road elements is based on the main points (= starting and finishing points of the geometrical element) and on the element parameters. Refer to the example in the next diagram.



The alignment starts at main point no. 1 and finishes at main point no. 4.
Here, the geometrical elements are:
Straight - curve - straight.
The curve radius is R**.**

The starting point of a geometrical element is also the finishing point of the preceding adjacent element.

RO

Element	Defined by:	Declaration
Straight	Starting point [E, N]	STRAIGHT
Arc	Start of curve [E, N], radius R.	000CURVE
Spiral into curve starting with R=∞ *)	Start of curve [E, N], A-parameter	00SPIRIN
Spiral out of curve ending at R= ∞*)	Start of curve [E, N], A-parameter	0SPIROUT
End of project	End point [E, N]	00000EOP

*) The spiral must begin or end with R = ∞ .

The Hz-alignment file is structured as follows:

1. Header
2. Data block: Definition 1st geometrical element
3. Data block: Definition 2nd geometrical element
4. Data block: Definition 3rd geometrical element

.....

n. Data block: Definition of end of project

The **header**

41....+00Job-ID 42....+HZALIGNM 43....+STACOORD

RO

WI 41 Job-ID: Job identification consists of 8 alphanumeric characters.

WI 42 Fixed name of the Hz-alignment file. May not be changed.

WI 43 Fixed name of the main-point method. May not be changed.

The **data block**

```
11....+0STATION 71....+GEOM_ELE 72....+RAD/PARA 73....+TEMPLATE
81..10+00000000 82..10+00000000
```

WI 11 STATION: Chainage at the start of the element. 8-digit number.

WI 71 GEOM_ELE: Geometrical element according to table *page 190* (STRAIGHT, 000CURVE, 00SPIRIN, 0SPIROUT, 00000EOP).

WI 72 RAD/PARA: Arc radius or A-parameter for the spirals. 8-digit number.
If WI 71 = STRAIGHT / 00000EOP, then WI 72 = 00000NON.
Sign:
+, for curves to the right (centre of circle to the right of the alignment),
-, for curves to the left (centre of circle to the left of the alignment).

WI 73 TEMPLATE: Name/number of the cross-sectional profile for the geometrical element defined in WI 71. 8 alphanumeric characters. The following combinations are reserved and are not to be used: 00000NON and LASTTMPL.

WI 81 E-coordinate of the main point (starting point, start of curve, end point according to table *page 190*). 8-digit number.

WI 82 N-coordinate of the main point (starting point, start of curve, end point according to table *page 190*). 8-digit number.

RO

Also:

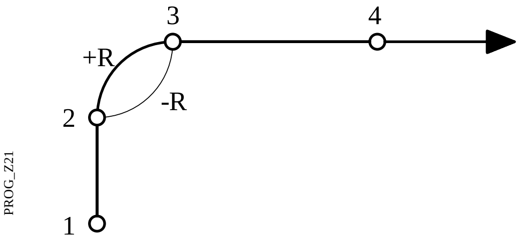
- The header is always at the beginning of the file.
- The Hz-alignment file must always contain at least two elements.
- The units and decimal places used in the WIs 11 and 72 are in accordance with the definitions in WIs 81 and 82.
- The chainage is produced from the sum of the element lengths.
- A cross-sectional profile may be assigned more than once.
- Geometrical elements can be combined freely, for example as:
  - Transition curve (straight - spiral - arc)
  - Vertex spiral (straight - spiral into curve
  - spiral out of curve - straight)

  Unusual applications are also possible:

  - Breakpoint (straight - straight)
  - Right-angle (straight - straight, or straight - 90° arc - straight)
- There is no limitation on the size of the Hz-alignment file. As a result, as many data blocks as required can be entered if a file is created on the PC using the DOS program "ROADDATA.EXE". If a file is created/edited using the program "FILE EDITOR" on the TPS1000 there is a limitation of 200 data blocks.

Check your data for errors (typing errors, signs etc.) before you load it into the memory card.

The program supports the user during the setting-out by controlling the length of curves. It compares the length of the element from the chainage (WI 11) with the calculated main-point values, thus enabling input errors in the chainage or in the coordinates to be detected. However, the signs of arcs and of spirals are not checked (see example below).



If the wrong sign (-R) is used, the arc is mirrored between the main points 2 and 3.

Example: S-line with a straight connection

```
410001+Example1 42....+HZALIGNM 43....+STACOORD

110002+00000000 71....+STRAIGHT 72....+00000NON 73....+Tmpl0125
81..10+02000000 82..10+06000000

110003+00198832 71....+00SPIRIN 72....-00122474 73....+Tmpl0123
81..10+02186841 82..10+06068005

110004+00348832 71....+000CURVE 72....-00100000 73....+Tmpl0123
81..10+02307751 82..10+06150344

110005+00450725 71....+0SPIROUT 72....-00100000 73....+Tmpl0123
81..10+02304071 82..10+06247816

110006+00550725 71....+STRAIGHT 72....+00000NON 73....+Tmpl0125
81..10+02227794 82..10+06310759

110007+00714138 71....+00SPIRIN 72....+00054772 73....+Tmpl0124
81..10+02086275 82..10+06392465

110008+00789138 71....+000CURVE 72....+00040000 73....+Tmpl0124
81..10+02037807 82..10+06445859

110009+00824376 71....+0SPIROUT 72....+00044721 73....+Tmpl0124
81..10+02048886 82..10+06478120

110010+00874376 71....+STRAIGHT 72....+00000NON 73....+Tmpl0125
81..10+02094478 82..10+06496445

110011+01127904 71....+00000EOP 72....+00000NON 73....+Tmpl0125
81..10+02344154 82..10+06540469
```

RO

The project start is at the nadir. After the first straight there follows a left curve, then a right curve. There are also spirals and a straight between the arcs.

The cross sections are assigned as follows:

Straight	Tmpl0125
Left curve	Tmpl0123
Right curve	Tmpl0124

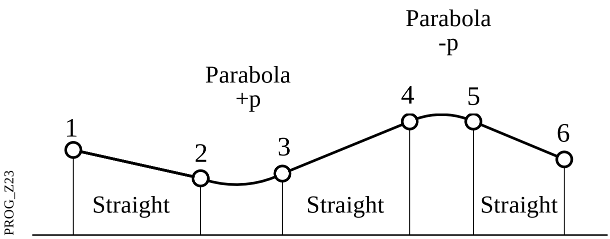
The last character at the end of each data line must be a space (ASCII character 32).

WI 11 and WI 41: The block number is located from position 3 to 6.

- **V-alignment**

The V-alignment definition (= V-alignment)

The V-alignment is defined with the main points (1 - 6). The main points form the starting and finishing points



of the geometrical elements. The starting point of one element is also the finishing point of the previous element.

RO

Element	Defined by:	Declaration
Straight	Starting point [chainage, H]	STRAIGHT
Arc	Start of curve [chainage, H], radius R.	000CURVE
Parabola	Start of curve [chainage, H], parabola parameter p	PARABOLA
End of project	Finishing point [chainage, H]	00000EOP

The V-alignment file is structured as follows:

1. Header
2. Data block: Definition 1st geometrical element
3. Data block: Definition 2nd geometrical element
4. Data block: Definition 3rd geometrical element

.....

n. Data block: Definition of end of project

The **Header**

```
41....+00Job-ID 42....+0VALIGNM 43....+STACOORD
```

WI 41 Job-ID: Job identification consists of 8 alphanumeric characters.

WI 42 Fixed name of the V-alignment file. May not be changed.

WI 43 Fixed name of the main-point method. May not be changed.

RO

The **Data block**

11....+0STATION 71....+GEOM_ELE 72....+RAD/PARA 83..10+00HEIGHT

WI 11 STATION: Chainage (from the Hz-alignment) at the start of the element. 8-digit number.

WI 71 GEOM_ELE: Geometrical element according to table *page 195* (STRAIGHT, 000CURVE, PARABOLA, 00000EOP).

WI 72 RAD/PARA: Arc radius or parabola parameter. 8-digit number.
If WI 71 = STRAIGHT / 00000EOP, then WI 72 = **00000NON**.
Sign: "+" = dip, "-" = crest

WI 83 HEIGHT: Height H of the main point (starting point, start of curve, end point, in accordance with table *page 195*). 8-digit number.

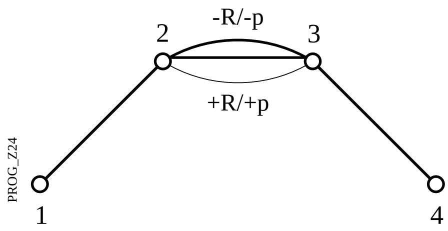
Also:

- The header is always at the beginning of a data file.
- The V-alignment file must be composed of at least two parts (starting- and finishing point).
- The units and decimal places used in the WIs 11 and 72 are in accordance with the definition in WI 83.
- The chainage is given by the sum of the horizontal element lengths.
- Geometrical elements can be combined freely.
- There is no limitation on the size of the V-alignment file. As a result, as many data blocks as required can be entered if a file is created on the PC using the DOS program "ROADDATA.EXE". If a file is created/edited using the program "FILE EDITOR" on the TPS1000 there is a limitation of 200 data blocks.

RO

Check your data for errors (typing errors, signs etc.) before you load it into the memory card.

An example of the wrong sign used with an arc of radius R or with the parabola parameter p:



If the wrong sign (+R/+p) is used, the summit becomes a trough.

Example: Crest and dip

```
410001+Example1 42....+0VALIGNM 43....+STACOORD
110002+00000000 71....+STRAIGHT 72....+00000NON 83..10+00400000
110003+00300000 71....+PARABOLA 72....-01142936 83..10+00422500
110004+00500000 71....+STRAIGHT 72....+00000NON 83..10+00420000
110005+00550000 71....+PARABOLA 72....+02091126 83..10+00415000
110006+00850000 71....+STRAIGHT 72....+00000NON 83..10+00406522
110007+01127904 71....+00000EOP 72....+00000NON 83..10+00418605
```

RO

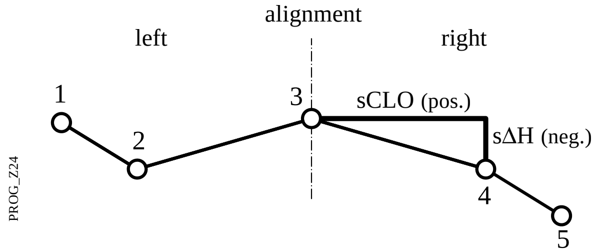
The last character in each data line must always be a space (ASCII character 32).

WI 11 and WI 41: The block number is located from position 3 to 6.

- **Cross sections**

The points in the cross section are defined in accordance with:

- the centre-line offset sCLO (neg.: pt. left / pos.: pt. right) and
- the height difference sH related to the alignment point (neg.: pt. lower / pos.: pt. higher than alignment)



Aspect:
chainage increasing

Element	Defined by:	Declaration
Height difference	Planned height difference with respect to alignment	-
Centerline offset	Planned centre-line offset	-

The template file is structured as follows:

1. Header
2. Data block: Cross section 1 / point no. 1
3. Data block: Cross section 2 / point no. 2
4. Data block: Cross section 3 / point no. 3

.....

n. Data block: Cross section x / point no. y

RO

The **Header**

```
41....+00Job-ID 42....+TEMPLATE
```

WI 41	Job-ID: Job identification consists of 8 alphanumeric characters.
WI 42	Fixed name of the template file. May not be changed.

The **data block**

```
11....+TMPLNAME 35..10+DISTANCE 36..10+000HDIFF
```

WI 11	TMPLNAME: Name/number of the cross section, consisting of 8 alphanumeric characters. The following designations are reserved and may not be used: 00000NON and LASTTMPL.
WI 35	DISTANCE: Centre-line offset of a transverse-profile point. 8-digit number.
WI 36	HDIFF: Height difference of a transverse-profile point. 8-digit number

Also:

- The header must always be at the start of a data file.
- The file must contain at least one cross section.
- Profile points belonging to the same cross section must always be together in a single data set. The points need not be sorted within the data set.
- The individual transverse-profile data sets need not be sorted within the template file.
- For a cross section file there is a limitation of 200 data blocks. The maximum number of points in a cross section is 48.

Recommendation:
If in general you prepare an empty template (only the zero point), you can at any time choose this template in order to manually enter points or to call up axis points. Call this template something like AXIS or EMPTY.

Check your data for errors (typing errors, signs etc.) before you load it into the memory card.

Example: Cross section

```
41....+Example1 42....+TEMPLATE
110002+Tmpl0123 35..10-00013000 36..10-00003000
110003+Tmpl0123 35..10-00010000 36..10-00005000
110004+Tmpl0123 35..10-00004000 36..10-00000100
110005+Tmpl0123 35..10+00004000 36..10+00000100
110006+Tmpl0123 35..10+00010000 36..10-00006000
110007+Tmpl0123 35..10+00013000 36..10-00003500
110008+Tmpl0124 35..10-00012000 36..10-00002000
110009+Tmpl0124 35..10-00011000 36..10-00004000
110010+Tmpl0124 35..10-00004000 36..10+00000100
110011+Tmpl0124 35..10+00004000 36..10-00000100
110012+Tmpl0124 35..10+00011000 36..10-00005000
110013+Tmpl0124 35..10+00012000 36..10-00002500
```

RO

The last character at the end of each data line must always be a space (ASCII-character 32).

WI 11 and WI 41: The block number is located from position 3 to 6.

The Road - Data Entry program

The Leica "ROADDATA.EXE" for providing setting-out data files

Once the alignment has been designed using road-design software, the resulting data consist of main points, element parameters and cross sections. These data must be brought into a structure which can be loaded into the memory card. There are two ways to product the three setting-out data files (Hz-alignment file, V-alignment file and transverse-profile file):

a) writing an individually-customised program to automatically generate and convert the necessary data

b) entering the data by hand into the Leica "ROADDATA.EXE" program. The program offers a convenient way of entering the values by offering suitable menu controls. The program reformats the data into the structure required.

Once the three setting-out data files are ready, all you need to do is to transfer the data into the memory card, using a suitable transfer program.

Using the "ROADDATA.EXE" program

- Copy the program from the diskette to your hard disk, using the DOS command

  COPY

  and from there into e.g. disk drive C:\.

- Start the program with the command

  C:\>roaddata

- Follow the menu directives. An integrated Help function gives you support, particularly when you are using the keyboard commands.

COGO

Introduction

This manual describes the "**COGO**" program of the TPS SYSTEM 1000 theodolite series.
The following provides a general overview of the individual COGO functions.

The "**Inverse**" routine computes the direction and distance between two points.

The "**Traverse**" routine computes a new coordinate point given a direction and distance from a known point (Polar plotting).

The "**Intersections**" routine computes:

- Bearing-Bearing intersections,
- Bearing-Distance intersections or
- Distance-Distance intersections.

The function "**Offsets**" consists of the following subfunctions:

- "Distance point straight line"
  Calculates the difference in length/abscissa and the lateral deviation/ordinate with reference to a basis line emanating from a known point.
- "Orthogonal point calculation"
  A new point can be calculated which emanates from a basis line using the difference in length/abscissa and the lateral deviation/ordinate.

The "**Point Arc**" routine computes a radius point given any three points.

The point coordinates can either:
- be determined by measurement,
- entered manually using a keyboard or
- read from the memory card.

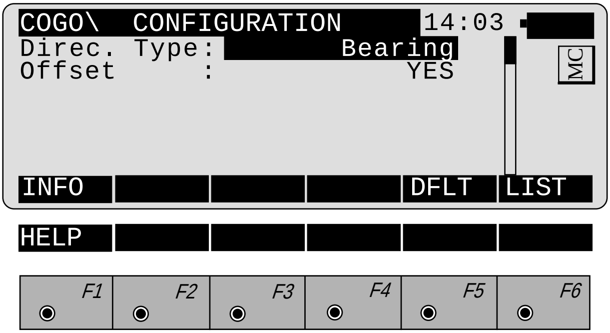
Data, both measured and read from the file, can be mixed. This means, however, that station coordinates and orientation have to be correctly set.

Directions and distances can be entered manually, called up or freshly determined. The values can then be amended by means of multiplication, division, addition and subtraction.

The program "Stakeout" can be called up directly from the individual result dialog boxes (if available) in order to set out the points immediately.
The program "Stakeout" assumes that the instrument is set and oriented to a known point.

Shift F2

Start the "Configurations Editor" from the "**COGO MENU**" dialogue.



The "Configuration Editor" sets parameters for further program operations:

Direc. Type : Bearing
Azimuth

Offset : **YES** entering a parallel displacement is possible
NO entering a parallel displacement is not possible

F1 — Displays date and version.

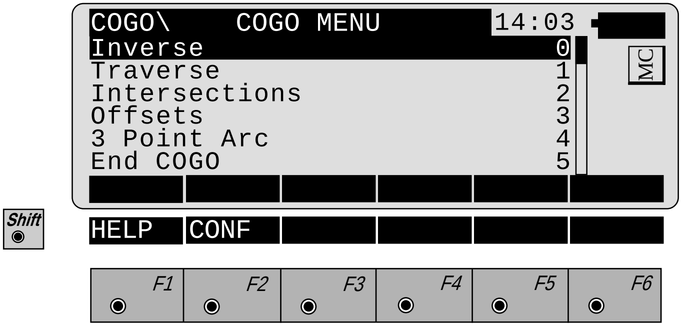
F5 — Set all values to default. The values are shown in *the dialogue above*.

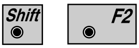
CONT — Accept displayed values and proceed to the dialogue "**COGO MENU**".

Shift ESC — Exit the program.

CO

Function selection (COGO Menu)



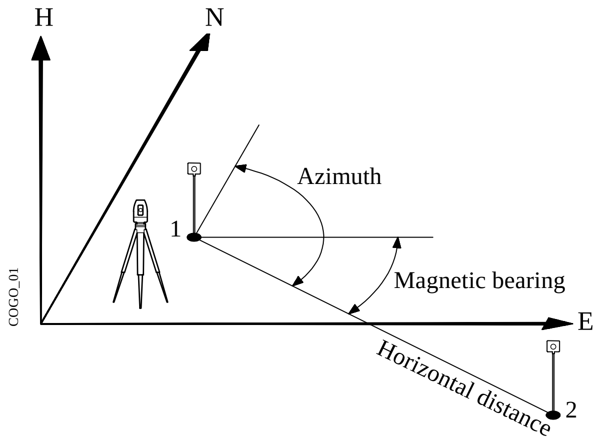


Call up the "Configuration-Editor".

CO

Inverse (polar calculation)

Computes distance and direction between two points.

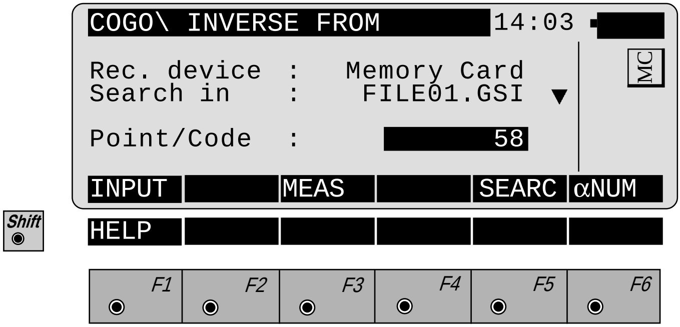


Search	:	• Direction (magnetic bearing or azimuth) • Horizontal distance
Given	:	• point 1 (y, x) • point 2 (y, x)

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 (and/or 2) can be determined by measurement.

CO

0 — Call up the function in the "**COGO MENU**" dialog.



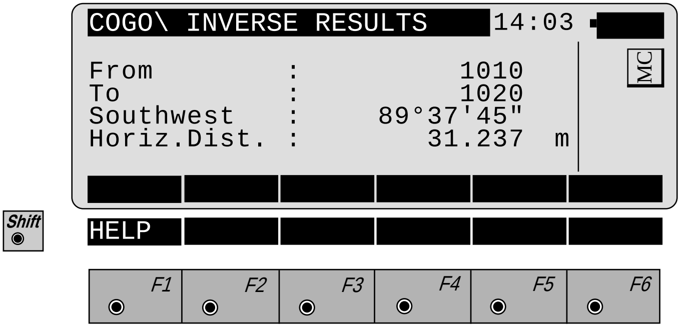
F1 — Manual entering of the first (second) point of the straight line. The standard TPS 1000 input dialog box appears.

F3 — Measuring the first (second) point of the straight line. This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System" - user manual*.

CONT or F5 — Search for the coordinates of the first (second) point in the coordinate file. This function is described in *chapter "Setups" (Import function) of the "System" - user manual*.

Shift ESC — Exit the program.

The following dialog box shows the result of the polar calculation from both the given points:



From : Display of point number of the first point

To : Display of point number of the second point

Southwest : Display of magnetic bearing. If "**Azimuth**" is selected in the configuration during "**Direc. Type:**", then the azimuth will be displayed between both the points.

Horiz.Dist. : Display of horizontal distance between the points

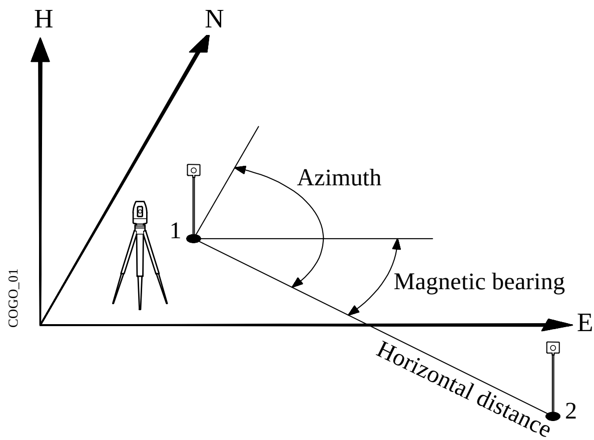
CONT — Return to "**COGO MENU**".

Shift ESC — Exit the program.

CO

Traverse

Computes a new point given a direction and distance from a known point.

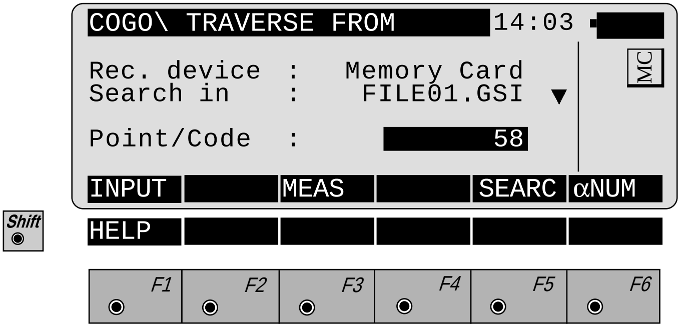


Search : • point 2 to be accetped (Y, X)

Given : • point 1 (Y, X),
• Direction (magnetic bearing or azimuth),
• Horizontal distance.

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 can be determined by measurement.

1 Call up the function from the "**COGO MENU**".



F1 Manual entering of the first point. The standard TPS 1000 input dialog box appears.

F3 Measuring the first point.
This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System" - user manual*.

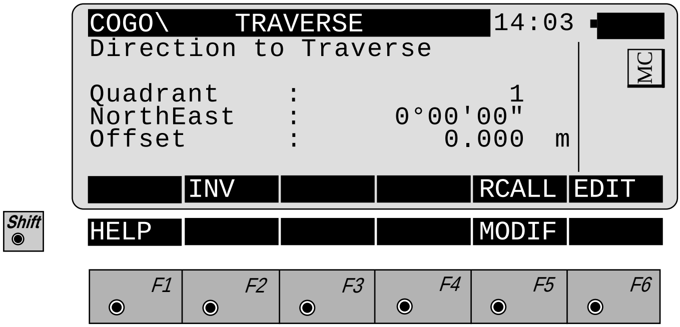
CONT or **F5** Search for the coordinates of the first point in the coordinate file. This function is described in *chapter "Setups" (Import function) of the "System" - user manual*.

Shift **ESC** Exit the program.

CO

Defining direction by magnetic bearing

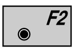
If "**Bearing**" is selected in the configuration during "**Direc. Type:**", then the following dialog box appears:



Quadrant : Enter quadrant:
1 = NorthEast
2 = SouthEast
3 = SouthWest
4 = NorthWest

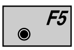
Northeast : Enter magnetic bearing

Offset : Enter parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset

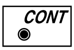


Determining the direction by means of the function "**Polar calculation**"*(refer to chapter "Inverse").*

CO



INPUT — Enter quadrant, magnetic bearing.
RCALL — Call up of a direction which has been previously stored using the function "**Polar calculation**".



Accept displayed values and proceed with *dialogue "TRAVERSE" (page 218).*

Shift F5 — *Changing the direction* see under existing dialog box *"MODIFY BEARING"*

Shift ESC — Exit the program.

```
COGO\  MODIFY BEARING          14:03
NorthEast     :       0°00'00"
Multiply      :          -----
Divide        :          -----
Add           :       0°00'00"
Subtract      :       0°00'00"
NorthEast     :       0°00'00"
                                 EDIT
```

Shift

```
HELP
```

F1	F2	F3	F4	F5	F6

NorthEast : Display of entered magnetic bearings *(ref. to dialogue "TRAVERSE", page 214)*

Multiply : Entering multiplication factor

Divide : Entering division factor

Add : Entering angle for a correction to the right

Subtract : Entering angle for a correction to the left

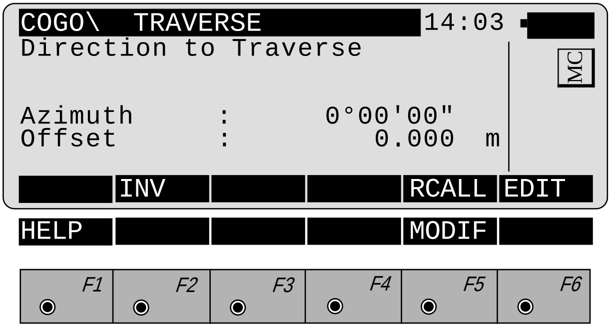
NorthEast : Display of corrected magnetic bearings

CONT — Accept displayed values and proceed with *dialogue "TRAVERSE" (page 218).*

CO

Defining direction by Azimuth

If "**Azimuth**" is selected in the configuration during "**Direc. Type:**", then the following dialog box appears:



Azimuth : Entering Azimuth

Offset : Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset

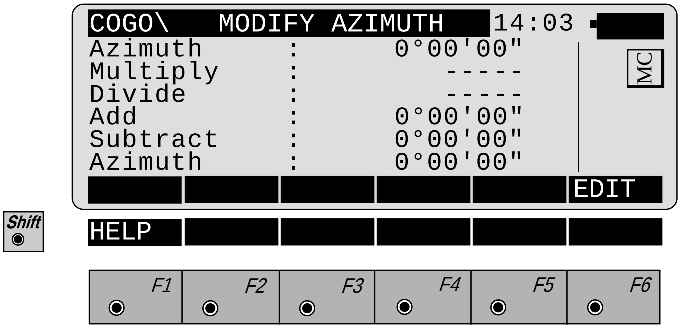
F2 — Determining the direction by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 — INPUT: Entering Azimuth
RCALL: Call up of a direction which has been previously stored using the function "**Polar calculation**".

CONT — Accept displayed values and proceed with *dialogue "TRAVERSE" (page 218).*

Shift F5 — Changing the direction *(refer to dialogue "MODIFY AZIMUTH ", page 217)*

Shift ESC — Exit the program.



Azimuth : Display of entered Azimuth *(ref. to "TRAVERSE", page 216)*

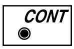
Multiply : Entering multiplication factor

Divide : Entering division factor

Add : Entering angle for a correction to the right

Subtract : Entering angle for a correction to the left

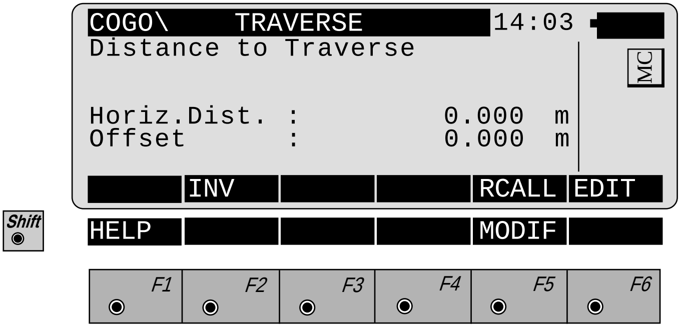
Azimuth : Display of corrected Azimuth



Accept displayed values and proceed to *dialogue "TRAVERSE" (page 218).*

CO

Defining horizontal distance



Horiz Dist : Entering horizontal distance

Offset : Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset

F2 — Determining the distance by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

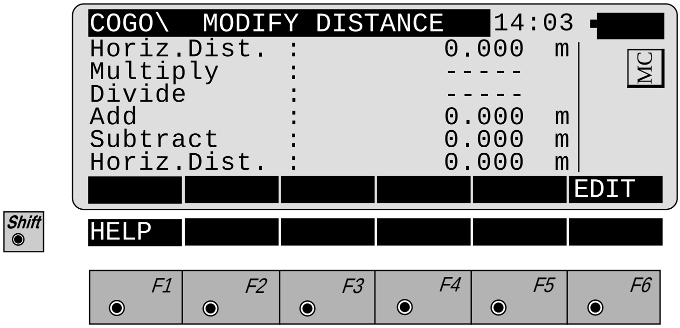
F5 — INPUT: Entering horizontal distance
RCALL: Call up of a distance which has been previously stored using the function "**Polar calculation**".

CONT — Accept displayed values and proceed to *dialogue "TRAVERSE RESULTS" (page 220).*

Shift F5 — Changing the distance *(refer to dialogue "MODIFY DISTANCE", page 219).*

Shift ESC — Exit the program.

CO



Horiz.Dist. : Display of entered horizontal distance *(refer to dialogue "TRAVERSE", page 218)*

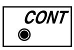
Multiply : Entering multiplication factor

Divide : Entering division factor

Add : Entering distance for a positive correction

Subtract : Entering distance for a negative correction

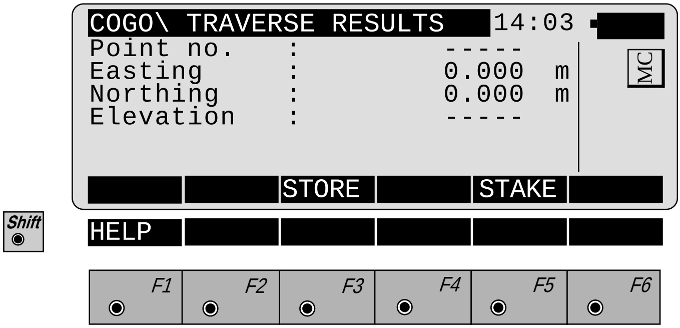
Horiz.Dist. : Display of corrected horizontal distance



Accept displayed values and proceed to *dialogue "TRAVERSE RESULTS" (page 220).*

CO

The following dialog box shows the result of the traverse:



Point no.	:	Entering point number of the point to be accepted
Easting	:	Display of east coordinate
Northing	:	Display of north coordinate
Elevation	:	Entering height (optional)

F3

The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

CO

F5

Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

CONT

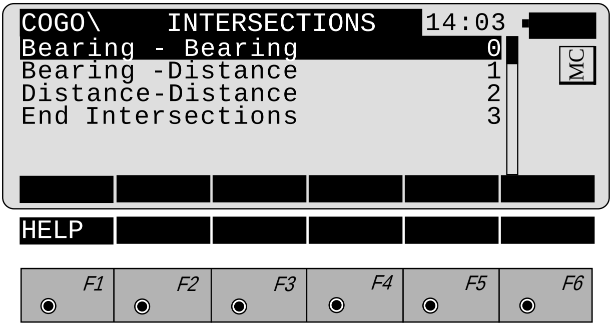
Return to "**COGO MENU**".

Shift ESC

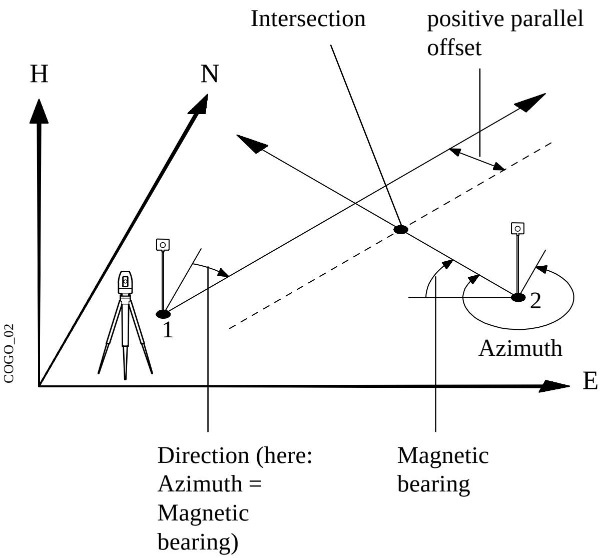
Exit the program.

Intersections

Call up the function from the "**COGO MENU**".



Bearing-Bearing Intersection



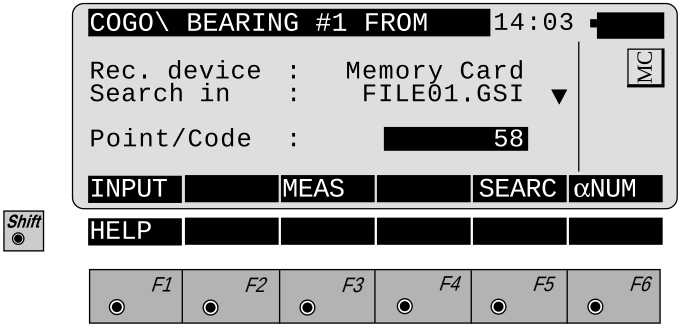
Search : • Coordinates of intersection (Y, X)

Given : • point 1 (Y, X), direction (magnetic bearing or azimuth)
• point 2 (Y, X), direction (magnetic bearing or azimuth)

☞ Station coordinates and orientation need to have been set correctly before the coordinates of point 1 (and/or 2) can be determined by measurement.

CO

0 Call up the function from the menu "**INTERSECTIONS**".



F1 Manual entering of the first (second) point. The standard TPS 1000 input dialog box appears.

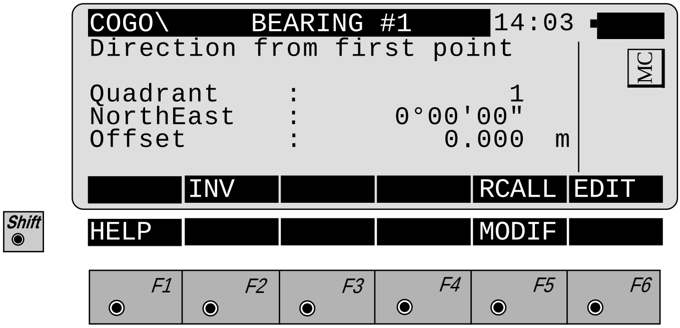
F3 Measuring the first (second) point of the straight line. This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System" - user manual*.

CONT or **F5** Search for the coordinates of the first (second) point in the coordinate file. This function is described in *chapter "setups" (Import function) of the "System"-user manual.*

Shift **ESC** Exit the program.

CO

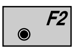
If "**Bearing**" is selected in the configuration during "**Direc. Type:**", then the following dialog box appears:



Quadrant : Enter quadrant (First or second straight lines)
1 = Northeast
2 = Southeast
3 = Southwest
4 = Northwest

NorthEast : Enter magnetic bearing (First or second straight lines)
If "**Azimuth**" is selected in the configuration during "**Direc.Type:**", then the azimuth of the first straight line (or the second straight line) can be entered.

Offset : Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset



Determining the direction by means of the function "**Polar calculation**" *(refer to chapter "*Inverse*").*

F5	INPUT	Enter bearing, mangnetic bearing resp. azimuth (if "**Azimuth**" is selected in the configuration during "**Direc. Type:**"
	RCALL	Call up of a direction which has been previously stored using the function "**Polar calculation**".

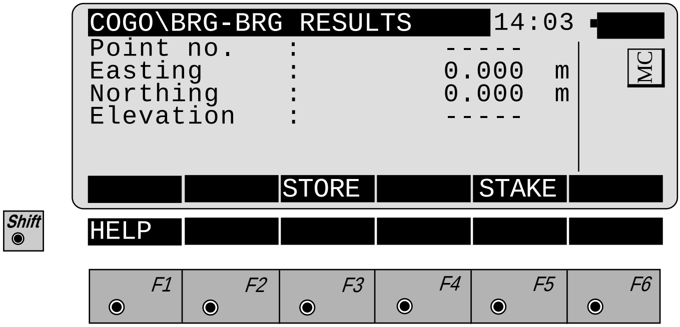
CONT Accept displayed values

Shift F5 Changing the direction (as dialog box *"MODIFY BEARING", page 215 resp. "MODIFY AZIMUTH", page 217)*

Shift ESC Exit the program.

CO

The following dialog box shows the result of the bearing-bearing intersection:



Point no.	:	Entering point number of the bearing-bearing
Easting	:	Display of east coordinate
Northing	:	Display of north coordinate
Elevation	:	Entering height (optional)

F3

The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

F5

Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

CONT

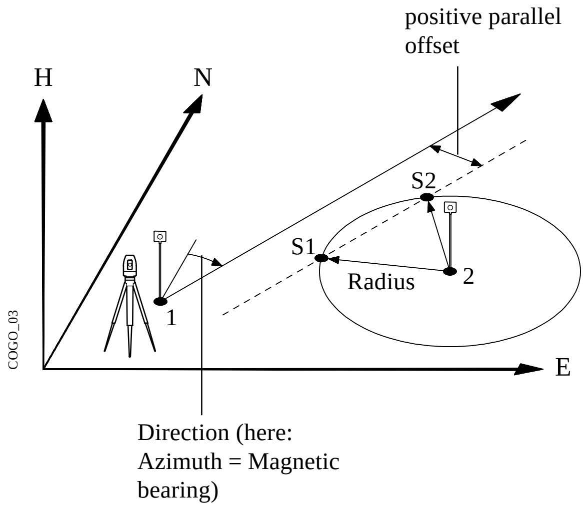
Return to "**INTERSECTIONS**".

Shift ESC

Exit the program.

CO

Bearing-Distance Intersection



Search : • Bearing-bearing coordinates S1 and S2 (Y, X)

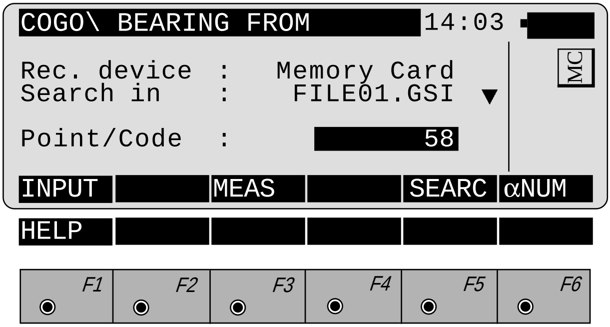
Given : • point 1 (Y, X), direction (magnetic bearing or azimuth)
• point 2 (Y, X), radius

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 (and/or 2) can be determined by measurement.

CO

1 Call up the function from the menu "**INTERSECTIONS**".

Shift



F1 Manual entering of the first point (or circle centre point). The standard TPS 1000 input dialog box appears.

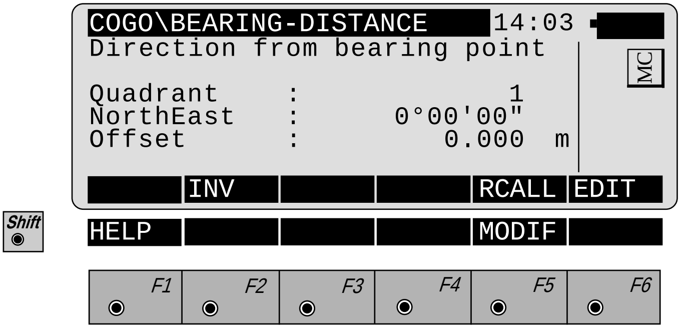
F3 Measuring the first point (or circle centre point). This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System"-user manual.*

CONT or F5 Search for the coordinates of the first point (or circle centre point) in the coordinate file. This function is described in *chapter "Setups" (Import function) of the "System"-user manual.*

Shift ESC Exit the program.

CO

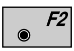
If "**Bearing**" is selected in the configuration during "**Direc. Type:**", then the following dialog box appears:



Quadrant : Enter quadrant:
1 = Northeast
2 = Southeast
3 = Southwest
4 = Northwest

NorthEast : Enter magnetic bearing
If "**Azimuth**" is selected in the configuration during "**Direc. Type:**", then the azimuth of the straight line can be entered.

Offset : Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset



Determining the direction by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

CO

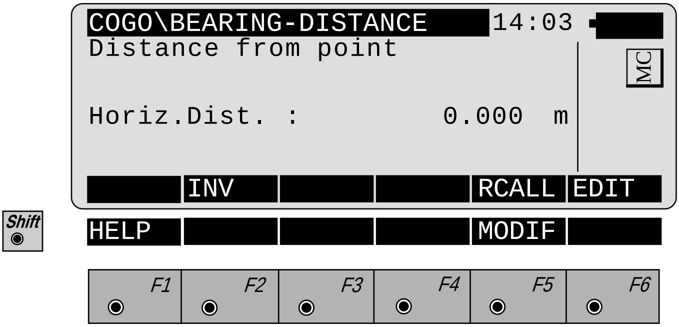
F5	INPUT	Enter bearing, mangnetic bearing resp. azimuth (if "**Azimuth**" is selected in the configuration during "**Direc. Type:**"
	RCALL	Call up of a direction which has been previously stored using the function "**Polar calculation**".

CONT — Accept displayed values

Shift F5 — Changing the direction (as dialog box *"MODIFY BEARING", page 215 resp. "MODIFY AZIMUTH", page 217)*

Shift ESC — Exit the program.

Enter distance from point:



Horiz.Dist. : Entering radius

F2 Determining the radius by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 INPUT Entering radius
RCALL Call up of a radius which has been previously stored using the function "**Polar calculation**".

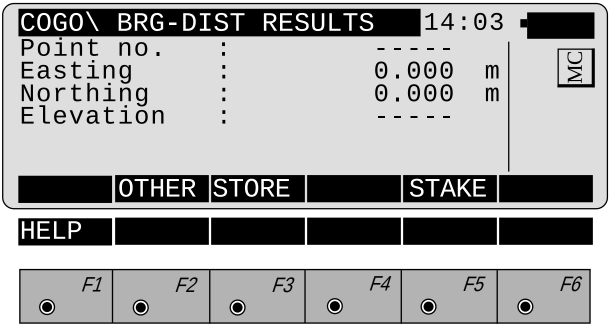
CONT Accept displayed values

Shift F5 Changing the direction (as dialog box *"MODIFY DISTANCE", page219).*

Shift ESC Exit the program.

CO

The following dialog box shows the result of the bearing-distance intersection:



Point no.	:	Entering point number of the bearing-bearing
Easting	:	Display of east coordinate
Northing	:	Display of north coordinate
Elevation	:	Entering height (optional)

F2 — Changing between both solutions

F3 — The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

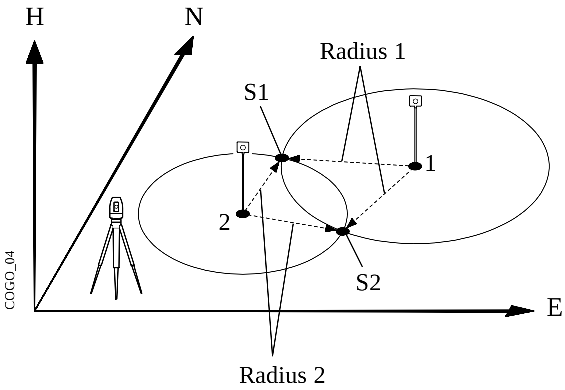
CO

F5 — Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

CONT — Return to "**INTERSECTIONS**".

Shift ESC — Exit the program.

Distance-Distance Intersection



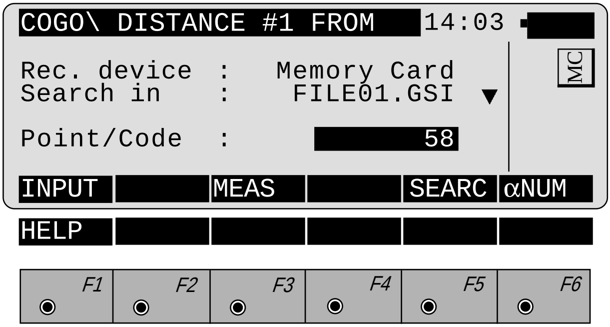
Search : • Bearing-bearing coordinates S1 and S2 (Y, X)

Given : • point 1 (Y, X), radius 1
• point 2 (Y, X), radius 2

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 and/or 2 can be determined by measurement.

CO

Call up the function from the menu "**INTERSECTIONS**".



F1 Manual entering of the first circle centre point (2nd circle centre point). The standard TPS 1000 input dialog box appears.

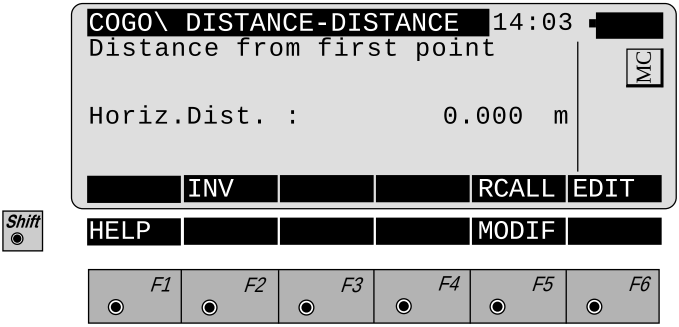
F3 Measuring the first circle centre point (2nd circle centre point). This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System"-user manual*.

CONT or **F5** Search for the coordinates of the first circle centre point (2nd circle centre point) in the coordinate file. This function is described in *chapter "Setup" (Import function) in the "System" - user manual.*

Shift **ESC** Exit the program.

CO

Enter distance from points:



Horiz.Dist. : Entering distance from first point (2nd point)

F2 — Determining the radius by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 — INPUT: Entering radius
RCALL: Call up of a radius which has been previously stored using the function "**Polar calculation**".

CONT — Accept displayed values

Shift F5 — Changing the direction (as dialog box *"MODIFY DISTANCE", page219).*

Shift ESC — Exit the program.

CO

The following dialog box shows the result of the distance/distance intersection:

```
COGO\ DIST-DIST RESULTS 14:03
Point no.    :         -----
Easting      :         0.000  m
Northing     :         0.000  m
Elevation    :         -----

      OTHER  STORE        STAKE
HELP
```

Shift

F1 F2 F3 F4 F5 F6

Point no. : Entering point number of the bearing-bearing

Easting : Display of east coordinate

Northing : Display of north coordinate

Elevation : Entering height (optional)

F2

Changing between both solutions

F3

The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

CO

F5

Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

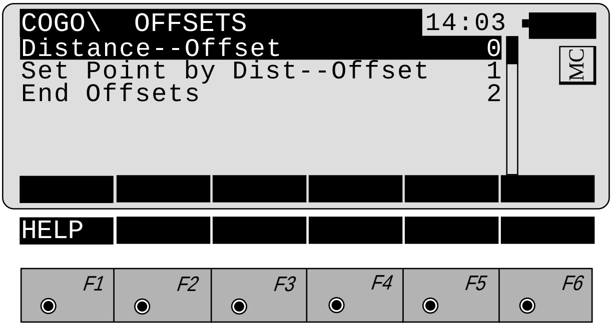
CONT

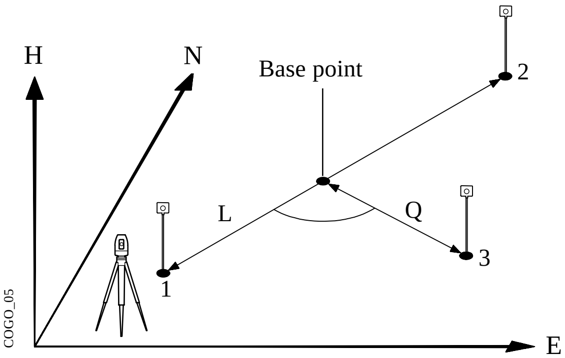
Return to "**INTERSECTIONS**".

Shift ESC

Exit the program.

Call up the function in the "**COGO MENU**".





Search : • Difference in length/abscissa (L)
• Lateral deviation/ordinate (Q)
• Base point coordinates (Y, X)

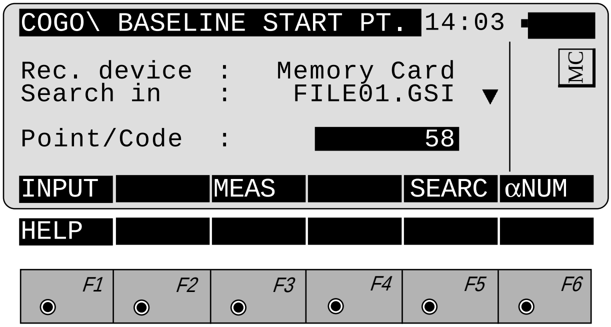
Given : • Baseline Start Point 1 (Y, X),
• Baseline End Point 2 (Y, X),
• lateral point 3 (Y, X)

Station coordinates and orientation need to have been set correctly before the coordinates of point 1resp. 2 and/or point 3 can be determined by measurement.

Explanation of the polarity rule of L and Q
During entering, the polarity is based on the straight line 1 -> 2.
+ Q Parallel displacement to the right
- Q Parallel displacement to the left
+ L Displacement from basis point 1 in the direction of basis point 2
- L Displacement from basis point 1 in the opposite direction to basis point 2

CO

0 Call up the function from the menu "**OFFSETS**".



F1 Manual entering of the baseline start point resp. the baseline end point (or the lateral point) . The standard TPS 1000 input dialog box appears.

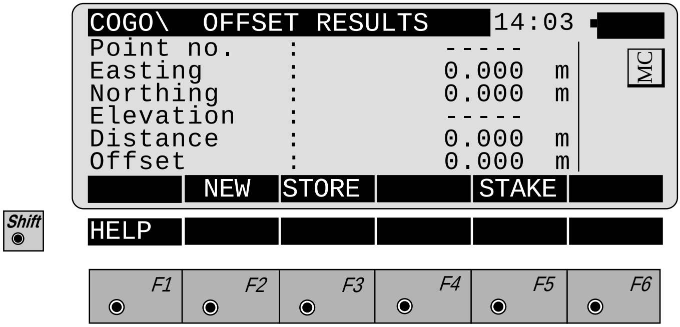
F3 Measuring the baseline start point resp. the baseline end point (or the lateral point).This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System"-user manual*.

CONT or **F5** Search for the coordinates of baseline start point resp. the baseline end point (or the lateral point) in the coordinate file. This function is described in *chapter "Setup" (Import function) of the "System"-user manual.*

Shift **ESC** Exit the program.

CO

The following dialog box shows the results:



Point no. : Entering point number of the base point

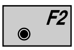
Easting : Display of east coordinate

Northing : Display of north coordinate

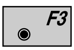
Elevation : Entering height (optional)

Distance : Display difference in length/abscissa (L)

Offset : Display lateral deviation/ordinate (Q)



Entering the new lateral point with reference to the already existing basis line.



The following results have been stored in the active measurement data file:

WI 11 Station Point Number
WI 81 Easting coordinate
WI 82 Northing coordinate
WI 83 Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

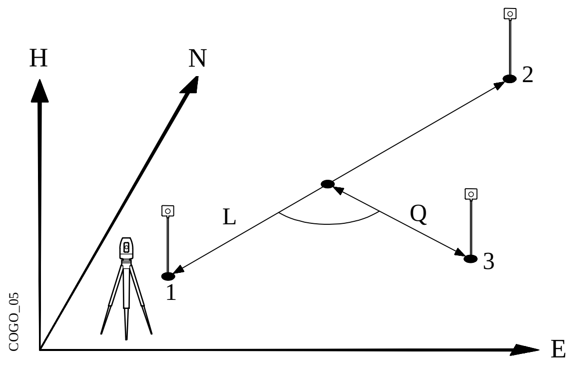
CO

F5 | Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

CONT | Return to the menu "**OFFSETS**".

Shift ESC | Exit the program.

Orthogonal point calculation



Search : • Lateral point 3 coordinates (Y, X)

Given : • Baseline Start Point 1 (Y, X),
• Baseline End Point 2 (Y, X),
• Difference in length/abscissa (L)
• Lateral deviation/ordinate (Q)

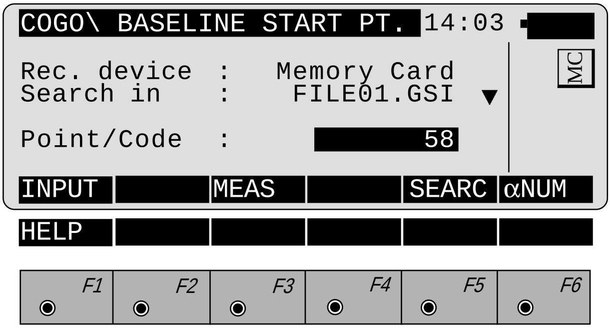
Station coordinates and orientation need to have been set correctly before the coordinates of point 1resp. point 2 can be determined by measurement.

CO

Explanation of the polarity rule of L and Q
During entering, the polarity is based on the straight line 1 -> 2.

+ Q Parallel displacement to the right
- Q Parallel displacement to the left
+ L Displacement from basis point 1 in the direction of basis point 2
- L Displacement from basis point 1 in the opposite direction to basis point 2

1 — Call up the function in the menu "**OFFSETS**".



F1 — Manual entering of the baseline start point (or the baseline end point). The standard TPS 1000 input dialog box appears.

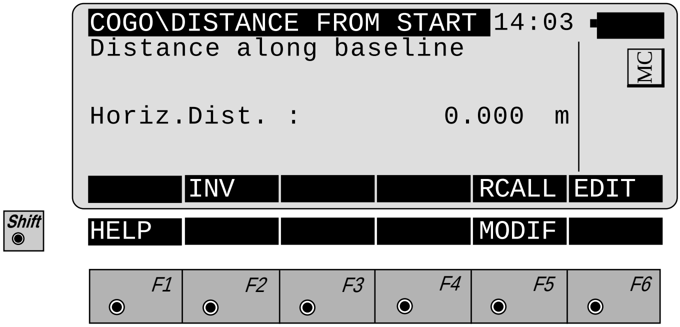
F3 — Measuring the baseline start point (or the baseline end point). This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System"-user manual.*

CO

CONT or F5 — Search for the coordinates of baseline start point (or the baseline end point) in the coordinate file. This function is described in *chapter "Setup" (Import function) of the "System"-user manual.*

Shift ESC — Exit the program.

Enter distance along baseline (L):



Horiz.Dist. : Enter distance along baseline (L)

F2 — Determining the distance along baseline (L) by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5

INPUT	Entering distance along baseline
RCALL	Call up of a distance along baseline which has been previously stored using the function "**Polar calculation**".

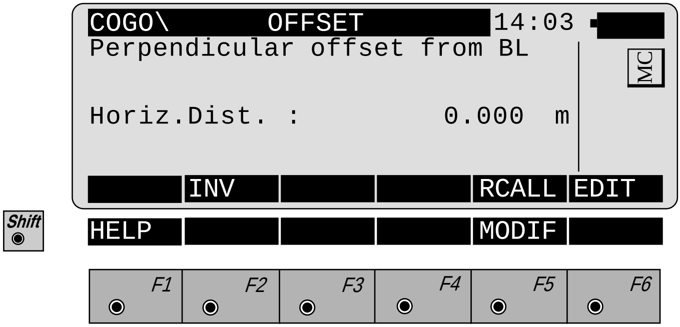
CONT — Accept displayed values

Shift F5 — Changing the direction *(*as dialog box *"MODIFY DISTANCE", page219).*

Shift ESC — Exit the program.

CO

Enter lateral deviation/distance from start (Q):



Horiz.Dist. : Enter lateral deviation/distance from start (Q)

F2 — Determining the lateral deviation/distance from start (Q) by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 — INPUT: Entering lateral deviation/distance from start

RCALL: Call up of a lateral deviation/distance from start which has been previously stored using the function "**Polar calculation**".

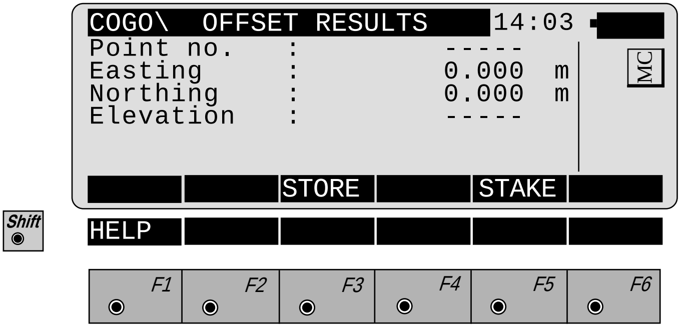
CONT — Accept displayed values

CO

Shift F5 — Changing the direction *(*as dialog box *"MODIFY DISTANCE", page219).*

Shift ESC — Exit the program.

The following dialog box shows the results of the orthogonal point calculation:



Point no. : Entering point number of the lateral point

Easting : Display of east coordinate

Northing : Display of north coordinate

Elevation : Entering height (optional)

F3

The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

F5

Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

CONT

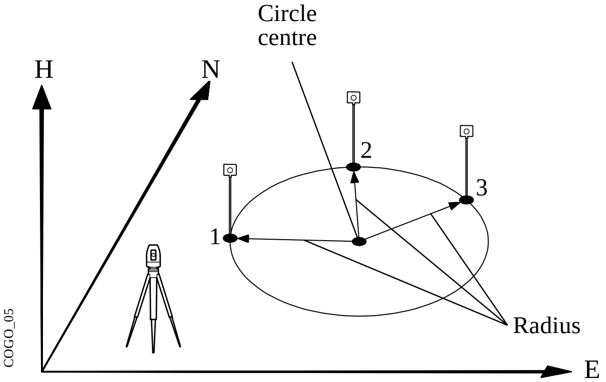
Return to the menu "**OFFSETS**".

Shift ESC

Exit the program.

CO

Three Point Arc



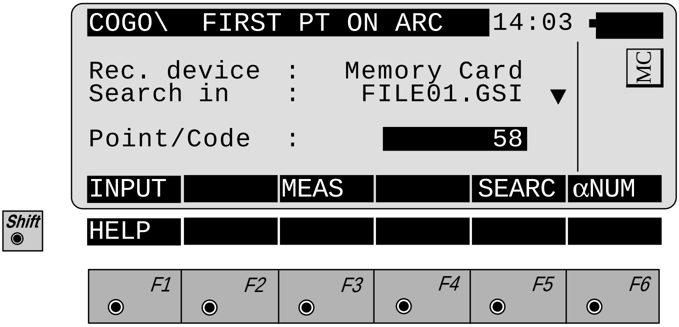
Search	:	• Circle centre coordinates (Y, X), • Radius
Given	:	• Arc point 1 (Y, X), • Arc point 2 (Y, X), • Arc point 3 (Y, X)

☞ Station coordinates and orientation need to have been set correctly before the coordinates of point 1, 2 and/or point 3 can be determined by measurement.

CO

4

Call up the function from the "**COGO MENU**"



F1

Manual entering of the first resp. the second resp. the third arc point. The standard TPS 1000 input dialog box appears.

F3

Measuring the first resp. the second resp. the third arc point. This function is described in *chapter "Measure & Record" (Measurement dialogue) of the "System"-user manual.*

CONT or F5

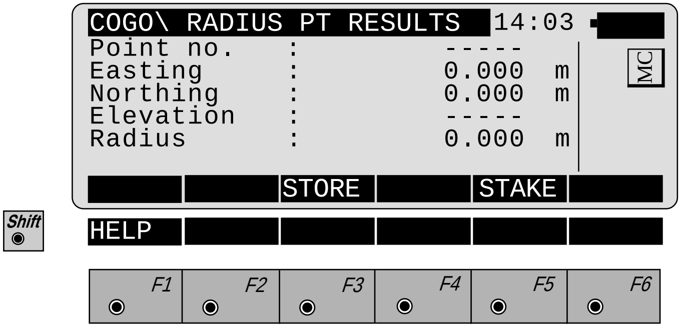
Search for the coordinates of the first resp. the second resp. the third arc point in the coordinate file. This function is described in *chapter "Setup" (Import function) of the "System"-user manual.*

Shift ESC

Exit the program

CO

The following dialog box shows the results of the calculation:



Point no. : Entering point number of the circle centre

Easting : Display of east coordinate

Northing : Display of north coordinate

Elevation : Entering height (optional)

F3

The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point no." has not be entered, the button is not occupied.

CO

F5

Call up the program "Stakeout".
The program "Plotting" assumes that the instrument is set and oriented to a known point.
If "Point no." has not be entered, the button is not occupied.

CONT

Return to the "**COGO MENU**".

Shift ESC

Exit the program.

Road Plus

Introduction

This manual describes the "**ROADPLUS**" program of the TPS SYSTEM 1000 theodolite series.

The program allows for the stakeout of roads using the typical offset method of construction staking. In addition the program supports station equations, cross section assignment by station, cross section definition, cross section interpolation, superelevation, widening and slope staking/catch points.

Alignment Definition

An alignment consists of the three basic components which are horizontal alignment, vertical alignment and cross-section template. "ROADPLUS" reads the elements of each of these components from data files that are in GSI file format. In addition, a file can be created for entering cross-section stations for specific locations such as points needed for the staking of superelevation points. If station equations are needed, "ROADPLUS" will read a file created for station equations and apply the appropriate corrections.

Data Files

Each of the data files "ROADPLUS" reads contain the necessary information specific to the component being defined. The files have unique identifiers and must be in the GSI file format:

Horizontal Alignment File	**ALN?????.GSI**
Vertical Alignment File	**PRF?????.GSI**
Template File	**CRS?????.GSI**
Cross-section Assignment File	**STA?????.GSI**
Station Equation File	**EQN?????.GSI**

The five identifiers ALN, PRF, CRS, STA and EQN identify the type of file and must be used when creating the data files. The ? can be any valid DOS character. The file extension GSI defines the file as a GSI file and must be used.

1. Permitted elements in the Hz-alignment

- **Straight** — defined by chainage and coordinates of starting point
- **Curve** — defined by chainage and coordinates of starting point Radius of arc (- = left-hand curve; + = right-hand curve)
- **Spiral** — defined by chainage and coordinates of starting point parameter A[1] of spiral (negative parameter = spiral into left-hand curve)
- **Compound curve** — defined by chainage and coordinates of starting point Radius of arc (R1, R2)
- **End of project** — (EOP) chainage and coordinates of end-point

RP

[1] $A^2 = L \times R$ where L = length of spiral; R = radius of curve

2. Permitted elements in V-alignments

- **Straight** — defined by chainage and height of starting point
- **Curve** — defined by chainage and height of starting point
  radius of arc (- = crest; + = dip)
- **Parabola** — defined by chainage and height of starting point
  parameters of parabola[2]
  (- = crest; + = dip)
- **End of project** — (EOP) chainage and height of end-point of gradient

3. Permitted elements in cross sections

- Chainage
- Offset
- Height difference relative to axis

RP

[2] $2p \times (H - H_0) = (S - S_0)^2$
S_0, H_0 station and height of vertex

Creating Data Files

There are two methods that can be used to create the necessary data files. If the program called "FILE EDITOR" is loaded into the theodolite, all necessary data for a given component can be entered through the keyboard. To enter data on the computer a DOS program called "ROADDATA.EXE" can be used. If you create the files using the "ROADDATA.EXE" program, the files must be copied to the PCMCIA card in a directory called GSI.

The following table shows an overview of the max. file sizes:

Type of file	Limitations
Horizontal alignment	No limitation for "RoadPlus"; max. 200 blocks for "File Editor"
Vertical alignment	No limitation for "RoadPlus"; max. 200 blocks for "File Editor"
Cross section	200 data blocks (number of points in a cross section max. 48)
Cross section assignment	100 data blocks
Station equation	100 data blocks

Program Overview

RP

"ROADPLUS" allows measurements in one telescope position only. A typical "ROADPLUS" session includes the following steps:

1. Enter setup information for the instrument and orient.
2. Start the ROADPLUS program and configure.
3. Select the alignment files
4. Select a station
5. Pick a point on the cross-section to stakeout, enter an offset, choose method.

6. Stake the point and record the data.
7. Choose another point on the cross-section and stake it out.
8. When all selected points on the cross section have been staked, enter a new station and repeat steps 5-7.

In the sections that follow, the operation of the program will be covered in more detail. The concepts of the program will be covered to assist you in becoming proficient with the "ROADPLUS" program for normal everyday operation such as staking a project with the

Getting Started

Before starting the program, enter the setup information for the location of the theodolite and orient the instrument to the reference point.

From the "MAIN MENU: PROGRAMS" display, move the highlighted cursor to the "ROADPLUS" program and press CONT on the keyboard of the instrument. This will bring up the "SELECT ALN FILES" display.

The display illustration examples contain text and values for example purposes only. The actual values you will see on the display of your instrument will be different.

```
ROAD+\ SELECT ALN FILES  14:03
Horiz.Aln.  :        ALN_EX1 ▼
Vert. Aln.  :        PRF_EX1 ▼
Cross Secs  :        CRS_EX1 ▼
Crs.Assign  :        STA_EX1 ▼
Station Eq  :        EQN_EX1 ▼
Log FlName  :   ROADPLUS.LOG
                          LIST
```

Shift

```
HELP  CONF
```

F1 F2 F3 F4 F5 F6

RP

Shift F2

Call up the "Configuration-Editor".

Before selecting the alignment files to use, you should enter the configuration parameters for the job.

Shift F2

Start the "Configuration-Editor" from the "SELECT ALN FILES" dialog.

```
ROAD+\  CONFIGURATION   14:03
Base Chainge:              0.000        MC
End Chainge  :            89.270
Chainge Incr:             10.000  m
Hght. Shift  :             0.000  m
Deflct. Tol.:          0°00'16"
Chainge Tol.:              0.010  m
INFO                        DFLT  EDIT
```

```
3D Stake     :                ON
Crs.Intrpl.  :               OFF
Crs.Movemnt  :  Left > Right  ▼
Hinge mode   :            normal  ▼
Log File     :                ON
Log FlName   :          ROAD.LOG
```

Shift

```
HELP
```

F1	F2	F3	F4	F5	F6

Base Chainge : Enter the beginning chainage for the project

End Chainge : Enter the ending chainage for the project

Chainge Incr : Enter the chainage interval to be used

Hght. Shift : Enter a vertical shift value if needed. The value entered will be applied to the whole alignment.

Deflct. Tol. : Enter an angle tolerance for deflection angles. Make this a small value but not 0.

Chainge Tol. : Enter a value for chainage tolerance. This value will determine how close the point will be to a 0 location.

3D Stake : Use the F6 key to toggle between OFF or ON. For cut/fill capability this should be set to ON.

Crs. Intrpl. : The abbreviation means "Cross Section Interpolation". When this is set to ON, cross sections will be interpolated both along and between cross sections. The interpolation between cross sections makes superelevation and widening possible.

If cross section interpolation is enabled, all cross sections must have the same number of points.

Use the F6 key to toggle between OFF and ON.

Crs. Movemnt: This function controls the movement along the cross section.

Press F6 to display the movement options. There are three choices: LEFT to RIGHT, RIGHT to LEFT and NONE. The direction chosen is for display purposes only. The rodperson can go in any direction desired along the cross section.

Hinge Mode : **Normal:** The points farest away from the axis are used for calculation of the slope piercing point.
Not from End Pts: The points farest away from the axis are not used for calculation of the slope piercing point, i.e. the slope piercing point is already available in the cross section definition (catch point between digital ground pattern and cross section).

RP

Log file : When the log file is set to ON, staked out data can be stored in a file for printing at al later date. Use the F6 key to toggle between OFF and ON.

Log FlName : Ente a file name for the log file. The default file name can be used. LogFlName appears only if "Log File = ON" is seledted in the "Configuration".

F1 Displays date and version of the program.

F5 Sets standard values. The values are displayed in dialog *on page 253*.

CONT Accepts and stores parameters displayed. Continues to display "SELECT ALN FILES"

Select Alignment Files

To proceed further, you must select a horizontal alignment file. The other files are optional and are dependent on what you are staking. For instance, if you are only staking the ”shape” of the road for clearing purposes, then it would not be necessary to have a vertical alignment, template, cross section assignment or station equation file. If your application requires these other files then you will need to select them.

All alignment files must be stored in the memory card in the GIS directory.

```
ROAD+\ SELECT ALN FILES  14:03
Horiz. Aln.:         ALN_EX1 ▼      MC
Vert. Aln.  :        PRF_EX1 ▼
Cross Secs  :        CRS_EX1 ▼
Crs.Assign  :        STA_EX1 ▼
Station Eq  :        EQN_EX1 ▼
Log FlName  :   ROADPLUS.LOG
                                LIST
```

Shift

```
HELP  CONF
```

F1 F2 F3 F4 F5 F6

RP

Horizontal Alignment File

The horizontal alignment file contains the following elements:

- **Station locations**
- **Straight line segments**
- **Circular curves**
- **Spiral curves**
- **Compound curves**
- **End of Project (EOP)**

F6

Select the horizontal alignment file. A dialog box appears with a list of all **ALN?????.GSI** files available. Move the cursor to the file needed and press ↵. The "SELECT ALN FILE" display will return and the cursor will be highlighting the vertical alignment file.

Vertical Alignment File

The vertical alignment file contains the following elements:

- **Station locations**
- **Straight line segments**
- **Circular vertical curves**
- **Parabolic vertical curves**
- **End of Project (EOP)**

F6

Select the vertical alignment file. A dialog box appears with a list of all **PRF?????.GSI** files available. Move the cursor to the file needed and press ↵. The "SELECT ALN FILE" display will return and the cursor will be highlighting the Cross Section file.

Cross Section/template File

The template file contains the following elements:

- **Station location**
- **Template name**
- **Offset from centerline**
- **Difference in height from the centerline profile**

F6

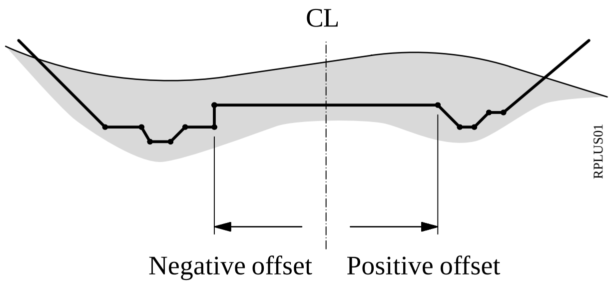
Select the cross section file. A dialog box appears with a list of all **CRS?????.GSI** files available. Move the cursor to the file needed and press ↵. The "SELECT ALN FILE" display will return and the cursor will be highlighting the Cross section assignment file.

RP

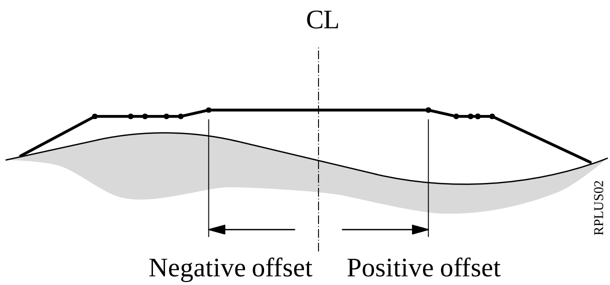
Cross Section Definition

When defining the cross section both a cut and fill template can be created similar to the following diagrams.

Cross section - Cut



Cross section - Fill



CL ... Centerline

RP

Cross Section Assignment File

The cross section assignment file contains the following elements:

- **Cross Section name**
- **Starting Chainage**

A cross section assigned in this manner will remain in effect until another cross section is defined. When the file is created you designate the name of the template to use and the chainage to begin using the template. The next template name entered also contains a starting chainage. A third template can be assigned to begin at another chainage and so forth.

For example, the file might contain the following information:

XSEC1, 0
XSEC2, 100
XSEC3, 300
XSEC1, 550

The program would interpret this to use the template XSEC1 beginning at chainage 0 and end at chainage 1+00, use XSEC2 beginning at chainage 1+00 and end at chainage 3+00, use XSEC3 from chainage 3+00 and transition back to XSEC1 ending at chainage 5+50.

F6

Select the cross section assignment file. A dialog box appears with a list of all **STA?????.GSI** files available.

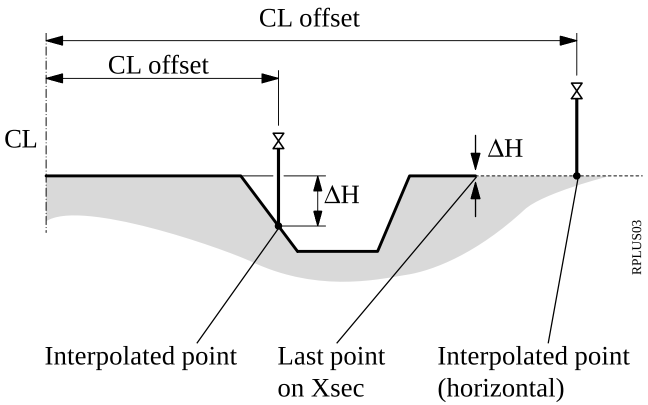
Move the cursor to the file needed and press ↵ .

RP

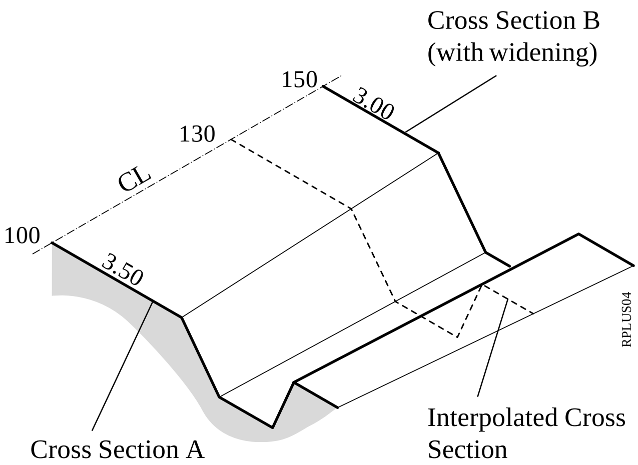
- **Cross Section Interpolation**

Cross sections can be interpolated both along the cross section i.e. between defined points, and between cross sections themselves. The interpolation between cross sections makes superelevtion and widening possible. The following diagrams illustrate these concepts.

Interpolation along a cross section



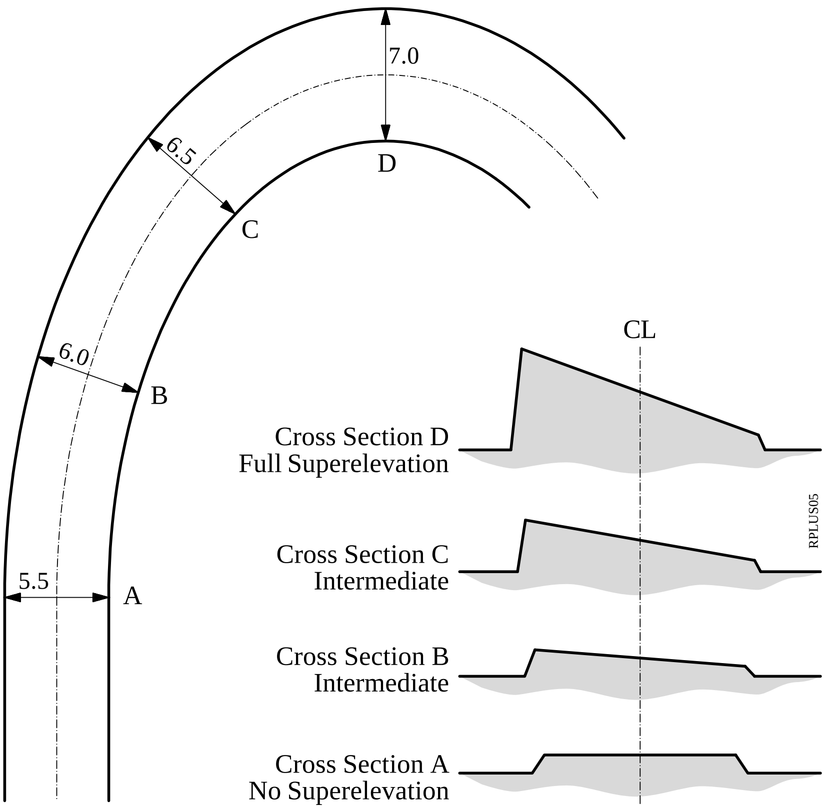
Interpolation between cross sections



- **Superelevation/Widening**

Superelevation is controlled by the cross sections. Cross sections must be placed at the appropriate chainage for the beginning of superelevation, full superelevation and back to no superelevation. The **STA?????.GSI** file contains these special locations for cross sections as well as cross section locations for widening. The diagram that follows illustrates the concept for superelevation.

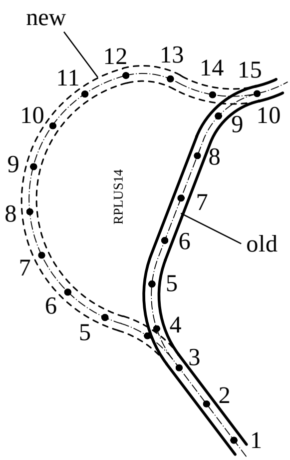
Superelvation governed by cross sections



RP

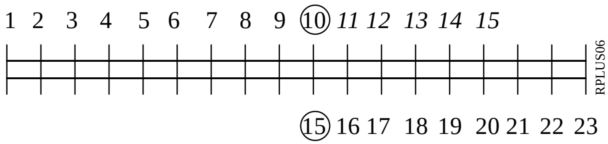
Station Equation File

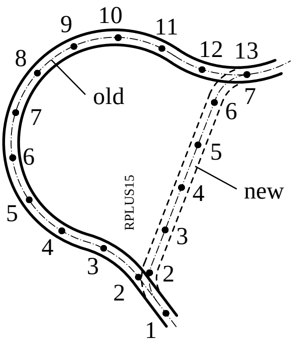
Station equations are used to adjust the alignment stationing. The most common reason for doing so is the insertion or removal of curves. Inserting or removing a curve would require re-calculating the stationing of an entire alignment. Using station equations eliminates this.



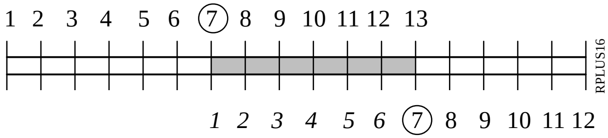
Station equations can create either a gap or overlap as shown in the following diagram.

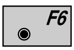
Forward Station Equation
Station Back 10 + 000 = Station Ahead 15 + 000



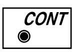


Backward Station Equation
Station Back 13 + 000 = Station Ahead 7 + 000





Select the station equation file. A dialog box appears with a list of all **EQN?????.GSI** files available. Move the cursor to the file needed and press ↵ . The "SELECT ALN FILE" display will return and the cursor will be highlighting the Log Filename. The filename can be changed or the default name can be accepted.

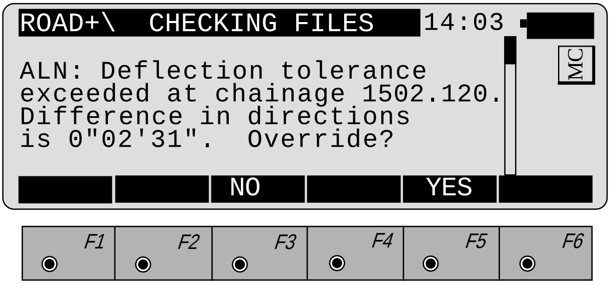


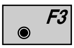
When all files have been selected. Continues to display "CHAINAGE & OFFSET". Prior to the "CHAINAGE & OFFSET" display appearing, you will see a brief message about checking for errors in the selected files.

RP

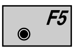
File Checking

During the file checking process, each file is inspected for possible errors in the data format such as missing or incorrect word index. If errors are found, an error message is displayed indicating the type of error. During the inspection process, if any errors are found that would cause erroneous data to be computed and displayed, the file checking routine will be aborted. If this occurs, the file(s) containing the problem must be fixed before continuing. In addition to checking for file errors, geometrical components are checked. This includes tangent directions of adjacent elements and chord lengths of elements. Any deviations which exceed permitted tolerances are displayed such as in the following example.





Selecting the "**NO**" option to override will bring up another display that says "Continue checking alignment"? (no quotes). If you choose "NO" the display will return to the "SELECT ALN FILES" menu. If you choose "YES" the program will continue to check the other files. If no other errors are found the program will go to the opening "CHAINAGE & OFFSET" display.



Selecting the "**YES**" option to override will cause the program to override the error and continue to check other files for possible errors. If no other errors are found the program will go to the "CHAINAGE & OFFSET" opening display.

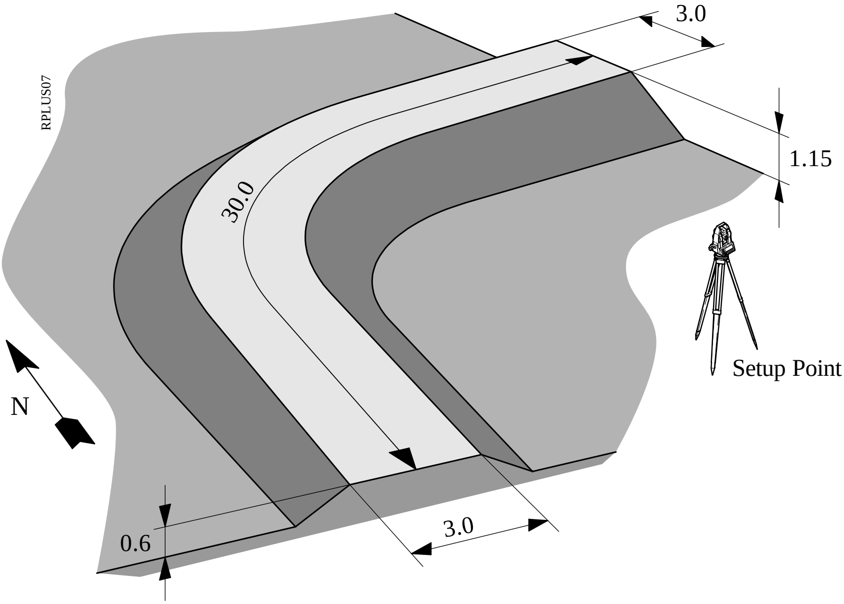
Stakeout Using Horizontal Offset

The most common method for staking out roads, pavement, curb & gutter etc. is to use a horizontal offset from the actual point. For instance, a four foot offset from finished back of curb (BC) is commonly used to provide cut/fill stakes for a street and curb lines.

Preparing for the example

In this section of the manual, a sample project will be used to demonstrate the procedures to follow for staking a portion of the job. The project consists of a 3 m wide paved bicycle path with a curve. The project will be staked on a 0.6 m offset from the edge of pavement. The POB and PC will be staked for both sides.

The example project for the TPS System "ROADPLUS" program consists of a simple horizontal and vertical alignment accompanied by a simple template. The project is designed to illustrate the application of the "ROADPLUS" System. It is not intended to provide a demonstration of road design procedures.



RP

Our bike path is about 30 m in length as illustrated here. The riding surface is 3 m wide, lying 1.5 m on each side of the centerline. From the edge of the driving surface, fill slopes extend downward at a slope of 2:1.

The vertical alignment (or profile) for the project is a simple 2% uphill slope. An assumed elevation of 30.50 is placed on the original ground at the Setup Point, and the road starts at elevation 31.1. This allows you to practice with all of the components of the "ROADPLUS" program. For the field work, we recommend a flat, open area about 25 m on a side.

The following pages contain illustrations and listings of all the data needed to run the example.

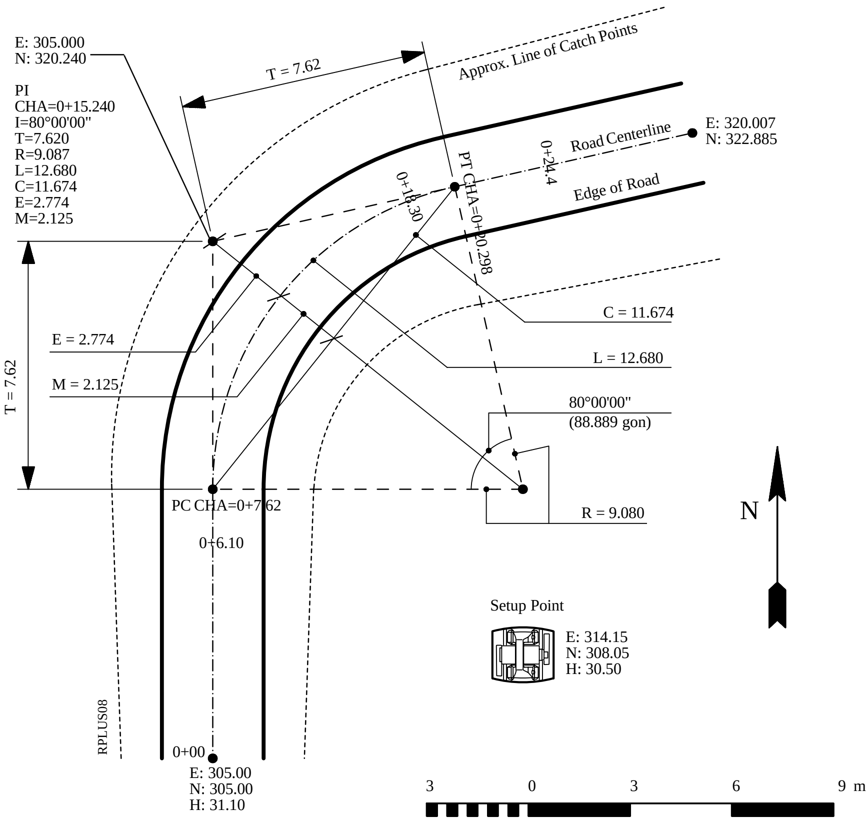
There are 3 easy steps to the example:

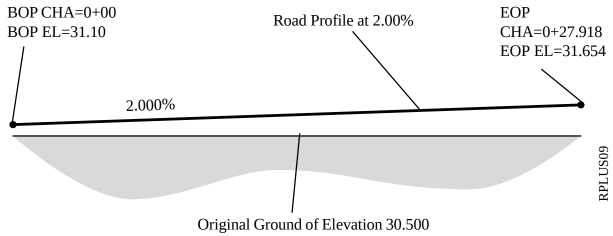
1. **Use the "ROADDATA.EXE" program on your PC to enter the design information for the Horizontal Alignment, Vertical Alignment, and Templates.**
   A special naming convention identifies the type of file that each alignment and template are stored in. The first three letters in the file name tell "ROADPLUS" what is in the file and how to view it. The GSI extension is also required.

Horizontal Alignment:	ALN?????.GSI
Vertical Alignment:	PRF?????.GSI
Templates:	CRS?????.GSI

In "ROADDATA.EXE", enter the following example project data. Let’s call the project "EXAMPLE" and configure the units to m, 3 decimal places. Let’s name the files "ALN_EX1.GSI", "PRF_EX1.GSI", and "CRS_EX1.GSI".

RP





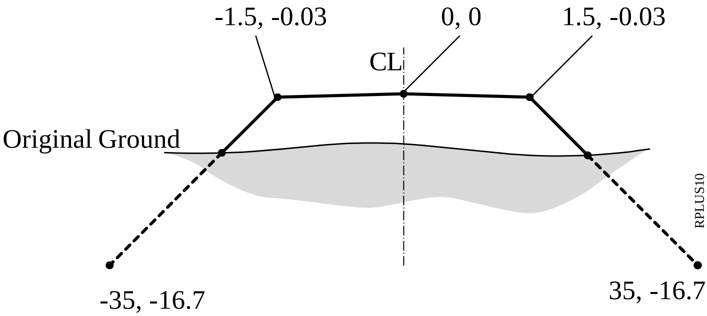
RP

Horizontal Alignment: ALN_EX1.GSI					
Station	**Element**	**Rad/Par**	**Template**	**E**	**N**
0.000	Straight	0.000	Tutor	305.000	305.000
7.620	Curve	9.080	Tutor	305.000	312.620
20.298	Straight	0.000	Tutor	312.502	321.562
27.918	EOP	0.000	Tutor	320.007	322.885

Vertical Alignment : PRF_EX1.GSI				
	Chainage	**Element**	**Rad/Par**	**H**
1	0	Straight	0	31.100
2	27.918	EOP	0	31.654

Template: CRS_EX1.GSI

The horizontal alignment file specifies a template for each chainage. Our horizontal alignment file specifies only one template, "TUTOR". You can, however, specify different templates for any chainage as you may require. We will define two templates, "TUTOR" and "TYP_CUT", in our template file. Notice that while running "ROADPLUS", you can switch templates at any time.



Slope extends well beyond expected Catch Point

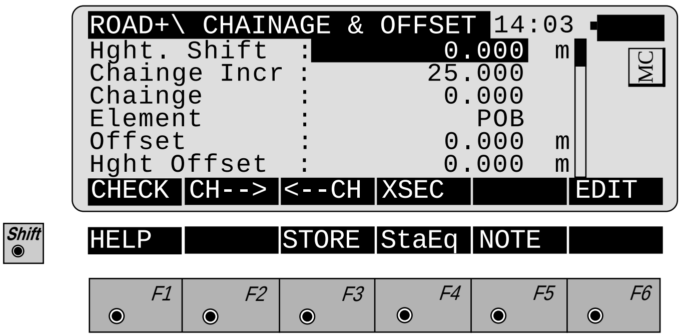
	Template	sCLO	s Δ H
1	Tutor	-35.000	-16.700
2	Tutor	-1.500	-0.030
3	Tutor	0.000	0.000
4	Tutor	1.500	-0.030
5	Tutor	35.000	-16.700
6	TypCut	-35.000	-16.630
7	TypCut	-1.500	-0.030
8	TypCut	0.000	0.000
9	TypCut	1.500	-0.030
10	TypCut	35.000	-16.630

RP

2. **Copy the alignment and template files to your PCMCIA card.** Copy the files into the GSI subdirectory on your PCMCIA card. If the GSI subdirectory doesn't already exist on the PCMCIA card, you will need to create one. Place the PCMCIA card in your instrument.

3. **Set up the instrument in your work area and stakeout the example roadway.** Set the instrument coordinates to the values shown for point 1 *(see figure page 264)*. Orient the instrument towards a convenient "North", and set Hzo to zero *(see figure page 264).* Start "ROADPLUS" and continue reading this manual.

When the "CHAINAGE & OFFSET" display appears, only the lower portion beginning with "Station" will be visible. To view the entire display, use the green up/down arrow keys on the keyboard to scroll up to the top.



RP

Hght. Shift : Vertical shift applied to the whole alignment.

Chainge Incr : The chainage increment set in the configuration is displayed. If desired, a new value can be entered.

Chainage : Enter the chainage location for the points to be staked.

Element : This displays the element for the chosen chainage such as POB, PC, CURVE etc.

Offset : Horizontal offset to apply to the current chainage.

Hght Offset : Vertical offset to apply to the current chainage.

F1 — Switches to measuring mode to allow for a measurement to determine the chainage and offset for the point shot. After taking the measurement, press CONT and the program will return to the "CHAINAGE & OFFSET" opening display. The chainage value of where the shot was taken along with the horizontal and vertical offset are displayed.

F2 — Changes to the next chainage.

F3 — Changes to the previous chainage.

F4 — Activates the cross section options.

Shift F3 — The result of the road chainage and offset is stored. Just active after taking a measurement.

Shift F4 — Activates the "Station Equation" option. Active only if a "Station Equation File" is selected during display "SELECT ALN FILES" *(page 254).*

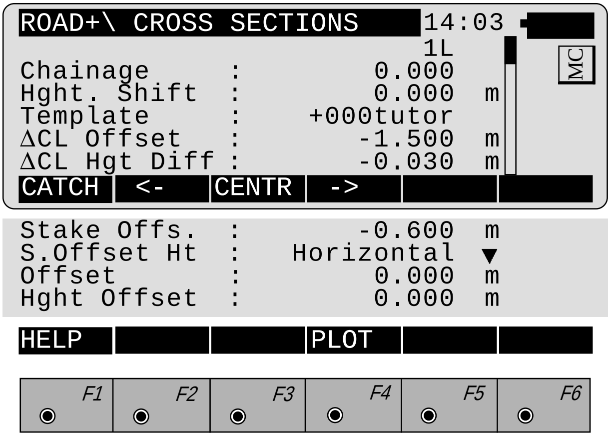
Shift F5 — Allows insertion of a note into a log file. This may be use for comments, errors, etc.

CONT — Calls the dialog "POINT COORDS" in order to display the coordinates of the point to be set out. From there, calls the program "STAKEOUT".

Select Template point and offset

The first step in the procedure is to select a point on the cross section to be staked and enter the offset.

Access the cross section options.



1L	:	Indicates the location of the cross section point in relation to the centerline. In this example, the "1L" means the first point of the template left of centerline.
Chainage	:	Displays the current chainage.
Hght. Shift	:	Displays the vertical shift, if any, applied to the whole alignment.
Template	:	Displays the template name being used.
ΔCL Offset	:	Displays the horizontal distance of the template point from centerline (- for left)
ΔCL Hgt Diff	:	Displays the difference in elevation of the template point between the centerline and the point to be staked.

Stake Offs. : This is the offset value that will be used for setting the offset stake. If the point is left of centerline, the value entered must be a negative number.

S. Offset Ht : This display indicates the method used in computing the elevation of the point to be staked. The three methods are "PREVIOUS ELEMENT", "INTERPOLATED" and "HORIZONTAL".

Offset : Horizontal offset to apply to current chainage.

Hght Offset : Vertical offset to apply to current chainage.

F1 Activates the slope staking options

F2 Move along the current cross section from right to left.

F3 Sets the cross section point to the centerline

F4 Move across the current cross section from left to right

Shift F4 Displays a plot of the template.

The first point we want to stake for the bike path is the left edge of pavement. This point is 1.5 m left of centerline so the "ΔCL Offset" value should be set to a -1.5 m.

F4 Change the location to -1.5 m. The "ΔCL Hght Diff" value will automatically change to the correct vertical difference based upon the design of the template.

The offset value needs to be set to a -0.600 m. The negative value is used because the point to stake is left of centerline.

To accept the value press .

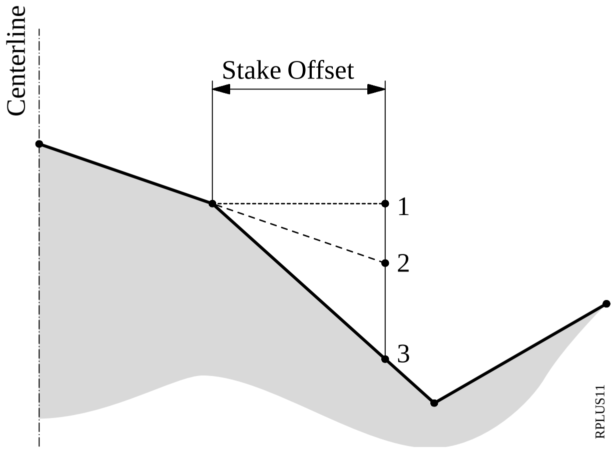
The final step in the process is to select the method to use for computing the elevation of the offset point to be staked. The "ROADPLUS" program provides three methods to choose from:

Horizontal - The elevation is computed horizontally to the catch point.

Previous Element - The elevation is computed on an extension of the grade of the previous element.

Interpolated - The elevation is interpolated to intersect the design slope of the cross section.

The following illustration shows the three vertical options for stake offset.



1 Horizontal
2 Previous Element
3 Interpolated

The most common method used is the "HORIZONTAL" method.
To select this method, move the cursor to "S. Offset Ht" and press F6 to display the three options.

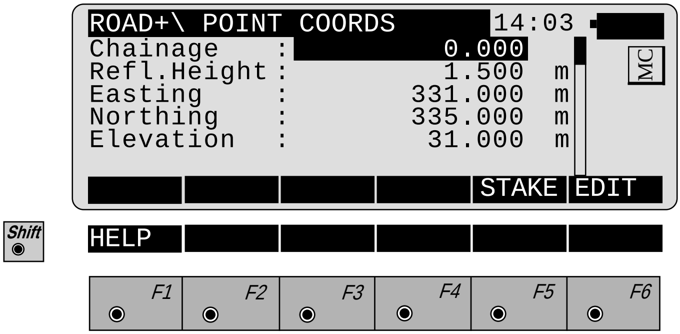
Move the cursor to "HORIZONTAL" and press ↵ .

This setting will remain as the current method until a different method is chosen. Therefore it is not necessary to go through the procedure every time.

CONT — Accepts and stores parameters set. Continues to display "POINT COORDS".

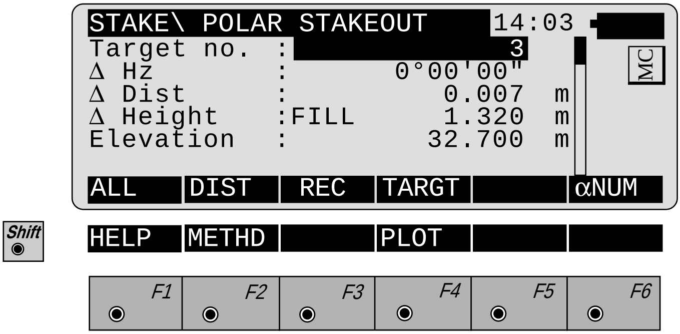
Stakeout and Record point

The "POINT COORDS" dialog displays the current chainage location of the offset point to be staked. The display also shows the value for the prism pole (Refl. Height) and the Easting and Northing coordinates of the offset point and the finished grade elevation of the actual point (not the offset location).



RP

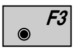
F5 — Activates the stakeout program



The polar method of stakeout is the default for "ROADPLUS".
Turn the instrument until "Δ Hz" is zero.
Line up the prism pole.

Measure the distance.

The "Δ Dist" value indicates how far away the measured point is from the point chosen to be staked. A positive value means to move away from the instrument by the amount shown. If the value is negative, move towards the instrument. The display will also show the cut or fill value for the measured point. When both the horizontal circle and distance read zero or close to it, the measurement can be recorded.



Record the staked out position, returns to the "CROSS SECTIONS" display and automatically moves to the next point on the cross section.

RP

Stakeout Next point on Cross Section

```
ROAD+\ CROSS SECTIONS   14:03
                           1R
Chainage      :         0.000
Template      :     +000tutor
ΔCL Offset    :         1.500  m
ΔCL Hgt Diff  :        -0.030  m
Stake Offs.   :         0.600  m
CATCH   <-   CENTR   ->
HELP
  F1    F2    F3    F4    F5    F6
```

Shift

To set the offset stake for the right side of our example project:

F4 — Set the "ΔCL Offset" value to positive 1.500 m. Note when you do this the position changes from "1L" to "1R". Scroll down and highlight "Stake Offs.". Change the offset value to positive 0.600 m.

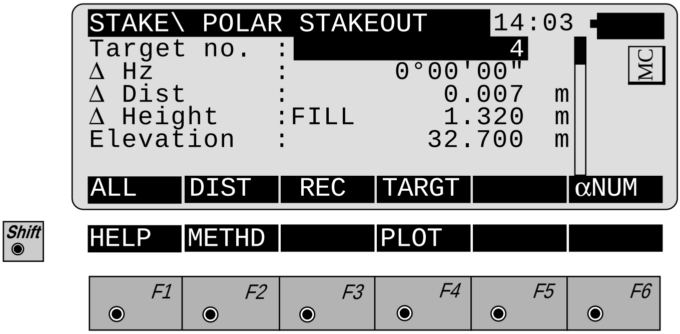
CONT — Returns to the "POINT COORDS" display.

```
ROAD+\ POINT COORDS     14:03
Chainage     :          0.000
Refl.Height  :          1.500  m
Easting      :        331.000  m
Northing     :        335.000  m
Elevation    :         31.000  m
                          STAKE EDIT
HELP
  F1    F2    F3    F4    F5    F6
```

Shift

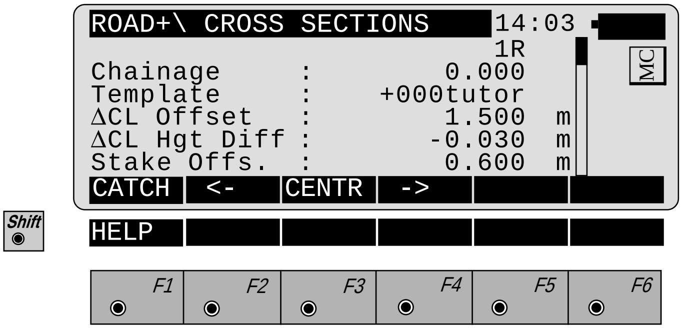
RP

F5 — Stakeout the 0.600 m offset stake for the right side of the bike path. The "POLAR STAKEOUT" display returns.



F2 Measures the distance.

F3 Record the point when it has been staked. The "CROSS SECTION" display returns showing the next point on the cross section to stake.



For this example, the last point staked was the 0.600 m offset point for the right side. When the "CROSS SECTIONS" display appears, the "ΔCL Offset" changes to the next point on the cross section. The next point to stake is the 0.600 m offset for the right side at the next station.

ESC Exits from the "CROSS SECTIONS" display and returns to the "CHAINAGE & OFFSET".

RP

```
ROAD+\ CHAINAGE & OFFSET 14:03
Chainage      :        0.000
Element       :          POB
Offset        :        0.000  m
Hght Offset   :        0.000  m

CHECK  CH-->  <--CH  XSEC         EDIT
```

Shift

```
HELP
```

F1 F2 F3 F4 F5 F6

F2 — Moves to the next chainage (you also may enter a chainage). The chainage and offset display will change to reflect the new chainage location.

F4 — Brings up the "CROSS SECTIONS" display.

```
ROAD+\ CROSS SECTIONS    14:03
                           1R
Chainage       :      25.000
Template       :   +000tutor
ΔCL Offset     :       1.500  m
ΔCL Hgt Diff   :      -0.030  m
Stake Offs.    :       0.600  m
CATCH   <-   CENTR   ->
```

Shift

```
HELP
```

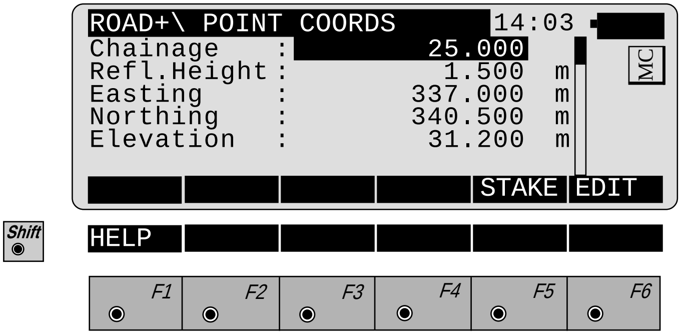
F1 F2 F3 F4 F5 F6

In our example the last point staked was on the right side. Rather than have the rod person cross back over to the left side, it makes sense to stay on the right side and stake that position and then cross over to the left side. To stake the catch point on the right side:

F4 — Set the "ΔCL Offset" from centerline value to positive 1.500 m. The offset value should be positive 0.600 m, but should not require a change because that was the last offset value used for the previous right side point.

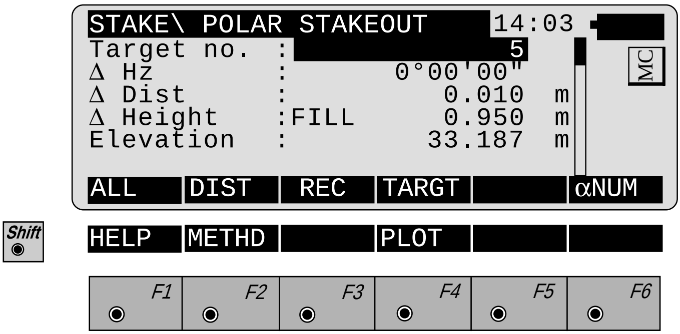
CONT — Access the "POINT COORDS" display.

RP



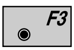
To stake the offset point on the right side for chainage 25+00:

Activates the stakeout program. The "POLAR STAKEOUT" display will appear.

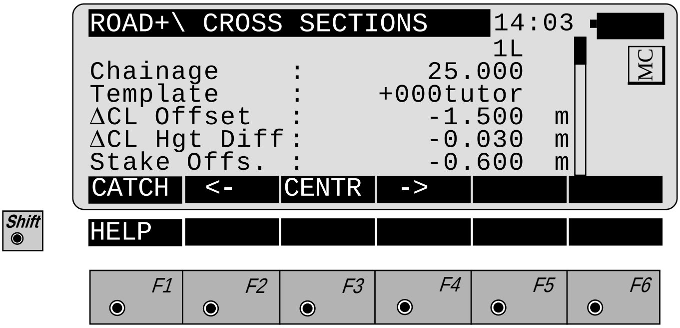


Use the normal procedure previously outlined for staking out the point.

RP



Records the staked out position and returns to the "CROSS SECTIONS" display.

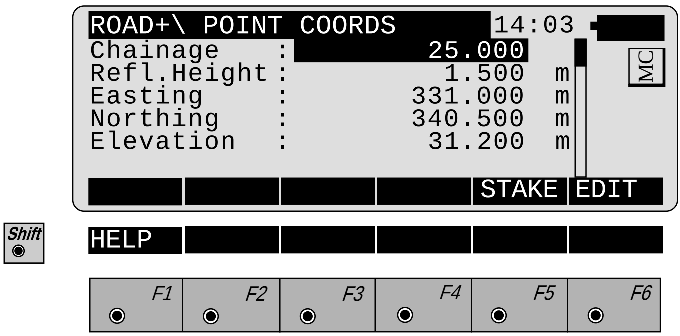


F4

Change the "ΔCL Offset" from centerline to negative 1.5 m. Change the "Stake Offs." value to negative 0.600 m.

CONT

Access the "POINT COORDS" display.



F5

Access the stakeout program. Follow the stakeout procedure previously outlined and record the staked out point. When the "CROSS SECTIONS" display returns, press ESC to access the "CHAINAGE & OFFSET" display.

RP

Horizontal Offset Stake Out Summary

In this section, a brief summary of using the horizontal offset method is provided. It is assumed the reader has reviewed sections "Stakeout using horizontal offset" through "Stakeout and recording" which provide a detailed explanation of program functions. We recommend making a copy of this short guide and keeping it in the instrument case.

Start ROADPLUS & Set Configuration Options

Start the "ROADPLUS" from the program menu.

Shift F2

Start the "Configuration-Editor" from the "SELECT ALN FILES" dialog.

```
ROAD+\  CONFIGURATION   14:03
Base Chainge:          0.000
End Chainge :         89.270       MC
Chainge Incr:         10.000  m
Hght. Shift :          0.000  m
Deflct. Tol.:       0°00'20"
Chainge Tol.:          0.010  m
INFO                  DFLT  EDIT
HELP
```

Shift

F1 F2 F3 F4 F5 F6

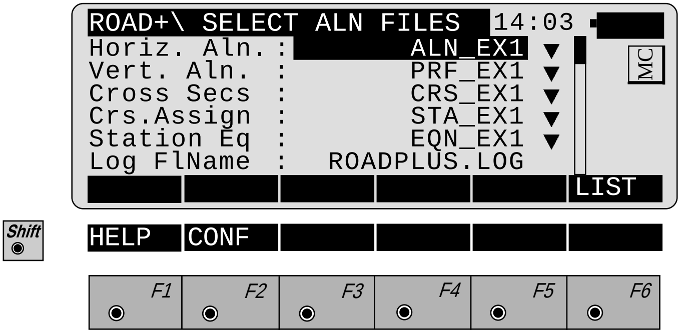
Enter the beginning and ending chainage, the chainage increment and so forth. Make all entries.

RP

CONT

Returns to the "SELECT ALN FILES" display.

Select Alignment Files



F6 Select the alignment files.

Place the cursor on each file type, press F6 and pick the file from the displayed list. Select the files.

CONT The "CHAINAGE & OFFSET" options are displayed.

A horizontal file must be selected.

RP

Set offset value and select point to stakeout

```
ROAD+\ CHAINAGE & OFFSET 14:03
Chainage      :        0.000
Element       :          POB
Offset        :        0.000  m
Hght Offset   :        0.000  m

CHECK  CH-->  <--CH  XSEC         EDIT
```

Shift

```
HELP
```

F1 F2 F3 F4 F5 F6

To select the template point to stake (back of curb, edge of pavement etc.):

F4 — The "CROSS SECTIONS" options display appears.

```
ROAD+\ CROSS SECTIONS    14:03
                            1R
Chainage       :      25.000
Template       :   +000tutor
ΔCL Offset     :       1.500  m
ΔCL Hgt Diff   :      -0.030  m
Stake Offs.    :       0.600  m
CATCH   <-   CENTR   ->
```

Shift

```
HELP
```

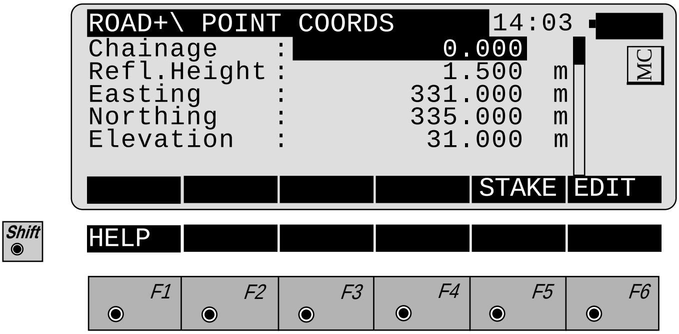
F1 F2 F3 F4 F5 F6

F2 or F4 — Set the "ΔCL Offset" value. This value is the distance from centerline of the point you want to stake.
Move the cursor to "Template" and pick the cross section template to use. Following set the "Stake Offs." (stake offset value). If the point is left of the centerline, enter the offset value as a negative value.

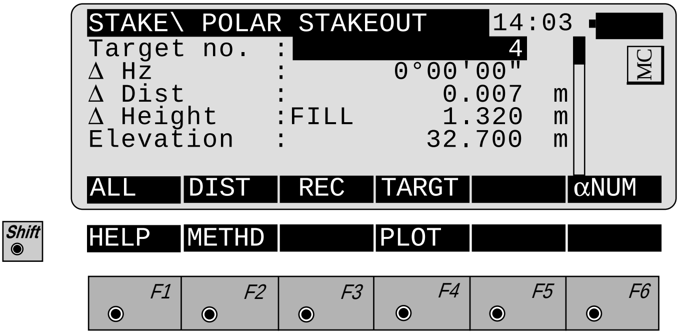
CONT — Continues with display "POINT COORDS".

RP

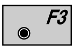
Stakeout the point



The stakeout program will start with the polar stakeout method being used.



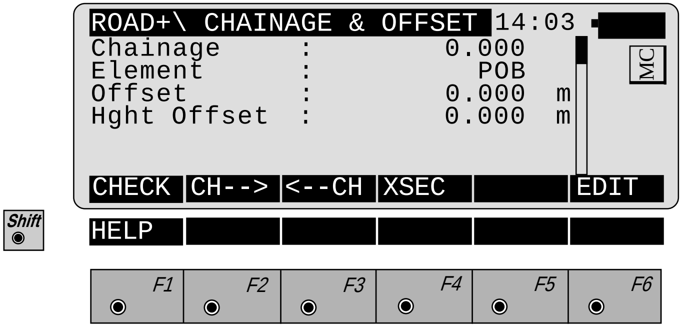
With the polar method, the theodolite is turned until the displayed horizontal circle reading is zero degrees. The rod person is moved on line and a distance is measured. The results are displayed telling you how far from the real point the prism pole is. Move the rodperson until the distance shows near zero. The CUT/FILL value is displayed along with the elevation of the point.



Record the point, and the "CROSS SECTIONS" display returns.

Move to a new chainage. The "CHAINAGE & OFF-SET" display returns.

Select new chainage



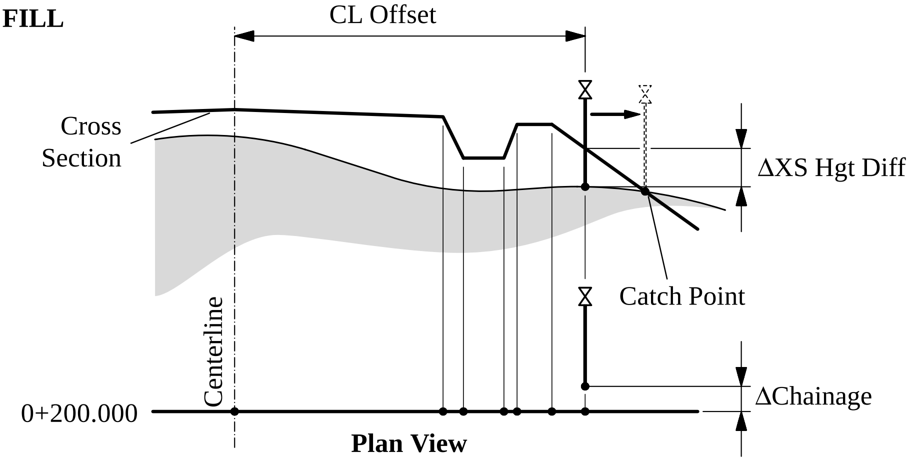
Select a new chainage (you also may enter a chainage).

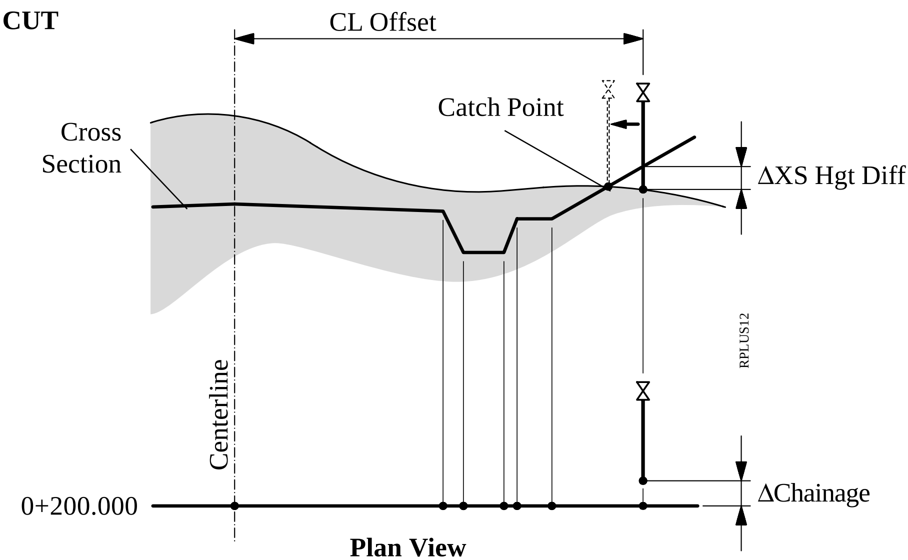
Select the point to stake out and the offset.
Repeat the procedure outlined in sections *"Set offset value and select point to stakeout" (page 282)* through *"Select new chainage" (page 284)*. Continue in this manner until all points have been staked.

RP

Slope Staking

Slope staking involves determining a point where the cross section template meets the ground surface. This point of zero cut/fill is found primarily by trial and error and a lot of computing. The following diagram illustrates the concepts of slope staking.





The slope staking routine is accessed from the "CROSS SECTIONS" display.

RP

F4 — Start the "CROSS SECTIONS" display from the "CHAINAGE & OFFSET" display.

```
ROAD+\ CROSS SECTIONS   14:03
                           1L
Chainage      :         0.000
Hght. Shift   :         0.000  m
Template      :     +000tutor
ΔCL Offset    :        -1.500  m
ΔCL Hgt Diff  :        -0.030  m
CATCH   <-   CENTR   ->
```

Shift:

```
HELP              PLOT
```

F1 F2 F3 F4 F5 F6

Before proceeding, move the cursor to the "Template" option.

F6 — Choose the template to use for slope staking. If the displayed template is the correct one, then it will not be necessary to change it.

F1 — Start the slope stake program.

```
ROAD+\ SLOPE STAKING    14:03
Chainage      :         0.000
Template      :        typcut
Xsection      :           CUT
ΔCL Offset    :         9.867  m
ΔXS Hgt Diff  :         1.089  m
ΔChainage     :         3.254  m
 ALL   DIST   REC   TARGT
```

Shift:

```
HELP  ΔSt=0  STORE  I<>II  REFPT
```

F1 F2 F3 F4 F5 F6

The "STORE" and "REFPT" options are not available until *after* a measurement is taken.

RP

F2

Measure to the current position of the prism pole.
The value for "ΔXS Hgt Diff" needs to be zero or close to it. When this value is zero the catch point has been determined. However, the value for "ΔChainage" is also important. This value shows where the actual point is in relation to the chainage of the cross section being used.

In the sample display shown, the value for "ΔXS Hgt Diff" is 1.089 m. The value is positive which means the catch point is higher than where the measurement was taken. Therefore the rodperson would look for a spot that is approximately 1 m higher than the current point.

Now look at the value for "ΔChainage". This indicates where the prism pole is in relation to the chainage. In this example, the rodperson would move approximately 3 m to his/her right looking towards the instrument. If the value is negative the pole would be moved to the left.

In addition, the horizontal distance from centerline is displayed which is 9.867 m for this example.

After moving to a new location, measure a distance to the prism and view the results. When the "ΔXS Hgt Diff" and "ΔStation" are at or near zero the catch point has been located both vertically and horizontally for the chosen chainage.

F3

Record the staked out position.
The "SLOPE STAKING" display returns and another catch point can be staked.

ESC

Exit the slope staking program.

SLOPE STAKING Menu Function Key Summary

F1 Measures the distance to the target, and automatically records the data as defined by the currently set recording mask.

F2 Measures the distance only, and updates the display.

F3 Records the information for the current measurements.

F4 Permits the user to change the height of the target.

Shift F3 Stores the data to the log file.

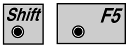
The store function is not available until a measurement is initiated with the "DIST" key.

Shift F4 Switches between face one and face two for measurements.

Shift F5 After a measurement is made to the prism pole the "REFPT" option will be available. *See section "Reference Point" for a detailed discussion of this option.*

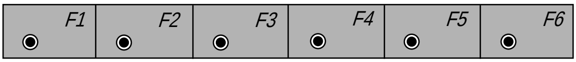
Shift F2 Moves along the alignment until "ΔChainage" =0, that is, move onto the correct cross section defined for that point. This allows checking against the actual cross section defined at that point.

The "ΔSt=0" function is not available until a measurement is initiated with the "DIST" key.



Displays additional information about how the location of the prism pole relates to components of the cross-section. Do this after a measurement has been made.

```
ROAD+\ REFERENCE POINT   14:03
                            1L
Chainage       :         0.000
Template       :        typcut
ΔChainage      :         3.254  m
ΔCatch Offs    :        -0.347  m
ΔCatch HgtD    :        -0.389  m
 ALL   DIST   REC   TARGT
ΔHinge Offs    :         8.154  m
ΔHinge HgtD    :        -2.123  m
ΔCL Offset     :         9.213  m
ΔCL HgtDiff    :        -1.124  m
HELP          STORE I<>II
```



1L : Indicates the location of the cross section point in relation to the centerline. In this example, the "1L" means the first point of the template left of centerline.

Chainage : Displays the current chainage.

Template : Displays the template name being used.

ΔChainage : Displays where the rod is in relation to the actual chainage. Move the rod to the right as you are looking from the pole towards the instrument if the value is positive. If the value is negative move to the left.

ΔCatch Offs : This value is where the pole is in relation to where the existing ground intersects the design slope of the template.

ΔCatch HgtD : This value is the vertical difference from the ground shot to where the existing ground catches the template.

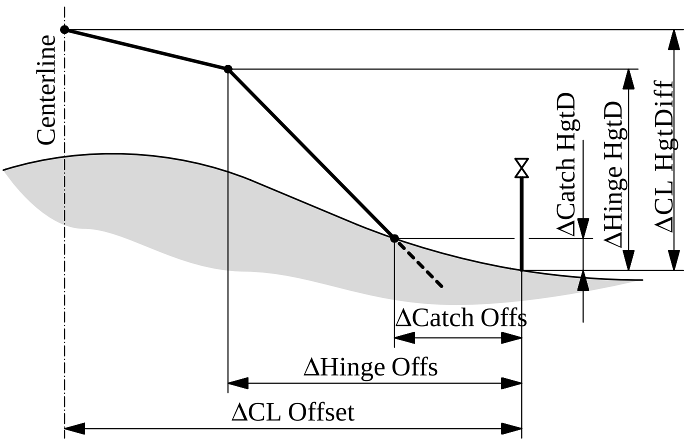
ΔHinge Offs : This is the horizontal distance from the prism to where the template begins the slope (hinges).

ΔHinge HgtD : The vertical difference between the ground shot and the hinge point.

ΔCL Offset : The horizontal distance from the ground shot to the centerline.

ΔCL HgtDiff : The vertical distance from the ground shot to the centerline.

The following illustration represents the various components of the REFPT option.



RPLUS13

RP

Data Formats

The following describes the format and contents of the data stored for alignments and cross-sections in the RoadPlus program. All files are in GSI format and must be located in the \GSI directory of the memory card.

Horizontal Alignment

The following geometric elements are supported:

Element	**Definition**	**Declaration in the alignment file**
Tangent	Coordinates (X,Y) to Coordinates (X,Y)	"STRAIGHT"
Circular curve	Beginning of arc (X,Y), Radius,	"000CURVE" End of arc (X,Y);
Spiral In	Beginning of curve (X,Y), A-Parameter / Length of curve + Radius, End of curve (X,Y);	"00SPIRIN"
Spiral out	Beginning of curve (X,Y), A-Parameter / Length of curve + Radius, End of curve (X,Y);	"0SPIROUT"
Compound curve in	Beginning of curve (X, Y), Radius 1, Radius 2	"0CURVEIN"
Compound curve out	Beginning of curve (X, Y), Radius 1, Radius 2	"CURVEOUT"
End of Project	Coordinates (X,Y)	"00000EOP"

Header of the Horizontal Alignment File:

41....+000JOBID 42....+HZALIGNM 43......+STACOORD

RP

WI 41 Job-Identification. Max. 8 ASCII-characters, may be defined by user.

WI 42 Identification of Horizontal Alignment file. May not be changed by user.

WI 43 Identification of principal point type file. May not be changed by user.

The data block for a principal point in the file is structured as follows :

```
11....+KILOMETR 71....+0NEXTGEO 72....+0NEXTRAD
73....+0TEMPLNR 81..10+00000000 82..10+00000000
```

WI 11 Chainage of the point.

WI 71 Type of the following geometric element.

WI 72 Radius of the next horizontal geometric element, Radius 1 for a compound curve, or the A-Parameter for spirals.

WI 73 Number of a cross-section (Template) assigned to the next geometric element.

WI 74 Radius 2 for compound curves.

WI 81 E-Coordinate of the point.

WI 82 N-Coordinate of the point.

Comments:

- The header consists of a single block at the start of a data file.
- Tangents and the EOP contain “00000NON” in WI72
- Data units in WI’s 11 and 72 are defined by WI81 and WI82.
- If the radius point for a curve (circular or spiral) is to the left of the alignment in the direction of increasing stations, the radius is negative.
- If the radius point for a curve (circular or spiral) is to the right of the alignment in the direction of increasing stations, the radius is positive.
- The same cross section (Template) may be assigned to more than one location.
- An alignment file must contain at least two elements.
- There is no limitation on the size of the Hz-alignment file. As a result, as many data blocks as you like can be entered if a file is created on the PC using the DOS program "ROADDATA.EXE". If a file is created/edited using the program "FILE EDITOR" on the TPS1000 there is a limitation of 200 data blocks.

Example of a Horizontal Alignment:

```
41....+0EXAMPLE 42....+HZALIGNM 43....+STACOORD
11....+00000000 71....+STRAIGHT 72....+00000NON
73....+QP000125 81..10+06000000 82..10+02000000
11....+00198832 71....+00SPIRIN 72....-00122474
73....+QP000123 81..10+06068005 82..10+02186841
11....+00348832 71....+000CURVE 72....-00100000
73....+QP000123 81..10+06150344 82..10+02307751
11....+00450725 71....+0SPIROUT 72....-00100000
73....+QP000123 81..10+06247816 82..10+02304071
11....+00550725 71....+STRAIGHT 72....+00000NON
73....+QP000125 81..10+06310759 82..10+02227794
11....+00714138 71....+00SPIRIN 72....+00054772
73....+QP000124 81..10+06392465 82..10+02086275
11....+00789138 71....+000CURVE 72....+00040000
73....+QP000124 81..10+06445859 82..10+02037807
11....+00824376 71....+0SPIROUT 72....+00044721
73....+QP000124 81..10+06478120 82..10+02048886
11....+00874376 71....+STRAIGHT 72....+00000NON
73....+QP000125 81..10+06496445 82..10+02094478
11....+01127904 71....+00000EOP 72....+00000NON
73....+QP000125 81..10+06540469 82..10+02344154
```

The principal points method allows joining elements without the use of intermediate tangents.
The following combinations, for example, may be defined:

- **Double spiral: spiral out followed by spiral in**
- **Multiple circular curves**
- **S curves with and without intermediate tangents**

Geometric elements supported:

Element	Definition	Declaration in the Alignment file
Tangent	Coordinate (Km,H) to Coordinate (Km,H)	"STRAIGHT"
Circular curve	beginning of curve(Km,H), Radius, end of curve (Km,H);	"000CURVE"
Parabola	Coordinate (Km,H), Parabola parameter / Parabola length;	"0PARABOL"
End of project	Coordinate (Km,H)	"00000EOP"

Vertical Alignment File Header:

41....+000JOBID 42....+0VALIGNM 43......+STACOORD

WI 41 Job-Identification. Max. 8 ASCII-characters, may be defined by user.

WI 42 Identification of Vertical Alignment file. May not be changed by user.

WI 43 Identification of principal point type file. May not be changed by user.

Example for a data block for a vertical alignment point:

11....+KILOMETR 71....+0NEXTGEO 72....+0NEXTRAD 83..10+00000000

WI 11 Chainage of a vertical alignment point

WI71 Type of the following geometric element

WI72 Radius of the following geometric element or parabola parameter

WI83 Elevation of the point

Comments:

- The header consists of a single block at the start of a data file.
- Tangents and the EOP contain “00000NON” in WI72
- Data units in WI’s 11, and 72 are defined by WI83.
- Tangent and arc lengths may be calculated from the stationing.
- The stationing is projected onto a horizontal plane.
- If the curve radius point lies above the centerline, the radius is positive.
- If the curve radius lies beneath the centerline, the radius is negative.
- An alignment file must contain at least two elements.
- There is no limitation on the size of the V-alignment file. As a result, as many data blocks as you like can be entered if a file is created on the PC using the DOS program "ROADDATA.EXE". If a file is created/edited using the program "FILE EDITOR" on the TPS1000 there is a limitation of 200 data blocks.

Example of a vertical alignment file:

```
41....+0EXAMPLE 42....+0VALIGNM 43....+STACOORD
11....+00000000 71....+STRAIGHT 72....+00000NON
83..10+00400000
11....+00300000 71....+0PARABOL 72....-01142932
83..10+00422500
11....+00500000 71....+STRAIGHT 72....+00000NON
83..10+00420000
11....+00550000 71....+0PARABOL 72....+02091126
83..10+00415000
11....+00850000 71....+STRAIGHT 72....+00000NON
83..10+00406522
11....+01127904 71....+00000EOP 72....+00000NON
83..10+00418605
```

Geometric elements supported:

Element	Definition
Height differences	Height difference to the centerline
Distance	Distance from the centerline
Cross section type	Differentiate between CUT and FILL cross sections
Slope	slope ratio

Header of the cross section file:

41....+00JOB_ID 42....+TEMPLATE

WI41 Job identification. Max. 8 ASCII characters, user definable.

WI42 Template file identification. May not be changed by user.

A data block for a cross section is structured as follows:

11....+ PROF_NR 35....+DISTANCE 36....+000HDIFF

WI 11 The cross section number.

WI 35 Horizontal distance from the centerline.

WI 36 Height difference from the centerline.

WI 71 Cross section type.

WI 72 Slope ratio.

Comments:
- The header consists of a single block at the start of a data file.
- All data blocks having the same cross section number (WI11) belong together.
- All data blocks belonging to a cross section must be consecutive in the file to minimize file access.
- The data blocks for a cross section must be sorted by ascending distance from the centerline.

- Cross-sections do not have to be sorted by number.
- A negative distance (WI35) indicates a point to the left of the centerline.
- A positive distance (WI35) indicates a point to the right of the centerline.
- A negative height difference (WI36) indicates a point below the centerline.
- A positive height difference (WI36) indicates a point above the centerline.
- For a cross section file there is a limitation of 200 data blocks. The maximum number of points in a cross section is 48.
- A template file must contain at least one cross-section.
- The entries for cross section type and slope are optional.
- The slope entry must be attached to the last point on either side of the cross section.

Example:

```
41....+0EXAMPLE 42....+TEMPLATE
11....+QP000123 35..10-00013000 36..10-00003000
11....+QP000123 35..10-00010000 36..10-00005000
11....+QP000123 35..10-00004000 36..10-00000100
11....+QP000123 35..10+00004000 36..10+00000100
11....+QP000123 35..10+00010000 36..10-00006000
11....+QP000123 35..10+00013000 36..10-00003500
11....+QP000124 35..10-00012000 36..10-00002000
11....+QP000124 35..10-00011000 36..10-00004000
11....+QP000124 35..10-00004000 36..10+00000100
11....+QP000124 35..10+00004000 36..10-00000100
11....+QP000124 35..10+00011000 36..10-00005000
11....+QP000124 35..10+00012000 36..10-00002500
11....+QP000125 35..10-00012000 36..10-00002000
11....+QP000125 35..10-00011000 36..10-00002500
11....+QP000125 35..10-00004000 36..10-00000070
11....+QP000125 35..10+00004000 36..10-00000070
11....+QP000125 35..10+00011000 36..10-00002500
11....+QP000125 35..10+00012000 36..10-00002000
11....+TEMPLATE 35..41-00002000 36..11+00000000
71....+0000FILL 72....+00002000
11....+TEMPLATE 35..41-00000500 36..11+00000000
71....+0000FILL 72....+00000000
11....+TEMPLATE 35..41+00000000 36..11+00000000
71....+0000FILL 72....+00000000
11....+TEMPLATE 35..41+00001000 36..11+00000000
71....+0000FILL 72....+00000000
11....+TEMPLATE 35..41+00002000 36..11+00000000
71....+0000FILL 72....+00002000
```

RP

Cross Section Assignments

Elements supported.

Element	Definition
Cross Section number	The number or identifier of the cross section
Chainage	The chainage from which the cross section is applied

Header of the Cross Section Assignment file:

```
410001+000asker 42..10+ASSIGNMT 43....+CRSASKER
```

WI41 Job identification. Max. 8 ASCII characters, user definable.

WI42 Cross section assignment file identification. May not be changed by user.

WI43 Name of the corresponding cross section file

A data block for a cross section assignment is structured as follows:

```
110002+0000NORM 71....+00382000
```

WI 11 The cross section number.

WI 71 Beginning chainage for that cross section

Comments:

- The header consists of a single block at the start of a data file.
- A cross section assignment file must have a corresponding cross section file.
- A cross section remains valid until a new cross section is assigned.
- A given cross section may be assigned to multiple chainage.
- The units for chainage are defined in WI 42 in the file header.
- For a cross section assignment file there is a limitation of 100 data blocks.

RP

Example:

```
410001+000asker 42..10+ASSIGNMT 43....+CRSASKER
110002+0000NORM 71....+00382000
110003+0000NORM 71....+00552000
110004+00000568 71....+00568000
110005+000568.1 71....+00568100
110006+000585.1 71....+00585100
110007+000585.2 71....+00585200
110008+0000NORM 71....+00611000
110009+0000NORM 71....+00775000
110010+00000811 71....+00811000
110011+000826.9 71....+00826900
110012+00000827 71....+00827000
110013+00000827 71....+00844000
110014+000826.9 71....+00844100
110015+00000860 71....+00860000
```

RP

Elements supported

Element	Definition
Station equation number	The number or identifier of the station equation
Chainage ahead	The chainage to be applied going forward along the alignment
Chainage back	The chainage to be applied going backward along the alignment

Header of the Station Equation file :

```
41....+00JOB_ID 42....+0STAEQTN
```

WI41 Job identification. Max. 8 ASCII characters, user definable.

WI42 Station Equation file identification. May not be changed by user.

A data block for a station equation is structured as follows:

```
41....+00000001 42....+00100000 43....+00200000
```

WI 41 The station equation number.

WI 42 Chainage ahead.

WI 43 Chainage back.

Comments:
- The header consists of a single block at the start of a data file.
- For a station equation file there is a limitation of 100 data blocks.

Example:

```
41....+00JOB_ID 42....+0STAEQTN
41....+00000001 42..10+00100000 43..10+00200000
41....+00000002 42..10+00566000 43..10+00600000
```

RP

Log File

If "Log File" is set to "ON" the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header includes:
- the program used,
- information about the instrument,
- the file to store the measurement data,
- the date and the time.

Configuration the name of the input files for:
- the Hz-alignment,
- the V-alignment and
- the cross section.

Measurement
- Instrument station with coordinates and instrument height.
- Stakeout point with heigth offset,
- offset[1] and height displacement[2] relative to centre line,
- comparison values from planning, and associated differences.

[1] This value results from
- the displacement of the zero point of the profile and
- the displacement taken from the transverse profile.

[2] This value results from
- the displacement of the zero point of the profile and
- the displacement taken from the transverse profile
- the height displacement in the configuration.

Leica VIP RoadPlus V2.11		
Instrument	:	TCM1100, Serial 412784, (not named)
User Templ.	:	User 1
Meas. File	:	FILE01.GSI
Program Start	:	04/08/1995 at 10:23
Horizontal Aln	:	ALNSPORT.GSI
Vertical Aln	:	PRFSPORT.GSI
Cross Sections	:	CRSSPORT.GSI
Station	:	1
		E= 0.000m N= 0.000m ELV= 0.000m hi= 0.000m
Point No.	:	55
Chainage	:	150.000, Offset= 0.000m, Hght Offset= 0.000m
Design	:	E= -79.269m, N= 19.917m, ELV= 400.501m
Staked	:	E= -1.057m, N= 2.578m, ELV= 0.107m
Deltas	:	dE= -78.211m, dN= 17.339m, dELV= 400.394m
Point No.	:	5
Chainage	:	100.000, Offset= 0.000m, Hght Offset= 0.000m
Design	:	E= -46.305m, N= 26.708m, ELV= 400.409m
Staked	:	E= -0.000m, N= 2.774m, ELV= 0.051m
Deltas	:	dE= -46.305m, dN= 23.934m, dELV= 400.358m
Point No.	:	5
Chainage	:	100.785, Offset= 0.000m, Hght Offset= 0.000m
Design	:	E= -46.688m, N= 27.392m, ELV= 400.365m
Staked	:	E= -0.000m, N= 2.774m, ELV= 0.051m
Deltas	:	dE= -46.688m, dN= 24.619m, dELV= 400.314m

Example of a log file for the program "ROAD PLUS"

RP

File Editor

Introduction

The manual describes the program "**FILE EDITOR (GSI)**" of the LEICA TPS SYSTEM 1000 theodolite series. This version of the file editor is only valid for a GSI configuration.
This program is used to open/to view and edit existing project files for the program "**RoadPlus**" or for creation of new project files.
In order to create new project files, the file names must comply with certain rules.

1. Horizontal Alignment File
   File Name: ALN?????.GSI
2. Vertical Alignment File
   File Name: PRF?????.GSI
3. Template File
   File Name: CRS?????.GSI
4. Station Equation File
   File Name: EQN?????.GSI
5. Cross-section Assignment File
   File Name: STA?????.GSI

You can insert a permitted character for a DOS file name in place of a ?.

Creation of files

The following table shows an overview of the max. file sizes:

Type of file	Limitations
Horizontal alignment	200 data blocks
Vertical alignment	200 data blocks
Cross section	200 data blocks (number of points in a cross section max. 48)
Cross section assignment	100 data blocks
Station equation	100 data blocks

FE

Editing files

It is possible to insert also a new data set:

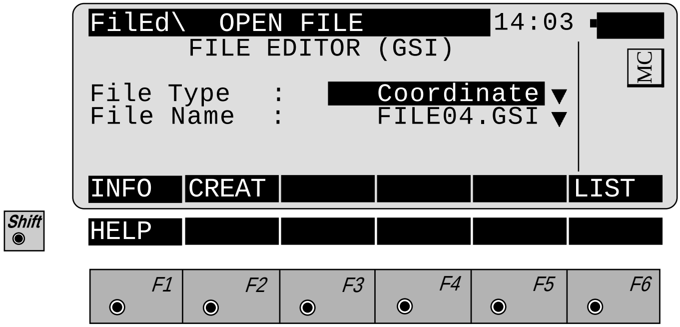
- With function "**Coordinate**", point coordinates, station coordinates or a code block can be inserted.
- With function "**Horizontal Alignment**" a tangent, a circular curve, a Spiral in, a Spiral out, a Curve in or a Curve out can be inserted.
  For the circular curve radius the following sign rule applies:
  With a right-hand curve (centre of circle right of alignment) the sign is positive.
  With a left-hand curve (centre of circle left of alignment) the sign is negative.
- With function "**Vertical Alignment**" a tangent, a circular curve or a parabola can be inserted.
  For the circular curve radius and/or the parabola parameter the following sign rule applies:

  If the centre of circle is above the alignment (dip) the sign is positive.
  If the centre of circle is below the alignment (crest) the sign is negative.
- With function "**Template**" an offset or a height difference relative to axis can be inserted.
  For the offset and/or the height difference the following sign rule applies:
  If the point is left of alignment the offset is negative.
  If the point is right of alignment the offset is positive.
  If the point is above the alignment the height difference is positive.
  If the point is below the alignment the height difference is negative.
- With function "**Station Equation**" a number for the station equation, a station ahead or a station back can be inserted.
- With function "**Cross-section Assignment**" the name of the template and the start station for this template can be inserted.

FE

Open file

Start program "**FILE EDITOR**" from the "**MAIN MENU: PROGRAMS**" dialog.



File Type : Select type of file:
Coordinate, *refer to chapter "Coordinates"*
Horiz. Align, *refer to chapter "Horizontal Alignment"*
Vert. Align, *refer to chapter "Vertical Alignment"*
Template, *refer to chapter "Template"*
Sta. Eqn., *refer to chapter "Station Equation"*
CRS Assignmnt, *refer to chapter "Cross-section Assignment"*

File Name : Select file name.

F1 Displays date and version of the running application.

F2 Create new file **"Coordinate"**, *see dialog page 306.*

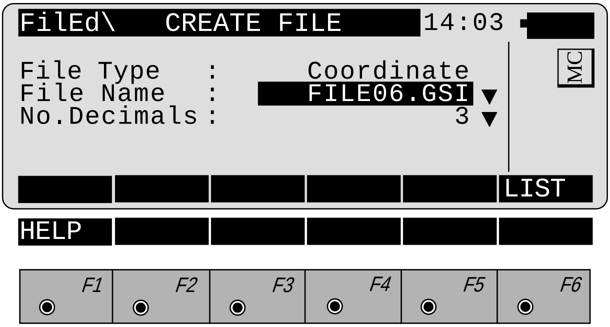
CONT View and edit existing file.

FE

F2 Press within *dialog page 305* in order to create a new file Coordinates *(see dialog below).*

CONT Press within *dialog page 305* in order to view and edit the selected file *(see dialog page 307 - 309).*

Shift



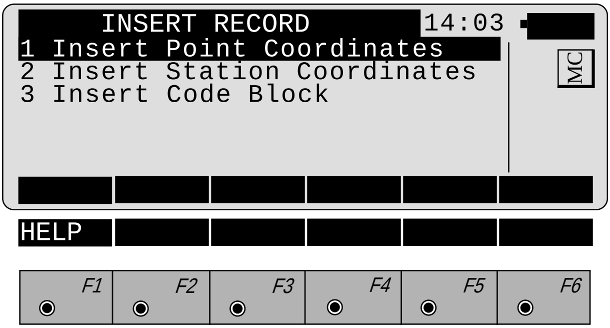
File Type : Display of type of file.

File Name : Select file name. Only files, which are not created yet, can be selected.

No.Decimals : Select number of decimals.

CONT Insert a new data set.

Shift



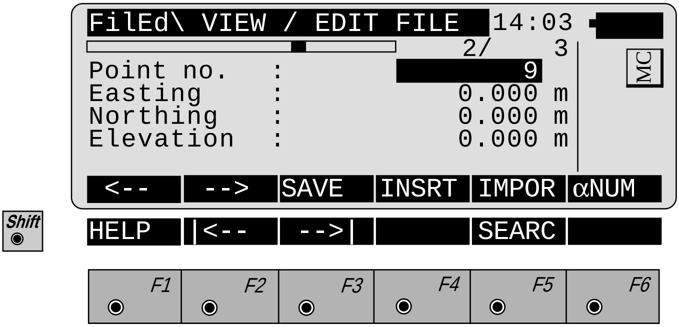
FE

1 Insert point coordinates, *see page 307.*

2 Insert station coordinates, *see dialog page 308.*

3 Insert code block, *see dialog page 309.*

1 Call function "**Insert Point Coordinates**" in menu "**INSERT RECORD**" *(page 306).*



2/ 3	:	Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.
Point no.	:	Input of point number.
Easting	:	Input of easting.
Northing	:	Input of northing.
Elevation	:	Input of elevation.

F1 Display of previous point.

F2 Display of following point.

F3 Save file.

F4 Insert new data set, *see dialog page 306, bottom.*

F5 Import of coordinates by reading in the active coordinate file. This function is described in *chapter "Select user template ..." of the "SYSTEM" Users Manual.*

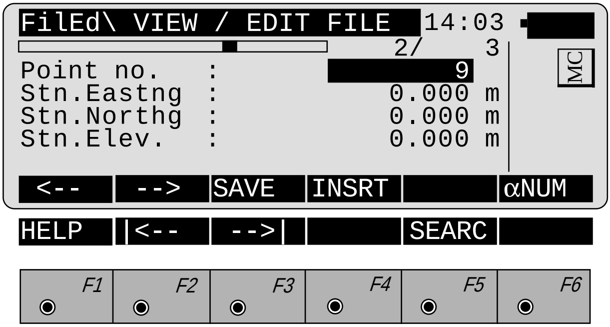
Shift F2 Goto start of file.

Shift F3 Goto end of file.

Shift F5 Point search, *see dialog page 310.*

FE

Call function "**Insert Station Coordinates**" in menu "**INSERT RECORD**" *(page 306).*



2/ 3 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Point no. : Input of point number.

Stn. Eastng : Input of station easting.

Stn. Northg : Input of station northing.

Stn. Elev. : Input of station elevation.

Meaning of the function keys is similar to *dialog page 307.*

FE

3

Call function "**Insert Code Block**" in menu "**INSERT RECORD**" *(page 306).*

```
FilEd\ VIEW / EDIT FILE 14:03
                          2/    3   MC
Code          :               1
Info 1        :      +00000000
Info 2        :      +00000000
Info 3        :      +00000000
Info 4        :      +00000000
 <--  | -->  |SAVE |INSRT|     |αNUM

Info 5        :      +00000000
Info 6        :      +00000000
Info 7        :      +00000000
```

Shift

```
HELP | |<-- | -->| |     |SEARC|
```

F1 F2 F3 F4 F5 F6

2/ 3 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

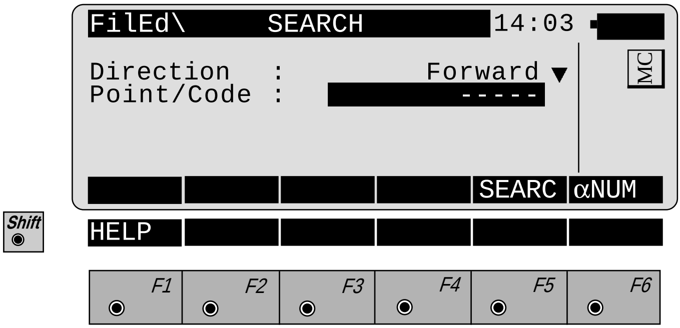
Code : Input of code number.

Info 1-7 : Input of information 1 to 7.

Meaning of the function keys is similar to *dialog page 307*.

FE

Shift F5 — Start dialog "**SEARCH**" in dialogs "**VIEW / EDIT FILE**" *(pages 307 - 309).*



Direction : **Forward**: Searching for point or code numbers in direction end of file.
Backward: Searching for point or code numbers in direction start of file.

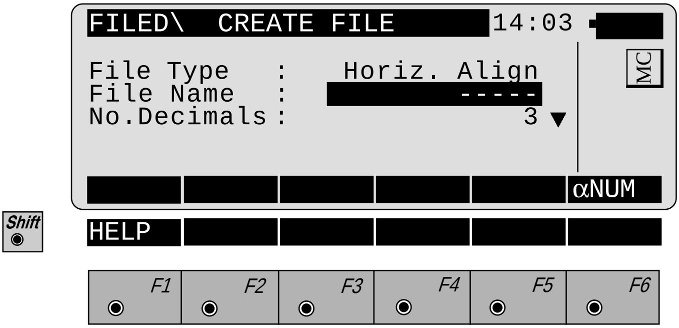
Point/Code : Input of point or code number.

CONT or F5 — Point search.

FE

F2 — Create new file **"Horiz. Align"** *in dialog page 305, see dialog bottom.*

CONT — View and edit selected file *in dialog page 305*, see *dialog page 312/314.*



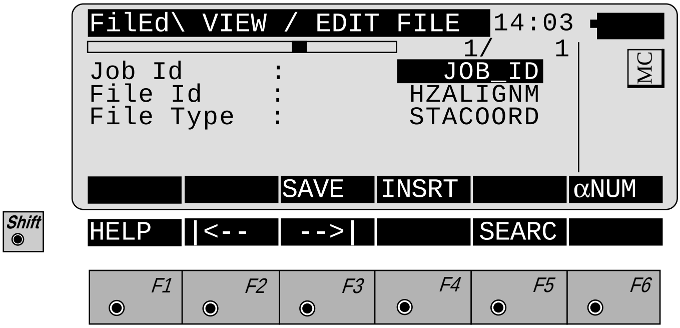
File Type : Display of type of file.

File Name : Input of file name (max. 5 char.), *see chapter "Introduction".*

No.Decimals : Selection of number of decimals.

CONT — Insert new **Header**, *see dialog page 312.*

FE



1/ 1 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Job Id : Input of job identification.

File Id : Display of horizontal alignment file.

File Type : Display for the main point method.

F3 Save file.

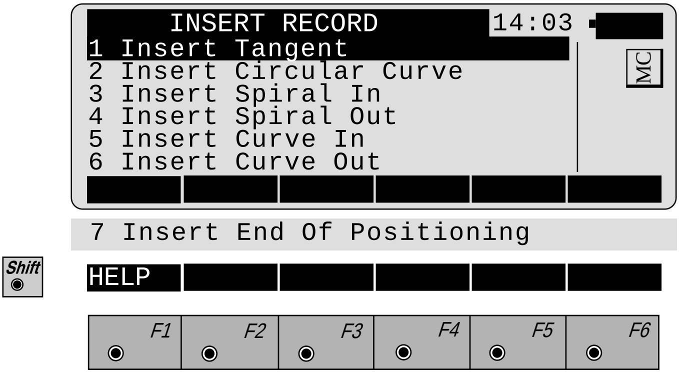
F4 Insert new data set.

Shift F2 Goto start of file.

Shift F3 Goto end of file.

Shift F5 Point search.

FE



1 Insert Tangent.

2 Insert Circular Curve.

3 Insert Spiral In.

4 Insert Spiral Out.

5 Insert Curve In, *see dialog page 314.*

6 Insert Curve Out.

7 Insert End Of Positioning.

The function "Insert Curve In" is used as an example. For the other functions refer to *dialog page 314.*

5

Call function "**Insert Curve In**" in menu "**INSERT RECORD**" *(page 313).*

```
FilEd\ VIEW / EDIT FILE  14:03
                          2/    3        MC
Station        :          0.000 m
Ele Type       :       Curve In
Radius 1       :          0.000 m
Template       :       TEMPLATE
Radius 2       :          0.000 m
 <--  |  -->  |SAVE |INSRT|IMPOR|EDIT
Easting        :          0.000 m
Northing       :          0.000 m
```

Shift

```
HELP  ||<--  | -->| |DEL  |SEARC|
```

F1	F2	F3	F4	F5	F6

2/ 3 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Station : Input of station (chainage).

Ele Type : Display of geometric element.

Radius 1 : Input of circular curve radius 1.

Template : Input of name/number of cross section.

Radius 2 : Input of circular curve radius 2.

Easting : Input of easting.

Northing : Input of northing.

FE

F1 Display of previous point.

F2 Display of following point.

F3 Save file.

F4 Insert new data set.

F5 Import of coordinates either by manual input or by reading in the active coordinate file. This function is described in *chapter "Select user template ..." of the "SYSTEM" Users Manual.*

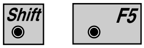
Shift F2 Goto start of file.

Shift F3 Goto end of file.

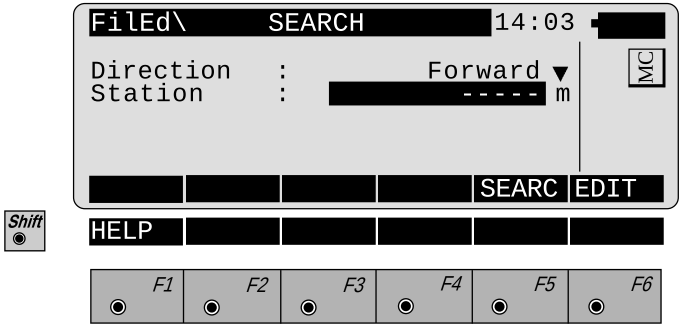
Shift F4 Delete a data block.

Shift F5 Point search.

FE

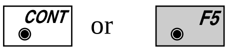


Start dialog "**SEARCH**" in the dialogs "**View / Edit File**" (*pages 312, 314).*



Direction : **Forward**: Searching for station in direction end of file.
Backward: Searching for station in direction start of file.

Station : Input of station (chainage).

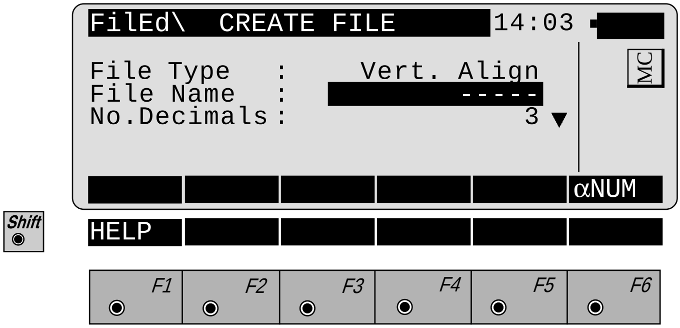


Search for station.

FE

F2 — Create new file **"Vert. Align"** *in dialog page 305, see dialog bottom.*

CONT — View and edit selected file *in dialog page 305*, see *dialog page 318 , 319.*

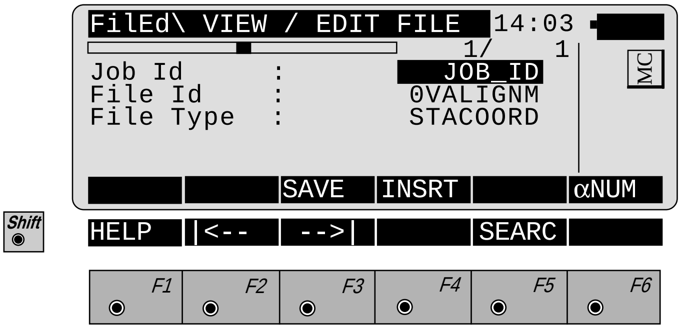


File Type : Display of type of file.

File Name : Input of file name (max. 5 char.), *see chapter "Introduction".*

No.Decimals : Selection of number of decimals.

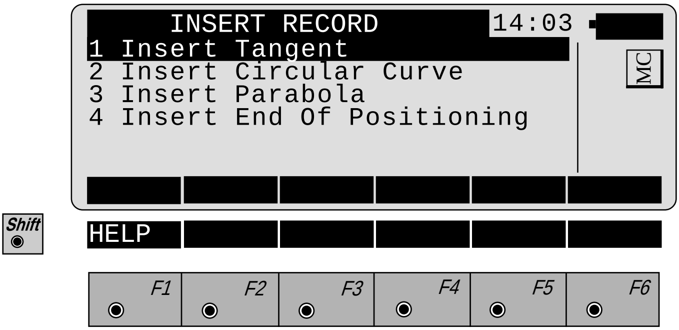
CONT — Insert new **Header**.



FE

1/ 1	:	Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.
Job Id	:	Input of job identification.
File Id	:	Display for the vertical alignment file.
File Type	:	Display for the main point method.

Meaning of the function keys is similar to *dialog page 312.*



1 Insert Tangent.

2 Insert Circular Curve.

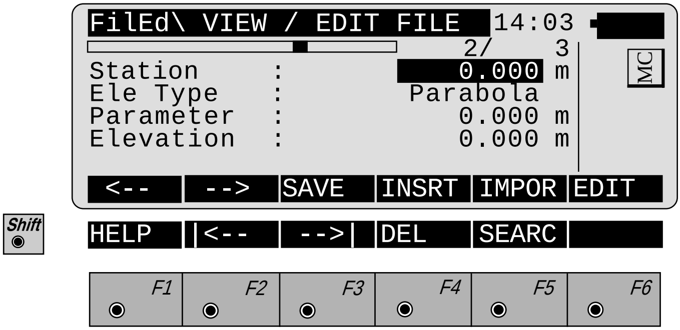
3 Insert Parabola, *see dialog page 319.*

4 Insert End Of Positioning.

FE

The function "Insert parabola" is used as an example. For the other functions refer to *dialog page 319.*

Call function "**Insert Parabola**" in menu "**INSERT RECORD**" *(page 318)*.



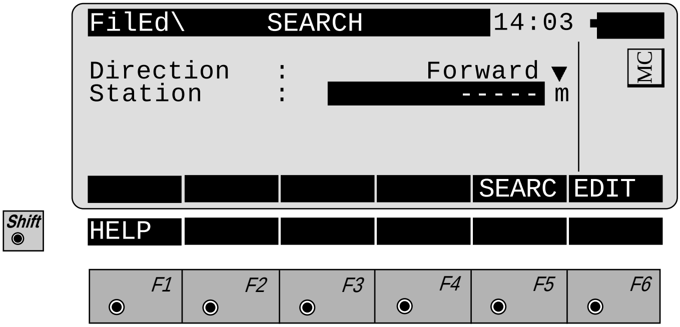
2/ 3	:	Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.
Station	:	Input of station (chainage).
Ele Type	:	Display of geometric element.
Parameter	:	Input of parabola parameter.
Elevation	:	Input of elevation.

Meaning of the function keys is similar to *dialog page 314.*

FE

Shift F5

Start dialog "**SEARCH**" in the dialogs "**View / Edit File**" *(pages 317, 319).*



Direction	:	**Forward**: Searching for station in direction end of file. **Backward**: Searching for station in direction start of file.
Station	:	Input of station (chainage).

CONT or F5

Search for station.

FE

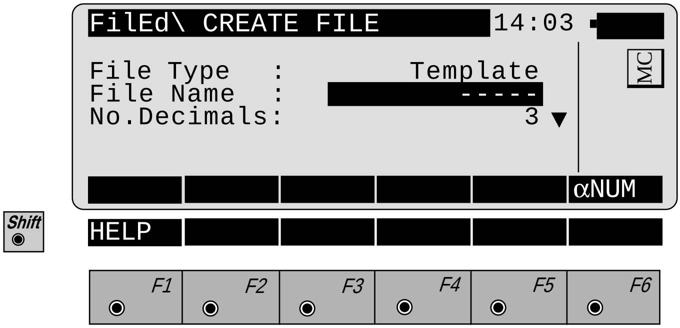
Template

F2

Create new file "**Template**" *in dialog page 305, see dialog bottom*.

CONT

View and editselected file in d*ialog page 305, see dialoges page 322/323.*



File Type : Display of type of file.

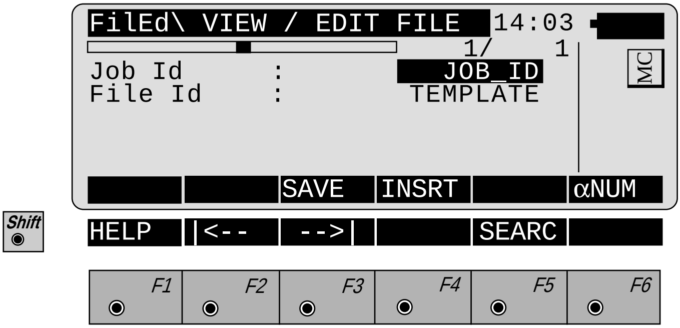
File Name : Input of file name (max. 5 char.), *see chapter "Introduction".*

No.Decimals : Selection of number of decimals.

CONT

Insert new **Header**, *see dialog page 322.*

FE



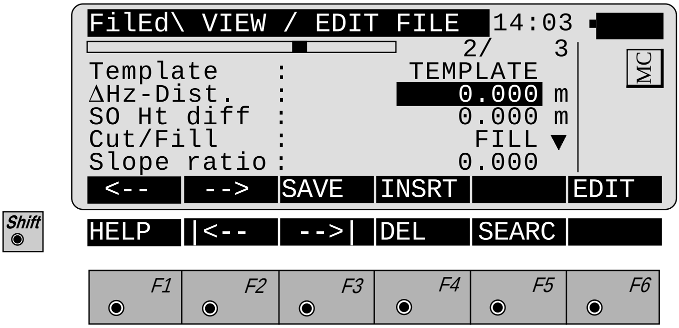
1/ 1 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Job Id : Input of job identification.

File Id : Display of cross section file.

Meaning of the function keys is similar to *dialog page 312.*

FE



2/ 3 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Template : Input of name/number of cross section point.

ΔHz-Dist. : Input of horiz. distance of cross section point.

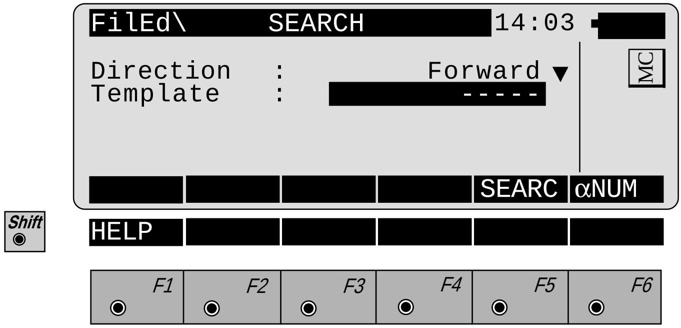
SO Ht diff : Input of nom. height difference of cross section point to axis.

Cut/Fill : Selection of cross section type. Available are:
CUT
FILL
STANDARD

Slope ratio : Input of slope ratio.

Meaning of the function keys is similar to *dialog page 314.*

Shift F5 Start dialog "**SEARCH**" in the dialogs "**View / Edit File**" *(pages 322, 323).*



Direction : **Forward**: Searching for templates in direction end of file.
Backward: Searching for templates in direction start of file.

Template : Input of template name.

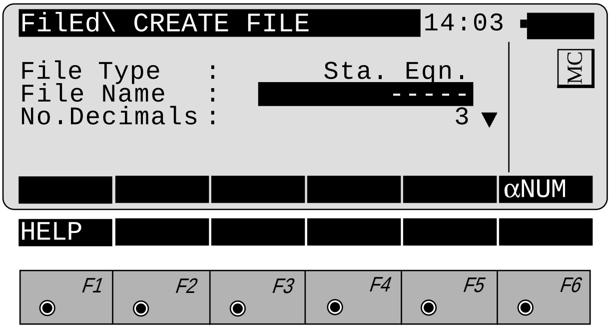
CONT or F5 Search for templates.

FE

F2 Create new file "**Sta. Eqn.**" *in dialog page 305, see dialog bottom*.

CONT View and edit selected file *in dialog page 305*, see *dialogs page 326/327*.

Shift



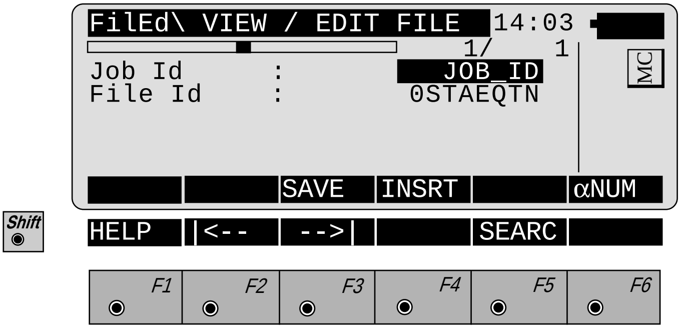
File Type : Display of type of file.

File Name : Input of file name (max. 5 char.), *see chapter "Introduction"*.

No.Decimals : Selection of number of decimals.

CONT Insert new **Header**, *see dialog page 326.*

FE



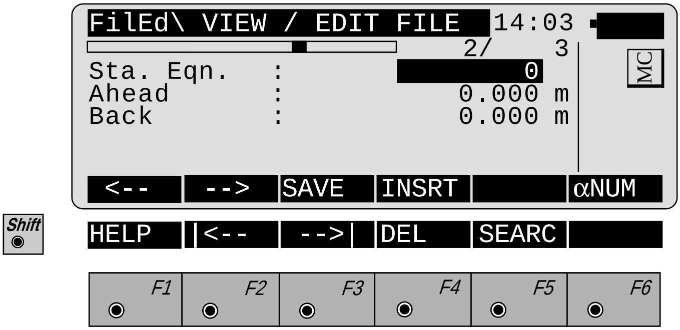
1/ 1 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Job Id : Input of job identificaton.

File Id : Display for the station equation file.

Meaning of the function keys is similar to *dialog page 312.*

FE



2/ 3 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Sta. Eqn. : Input of number of station equation.

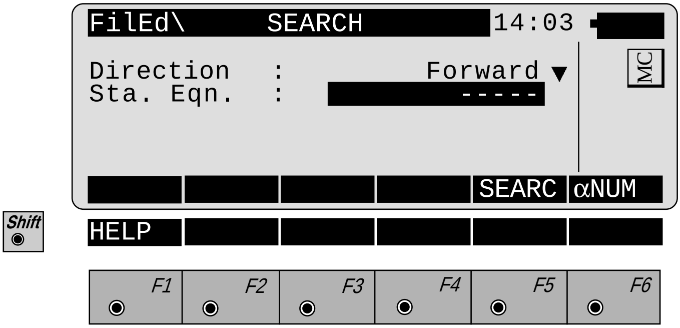
Ahead : Input of station ahead.

Back : Input of station back.

Meaning of the function keys is similar to *dialog page 314*.

FE

Shift F5 Start dialog "**SEARCH**" in dialogs "**View / Edit File**" *(pages 326, 327).*



Direction : **Forward**: Searching for station equations in direction end of file.
Backward: Searching for station equations in direction start of file.

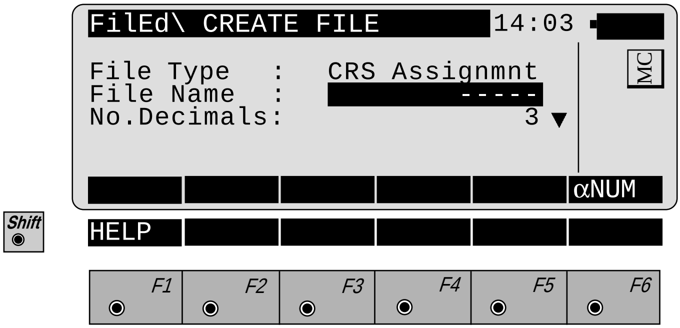
Sta. Eqn. : Input of number of station equation.

CONT or F5 Search for station equations.

FE

F2 — Create new file "**CRS Assignmnt**" *in dialog page 305, see dialog bottom.*

CONT — View and edit selected file *in dialog pagee 305, see dialogs page 330/331.*



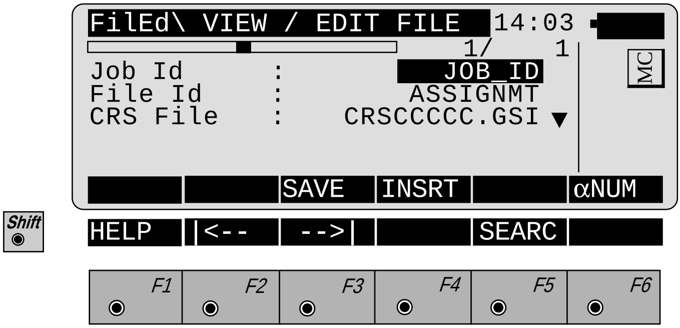
File Type : Display of type of file.

File Name : Input of file name (max. 5 char.), *see chapter "Introduction".*

No.Decimals : Selection of number of decimals.

CONT — Insert new **Header**, *see dialog page 330.*

FE



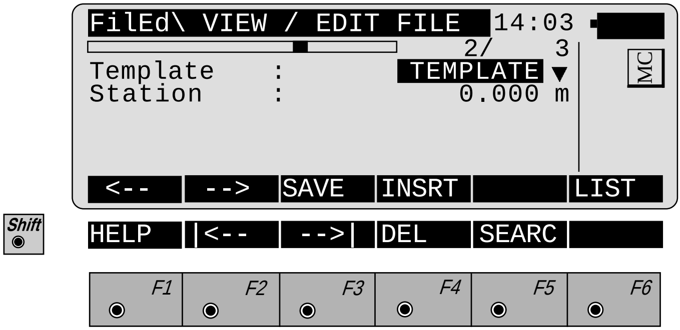
1/ 1 : Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Job Id : Input of job identification.

File Id : Display of section assignment file.

CRS File : Selection of relevant cross section file.

Meaning of the function keys is similar to *dialog page 312.*

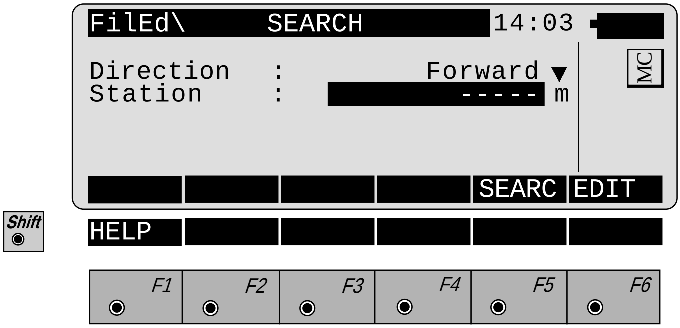


2/ 3	:	Sequence number of current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.
Template	:	Selection of template.
Station	:	Input of start station for this template.

Meaning of the function keys is similar to *dialog page 314.*

FE

Shift F5 Start dialog "**SEARCH**" in dialogs "**View / Edit File**" *(pages 330, 331)*.



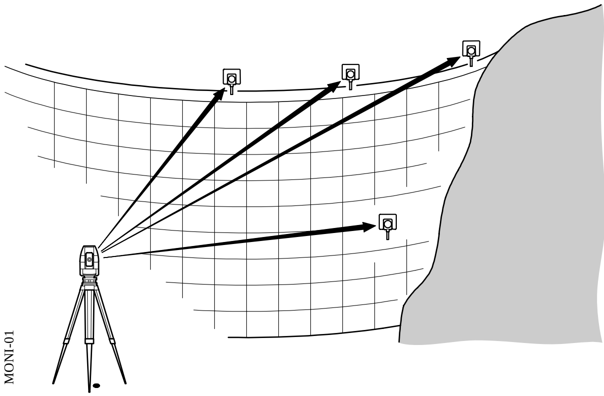
Direction	:	**Forward**: Searching for templates in direction end of file. **Backward**: Searching for templates in direction start of file.
Station	:	Input of station (chainage).

CONT or F5 Search for station.

FE

Monitoring

The manual describes the "Monitoring" program of the Leica TPS SYSTEM 1000 theodolite series.
The program allows for automatic measurement repetition.



Max. 50 measuring points and as many measurement repetitions as desired, at any time intervals.

Introduction

The instrument must be firmly mounted on a tripod or pillar.

Requirements to run this program:

- the licence number
- a PCMCIA card which is inserted into the instrument

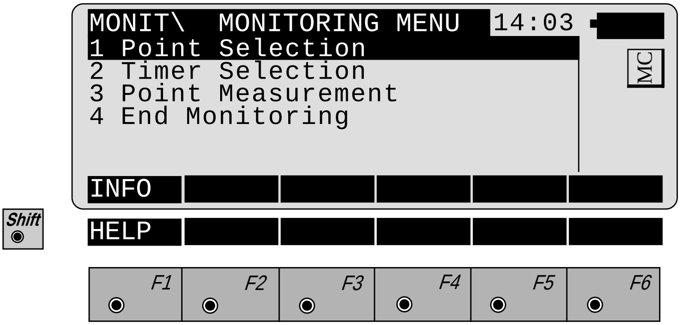
By means of a timer function, the program can trigger the automatic measurement, at predetermined intervals, of points which have already been measured once and learned by the instrument and which are stored on the PCMCIA card.

The measurements can be:

- repeated as often as is necessary,
- at any time
- performed in both faces.

The point number, the horizontal and vertical angles and the slope distance for the individual measurements are stored on the memory card.

The points to be measured must be permanently equipped with Leica prisms.
The measurements are limited only by the storage capacity of the PCMCIA memory card.



Selection of points to be measured, *see page 336.*

Set timer requirements, *see page 339.*

Start point measurement, *see page 340.*

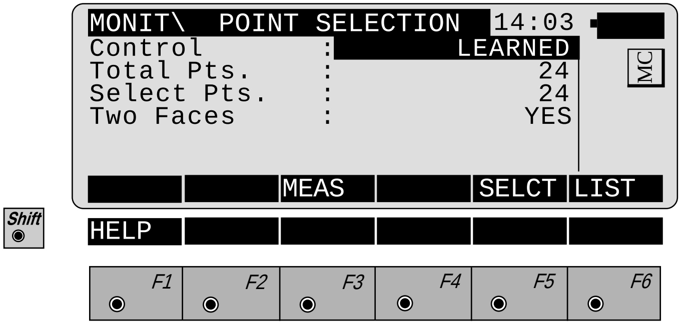
Exit the "Monitoring" program.

MO

Selecting points

The points to be measured are selected from this menu:

- by storing the appropriate measurement file, points already measured at the same station
- by entering the LEARNED file, points yet to be determined.



To learn points, the "LEARNED" file must be used as a control file.

To use points from another file, use F6 (LIST) to switch to the file selection und wählen die gewünschte Datei.
The point file must:

- be in the GSI directory on the PCMCIA card,
- include the point numbers and the angle measurements.

The instrument itself must have been positioned.

With the "Two Faces" option you can alternate between one-face and two-face measurement.
If you choose the two-face option, every single measurement is stored on the PCMCIA card.

F3 Calls the measurement menu, for first-time point measurement.

F5 Calls the point selection.

F6 Selects from the list of GSI files.

MO

Measurement menu

```
MONIT\  LEARN POINT    14:03
Point no.       :           2
Remark 1        :       -----
Refl.Height     :    0.0000  m
Hz              :  281°47'05"
V               :   92°15'36"
Horiz.Dist.     :  145.4821  m
 ALL  DIST  REC  TARGT  DONE  αNUM
```

Shift

```
HELP            I<>II
```

F1 F2 F3 F4 F5 F6

If the measurement file already includes points with the same point number, then when this function is called you will be asked whether the points are to be written over.

For the instrument to learn a point, the prism must be targeted manually
Triggering the distance measurement then initiates a distance measurement and a precise determination of the angle.

F2 Measure the distance.

F3 Store the measurement into the selected file.

F5 Quit the function after all points have been measured; return to the "POINT SELECTION" menu.

F1 (ALL) does not have any functions, for measuring and recording it is imperative to use F2 and F3.

The points will be saved in the set measurement file *(refer to chapter "Select user template and measurement file" of "System" - user manual).*

MO

Selecting the points to be measured

F5 Start selection of the points to be measured in the dialog "POINT SELECTION" (*page 336*).

```
MONIT\  POINT SELECTION 14:03
Point no.        :           1
Selected         :          IN
Hz               :  126°13'42"
V                :   89°44'11"
Slope  Dist.     :   29.7961  m
                  -->  DONE  OUT
Shift: HELP     NONE  ALL  POSIT
F1   F2   F3   F4   F5   F6
```

In this menu, you can select the points which you require for the automatic measurement.
A selected point can be either activated or deactivated. Several points with the same point number can be present.
When you have selected all the points you require, press **F5** (DONE) to quit the menu.

F4 Display the next point in the file.

F5 Quit the menu and goes to the main menu for the point selection *(page 336)*.

F6 Alternates between switching a point "IN" and "OUT".

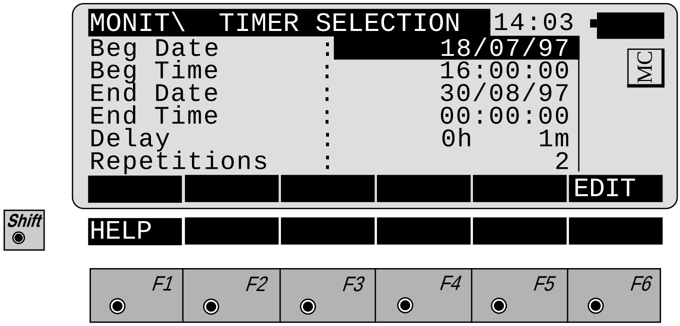
Shift F3 No point from the current file is to be selected.

Shift F4 All points from the current file are to be selected.

Shift F5 Position the instrument for the point selected.

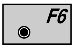
MO

Timer selection



This menu decides when the measurement will be taken.

Enter the date and time for the beginning and end of the measurement.
An interval of at least one minute between measurements must be defined.
The number of repeats can be defined in the field "Repetitions".



Edit the preset values.

MO

Point measurement

Choosing this option starts the measurement.
If a point cannot be measured, the TCA starts its internal search routine and, if unsuccessful, goes on to the next point to be measured.

ESC Abort the automatic measurement.

End monitoring

This option terminates the "Monitoring" program.

MO

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664901-2.3.1en

Translation of original text (664901-2.3.1de)

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