

Version 4.0 English



Electronical Total Station

Congratulations on the purchase of a TPS800 series instrument.



This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "Safety Directions" for further information

Read carefully through the User Manual before you switch on the product.

Product identification

The model and the serial number of your product are indicated on the type plate.

Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorized service workshop.

Symbols

The symbols used in this manual have the following meanings:

Type		Description
lack	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.

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

Trademarks

Windows (registered trademark of Microsoft Corporation).

All other trademarks are the property of their respective owners.

Validity of this manual

	Description		
General	This manual applies to all TPS800 Series instruments. Where there are differences between the various models they are clearly described.		
Telescope	When measuring distances to a reflector with EDM mode "IR" this telescope type uses a wide visible red laser beam, which emerges coaxially from the telescope's objective.		
	Instruments that are equipped with a reflectorless EDM additionally offer the EDM modes "RL" and "RL-Prism". When using these EDM modes a narrow visible red laser beam is used to measure distances.		

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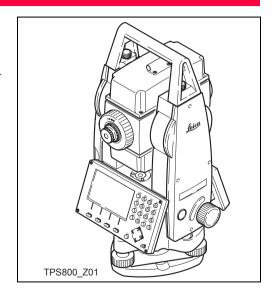
Introduction

The Leica Geosystems TPS800 is a high-quality electronic Total Station.

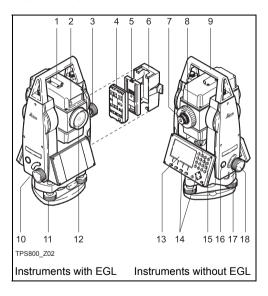
Its innovative technology makes the daily surveying iobs easier.

The instrument is ideally suited for simple construction surveys and stake out tasks.

The easy operation of the instrument functions can be learned without problems in no time.

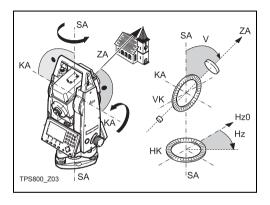


Important parts



- 1) Optical sight
- 2) Integrated guide light EGL (optional)
- Vertical drive
-) Battery
- Battery stand for GEB111
-) Battery cover
- 7) Eyepiece; focussing graticule
- 8) Focussing telescope image
- Detachable carrying handle with mounting screws
- 10) Serial interface RS232
- 11) Foot screw
- 12) Objective with integrated Electronic Distance Measurement (EDM); Beam exit
- 13) Display
- 14) Keyboard
- 15) Circular level
- 16) On/Off key
- 17) Trigger key
- 18) Horizontal drive

Technical terms and abbreviations



ZA = Line-of-sight / collimation axis

Telescope axis = line from the reticle to the centre of the objective.

SA = Standing axis

Vertical rotation axis of the telescope.

KA = Tilting axis

Horizontal rotation axis of the telescope (Trunion axis).

V = Vertical angle / zenith angle

VK = Vertical circle

With coded circular division for reading the V-angle.

Hz = Horizontal direction

HK = Horizontal circle

With coded circular division for reading the Hzangle.



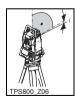
Standing axis inclination

Angle between plumb line and standing axis. Standing axis tilt is not an instrument error and is not eliminated by measuring in both faces. Any possible influence it may have on the Hz-direction resp. Vangle is eliminate by the dual axis compensator.



Line-of-sight error (Hz-collimation)

The line-of-sight error is the deviation from the perpendicular between tilting axis and line-of-sight. This could be eliminated by measuring in both faces.



V-Index (Vertical index error) With horizontal line-of-sight the V-circle reading should be exactly 90°(100gon). The deviation from this values is termed V-index (i).



Plumb line / Compensator

Direction of gravity. The compensator defines the plumb line within the instrument



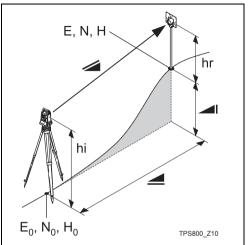
Zenith

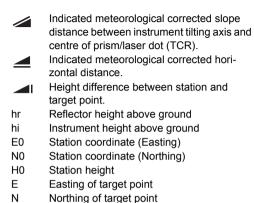
Point on the plumb line above the observer.



Reticle

Glass plate within the telescope with reticle





Height of target point

Н

Area of applicability

This User Manual is valid for all instruments of the TPS800 Series.

PC Program Package Leica Geo Office Tools (LGO-Tools)

The program package LGO-Tools is used for the data exchange between the Total Station and the PC. It contains several auxiliary programs in order to support your use of the instrument.

Installation on the PC

The installation program can be found on the CD-ROM supplied. Please note that LGO-Tools can only be installed on computers with MS Windows 2000, XP and Vista operating systems.

Any previous versions of LGO-Tools on your computer must be uninstalled first before installing the new version.

For the installation call program "setup.exe" in the directory \LGO-Tools on the CD-ROM and follow the input instructions of the installation program.

Program content

After successful installation the following programs appear:

Tools

Data Exchange Manager

For data exchange of coordinates, measurements, codelists and output formats between instrument and PC.

Coordinate Editor

Import/Export as well as creating and processing of coordinate files.

Codelist Manager

For creating and processing of codelists.

Software Upload

For loading system software and EDM-software.

For EDM Software upload only LGO/LGO-Tools Software Version 3.0 or higher must be used for error free operation.

Not using the correct upload Software can permanently damage the instrument.

Before the Software Upload, always insert a charged battery into the instrument.

Format Manager

For creating of own, special formatted data output files.

Configuration Manager

Import/Export as well as creating of instrument configuration.

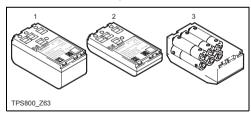
For more information about LGO-Tools refer to the comprehensive Online Help.

Power Supply

Use the Leica Geosystems batteries, chargers and accessories or accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

Power for the instrument can be supplied either internally or externally. An external battery is connected to the instrument using a LEMO cable.

- Internal battery:
 One GEB111 or 121 battery fit in the battery compartment.
- External battery:
 One GEB171 battery connected via cable.



- 1 GEB121
- 2 GFB111
- 3 Single cells in the battery adapter GAD39

Your Leica Geosystems instrument is powered by rechargeable plug-in batteries. For this product, we recommend the basic battery (GEB111) or the Pro battery (GEB121). Optionally six single cells can be used with the GAD39 battery adapter.

Six single cell batteries (1.5 V each) supply 9 Volts. The voltmeter on the instrument is designed for a voltage of 6 Volts (GEB111/ GEB121).

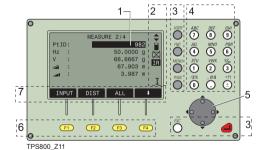
The battery charge is not displayed correctly when using single cells. Use the single cells with the battery adapter as emergency power supply. The advantage of the single cells is in a lower rate of discharge even over long periods.

Operating the Instrument

The On / Off key is located on the side cover of the Total Station.

All shown displays are examples. It is possible that local software versions are different to the basic version.

Keypad



- Focus
 Actively measured field.
- 2) Symbols
- Fixed keys

 Keys with firmly assigned functions.
- 4) Alphanumeric keys
- Navigation keys
 Control of input bar in edit and input mode or control of focus bar.
- Function keys
 Are assigned the variable functions displayed at the bottom of the screen.
- Softkey bar
 Displays functions that can be called up with the function keys.

Fixed keys

[PAGE] Scrolls to next page when a dialogue

consists of several pages.

[MENU] Accesses programs, settings, the data

manager, adjustments, communications parameters, system information

and data transfer.

[USER] Key, programmable with function from

the FNC menu.

[FNC] Quick-access to measurement-

supporting functions.

[ESC] Quit a dialog or the edit mode with acti-

vation of the "previous" value. Return to

next higher level.

Confirm an input; continue to the next

field.

Trigger key

The measurement trigger has three settings (ALL,DIST, OFF).

The key can be activated in the configuration menu.

At menus with multiple entries a shortcut number is shown on the right of each entry. Using this number allowing a direct start, without paging.

Selection of Language

After switching on the instrument the user is able to choose his preferred language.

The dialog to choose the language is only shown if two languages are loaded onto the instrument and **Lang.choice: On** is set in Settings dialog.

To load an additional language connect the instrument to LGO Tools Version 4.0 or higher via the serial interface and load using "LGO Tools - Software Upload".

Distance measurement

A laser distancer (EDM) is incorporated into the instruments of the TPS800 series.

In all versions, the distance can be determined by using an Laser beam which emerges coaxially from the telescope objective.

Measurements to strongly reflecting targets such as to traffic lights in Reflector EDM mode without prism should be avoided. The measured distances may be wrong or inaccurate.

For applications without reflector a special arrangement of the EDM, and appropriate arrangement of the beam paths, enable ranges of over five kilometres to be attained with standard prisms.

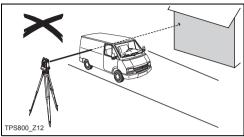
Miniprisms, 360° reflectors and reflector tapes can also be used, and measurement is also possible without a reflector

When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If e.g. people, cars, animals, swaying branches, etc. cross the laser beam while a measurement is being taken, a fraction of the laser beam is reflected and may lead to incorrect distance values.

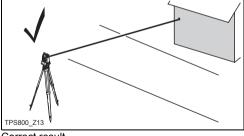
Avoid interrupting the measuring beam while taking reflectorless measurements or measurements using reflective foils. Measurements to prism reflectors are only critical if an object crosses the measuring beam at a distance of 0 to 30m and the distance to be measured is more than 300m.

In practice, because the measuring time is very short, the user can always find a way of avoiding these critical situations.

Very short distances may be measured reflectorless in IR mode to well reflecting targets. Note that the distances are corrected with the additive constant defined for the active reflector.



Incorrect result



Correct result

Reflectorless

Be sure that the laser beam is not reflected by anything close to the line of sight (e.g. highly reflective objects).

When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. In case of temporary obstruction (e.g. a passing vehicle, heavy rain, fog or snow) the EDM may measure to the obstruction.

When measuring longer distances, any divergence of the red laser beam from the line of sight might lead to less accurate measurements. This is because the laser beam might not be reflected from the point at which the crosshairs are pointing.

Therefore, it is recommended to verify that the Rlaser is well collimated with the telescope line of sight (refer to the chapter "Checking and adjusting").

Do not measure with two instruments to the same target simultaneously.

Red laser to prisms

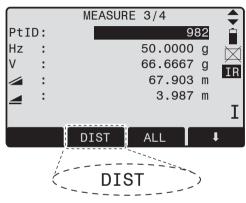
Accurate measurements to prisms should be made with the standard program (Reflector EDM mode).

Red laser to reflector tape

The visible red laser beam can be used to measure to reflective foils, also. To guarantee the accuracy the red laser beam must be perpendicular to the reflector tape and it must be well adjusted (refer to the chapter "Checking and adjusting").

Make sure the additive constant belongs to the selected target (reflector).

Softkeys



Under softkeys, a selection of commands and functions is listed at the bottom of the screen. They can be activated with the corresponding function keys. The available scope of each function depends on the applications / functions currently active.

General softkeys:

[ALL]	Starts distance and angle measure-
	ments and saves measured values.
[DIST]	Starts distance and angle measure-
	ments without saving measured values.
[REC]	Saves displayed values.
[ENTER]	Deletes current value in the display and
	is ready for the input of a new value.
[ENH]	Opens the coordinate input mode.
[LIST]	Displays the list of available points.
[FIND]	Starts the search for the point entered.
[EDM]	Displays EDM settings.
[IR/RL]	Toggles between reflector- and reflec-

torless measurement modes.

[PREV] Back to last active dialog.

[NEXT] Continue to next dialog.

Returns to highest softkey level.

To next softkey level.

[OK] Set displayed message or dialog and quit dialog.

Find further information about menu/application specific buttons in the relevant sections.

Symbols

Depending on software version different symbols are displayed indicating a particular operating status



A double arrow indicates choice fields.



Using the navigation keys the desired parameter can be selected



Quits a selection with the enter key or the navigation keys.



Indicates that several pages are available which can be selected with [PAGE].

I,II

Indicates telescope position I or II.



Indicates that Hz is set to "left side angle measurement" (anti-clockwise).

Status symbol "EDM type"



Reflector EDM mode for measuring to prisms and reflective targets.



Reflectorless EDM mode for measuring to all targets.

Status symbol "Battery capacity"



The battery symbol indicates the level of the remaining battery capacity (75% full shown in the example).

Status symbol "Compensator"



Compensator is on.



Compensator is off.

Status symbol "Offset"

! Offset is active.

Status symbol "Character Input"



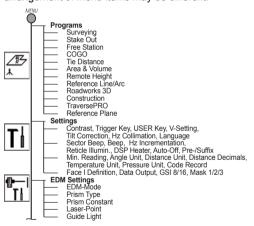
Numeric Mode

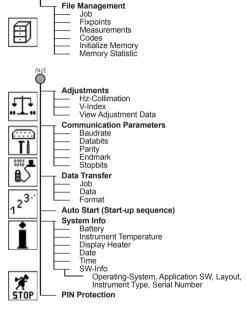


Alphanumeric Mode

Menu tree

Depending on user interface sequence and arrangement of menu items may be different.

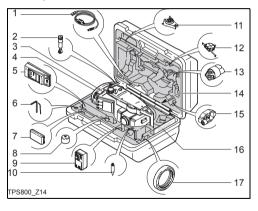




Measuring Preparation / Setting up

Unpacking

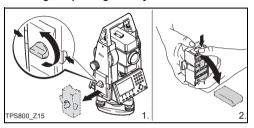
Remove instrument from transport case and check for completeness:



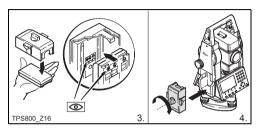
- Data cable (optional)
- Zenith eyepiece or eyepiece for steep angles (optional)
- 3) Total Station
- 4) Removable tribrach (optional)
- 5) Battery charger and accessories (optional)
- 6) Adjustment tools
- 7) Battery GEB111 (optional)
- 8) GAD105 Mini Prism Adapter (optional)
- Battery GEB121 (optional)
- 10) Tip for mini prism (optional)
- Spacing bracket GHT196 for height meter (optional)
- 12) Height meter GHM007 (optional)
- 13) Protective cover / Lens hood
- 14) Mini prism rods
- 15) Mini prism + holder (optional)
- 16) User Manual
- 17) Counterweight for Zenith eyepiece (optional)

Batteries

Inserting / Replacing Battery



- Remove battery holder.
- 2. Remove battery.



- 3. Insert battery into battery holder.
- Insert battery holder into instrument.

Insert battery correctly (note pole markings on the inside of the battery holder). Check and insert battery holder true to side into the housing.

- To charge the battery refer to chapter "Charging the batteries".
- For the type of battery refer to chapter "Technical data".

When using the GEB121 battery, remove the spacer for the GEB111 from the battery compartment.

Charging / first-time use

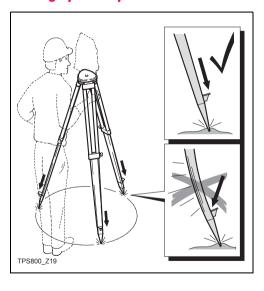
- The battery must be charged prior to using for the first time because it is delivered with an energy content as low as possible.
- For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make 3 - 5 charge/discharge cycles.
- The permissible temperature range for charging is between 0°C to +35°C / +32°F to +95°F. For optimal charging we recommend charging the batteries at a low ambient temperature of +10°C to +20°C/+50°F to +68°F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Leica Geosystems, it is not possible to charge the battery if the temperature is too high.

Operation/Discharging

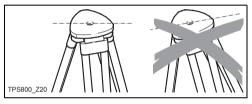
The batteries can be operated from -20°C to $+55^{\circ}\text{C}/-4^{\circ}\text{F}$ to $+131^{\circ}\text{F}$.

Low operating temperatures reduce the capacity that can be drawn; very high operating temperatures reduce the service life of the battery.

Setting up the tripod



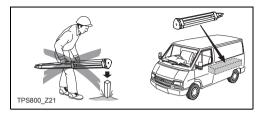
- Loosen the clamping screws on the tripod legs, pull out to the required length and tighten the clamps.
- In order to guarantee a firm foothold sufficiently press the tripod legs into the ground. When pressing the legs into the ground note that the force must be applied along the legs.



When setting up the tripod pay attention to a horizontal position of the tripod plate.

Slight corrections of inclination can be made with the foot screws of the tribrach. Larger corrections must be done with the tripod legs.

When using a tribrach with an optical plummet, the laser plummet cannot be used.



Careful handling of tripod

- · Check all screws and bolts for correct fit.
- · During transport always use the cover supplied.
- Use the tripod only for surveying tasks.

Instrument Setup

Description

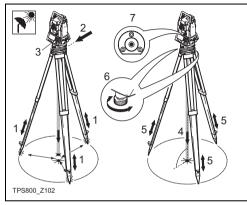
This topic describes an instrument setup over a marked ground point using the laser plummet. It is always possible to set up the instrument without the need for a marked ground point.



Important features:

- It is always recommended to shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
- The laser plummet described in this topic is built into the vertical axis of the instrument.
 It projects a red spot onto the ground, making it appreciably easier to centre the instrument.
- The laser plummet cannot be used in conjunction with a tribrach equipped with an optical plummet.

Setup step-by-step



- 1 Extend the tripod legs to allow for a comfortable working posture. Position the tripod over the marked ground point, centring it as well as possible.
- 2 Fasten the tribrach and instrument onto the tripod.

- 3 Turn on the instrument and switch on the laser plummet and electronic level by pressing [FNC] > [Level/Plummet].
- 4 Move the tripod legs (1) and use the tribrach footscrews (6) to centre the plummet (4) over the ground point.
- 5 Adjust the tripod legs to level the circular level (7).
- By using the electronic level turn the tribrach footscrews (6) to precisely level the instrument.

Refer to "Levelling up with the electronic level step-by-step" for more information.

- 7 Centre the instrument precisely over the ground point (4) by shifting the tribrach on the tripod plate (2).
- 8 Repeat steps 6. and 7. until the required accuracy is achieved.

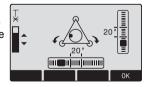
Levelling up with the electronic level step-by-step

The electronic level can be used to precisely level up the instrument using the footscrews of the tribrach.

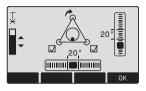
- 1 Turn on the instrument and switch on the electronic level by pressing [FNC] > [Level/Plummet].
- 2 Centre the circular level approximately by turning the footscrews of the tribrach.

The bubble of the electronic level and the arrows for the rotating direction of the footscrews only appear if the instrument tilt is inside a certain levelling range.

- 3 Turn the instrument until it is parallel to two footscrews.
- 4 Centre the electronic level of this axis by turning the two footscrews. Arrows show the direction for

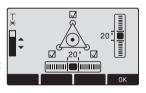


- rotating the footscrews. When the electronic level is centred the arrows are replaced by checkmarks.
- 5 Centre the electronic level for the second axis by turning the last footscrew. An arrow shows the direction for



rotating the footscrew. When the electronic level is centred the arrow is replaced by a checkmark.

When the electronic level is centred and three checkmarks are shown, the instrument has been perfectly leveled up.

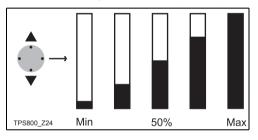


6 Accept with [OK].

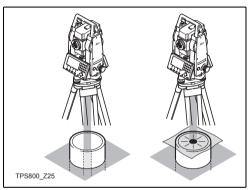
Laser intensity

Changing the laser intensity

External influences and the surface conditions may require the adjustment of the intensity of the laser. The laser can be adjusted in 25% steps as required.



Hints for positioning



Positioning over pipes or depressions

Under some circumstances the laser dot is not visible (e.g. over pipes). In this case, the laser dot can be made visible by using a transparent plate so that the laser dot can be easily aligned to the centre of the pipe.

Input mode

Due to the alphanumerical keypad you can enter characters directly.

Numeric fields:

Can only contain numerical values. By pressing a button of the numeric keypad the number will be displayed.

· Alphanumeric fields:

Can contain numbers and letters. By pressing a button of the alphanumeric keypad the input opens. By pressing several times you can toggle through the characters. For example: 1->S->T->U->1->S....

Edit characters



- Place cursor on character to be edited.
- 2. Input the new character.



3. Confirm input.

Erasing characters



 Place cursor on character to be deleted



2. Pressing the navigation key deletes the relevant character.



3. Confirm input.

[ESC] Deletes the change and restores the previous value.

Inserting characters

If a character was skipped (e.g. -15 instead of -125) you can insert it later.



1. Place cursor on "1".



- 2. Inserts an empty character on the right of "1".
- 3. Input the new characters.



4. Confirm input.

Character set

Entry mode contains the following characters for numeric and alphanumeric input.

Numerical		Alphanumerical	
" + " " - " " 0 - 9 "	(ASCII 43) (ASCII 45) (ASCII 46) (ASCII 48 - 57)	" ! " " # " " " " " " " " " " " " " " "	(ASCII 32) [space] (ASCII 35) (ASCII 35) (ASCII 35) (ASCII 36) (ASCII 37) (ASCII 38) (ASCII 40) (ASCII 41) (ASCII 41) (ASCII 42) (ASCII 43) (ASCII 44) (ASCII 44) (ASCII 45) (ASCII 47) (ASCII 58) (ASCII 60) (ASCII 60) (ASCII 61) (ASCII 62) (ASCII 63) (ASCII 64) (ASCII 65 90) (ASCII 95) [Underscore] (ASCII 96)

The character entry "*" can be used in data fields where point numbers or codes can be searched for.

Signs

+/- In the alphanumeric character set "+" and "-" are treated as normal alphanumeric characters with no mathematical function

Additional characters

- Place holder during Wildcard point search (see chapter "Wildcard search").
- "+" / "-" appears only in the front position of an input.

In the edit mode the position of the decimal place cannot be changed. The decimal place is skipped.

Pointsearch

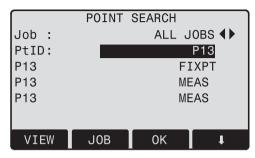
Pointsearch is a global function used by applications to e.g. find internally saved measured or fixed points.

It is possible for the user to limit the point search to a particular job or to search the whole storage.

The search procedure always finds fixed points before measured points that fulfill the same search criteria. If several points meet the search criteria, then the points are listed according to their age. The instrument finds the most current (youngest) fixed point first.

Direct search

By entering an actual point number (e.g. "P13") all points with the corresponding point number are found.



[VIEW] Displays the coordinates and the job of the selected point.

[ENH] For manual input of coordinates.

[OK] Confirm selected point.

[JOB] To select a different job.

Wildcard search

The Wildcard search is indicated by a "*". The asterisk is a place holder for any following sequence of characters.

Wildcards are always used if the point number is not fully known, or if a batch of points is to be searched for.





Starts point search.

Examples:

- * All points of any length are found.
- A All points with exactly the point number "A" are found.
- A* All points of any length starting with "A" are found (e.g.: A9, A15, ABCD).

- *1 All points of any length with a "1" as the second character are found (e.g.: A1, B12, A1C).
- A*1 All points of any length with an "A" as the first character and a "1" as the third character are found. (e.g.: AB1, AA100, AS15).

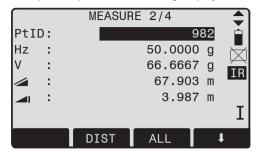
Measuring

After switching on and setting up correctly, the total station is immediately ready for measuring.

In the measurement display it is possible to call up fixed keys and function keys, as well as trigger keys and their functions.

All shown displays are examples. It is possible that local software versions are different to the basic version.

Example of a possible measuring display:



F1 - **F4** Calling up the assigned function.

FNC Key

Under [FNC] several functions can be called up. Their applications are described below.

Functions can also be started directly from the different applications.

Each function from the FNC menu can be assigned to the [USER]-key (see chapter "Settings").

Light On /Off

Switches display light on / off.

Level/Plummet

This function enables the electronic bubble and the range of intensity settings of the laser plummet.

IR/RL Toggle

Change between the two EDM types IR (on Reflectors) and RL (Reflectorless). New setting is displayed for about one second.

IR: Distance measurements with prisms.

RL: Distance measurements without prisms.

Find more information in chapter "EDM Settings".

Laser Pointer

Switches on or off the visible laser beam for illuminating the target point. The new settings are displayed for about one second and then saved.

Free-Coding

Starts "Coding" to select a code from a codelist or enter a new code. Same functionality like softkey button [CODE].

Units

Displays the current distance and angle unit and gives the possibility to change these.

Delete Last Record

This function deletes the last recorded data block. This can be either a measurement block or a code block

Deleting the last record is **not reversible**!

Only records can be deleted which were recorded in "Surveying" or in "Measuring".

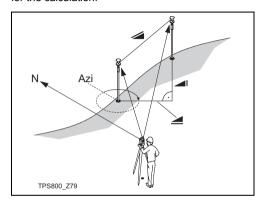
Lock with PIN

This function is used to prevent **unauthorized use** of the instrument. It enables you to lock the instrument from any application by pressing [FNC] > [Lock with PIN] without switching off the instrument. After that the instrument will prompt for a PIN code entry. The function is available when the PIN protection is activated under [MENU] > [PIN].

Check Tie

Calculation and display of the slope and horizontal distance, height difference, azimuth, grade, and coordinate differences between the last two measured

points. Valid distance measurements are required for the calculation



Important Messages

Less than two valid measurements!

Meaning

The values cannot be calculated as there exist less than 2 valid measurements.

Tracking

Switches on or off the tracking measurement mode. The new setting is displayed for approx. one second and then set. The function can only be activated from within the same EDM type and prism type.

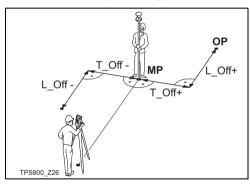
The following options are available:

	Tracking measurement mode Off <=> On
IR	IR-Fine <=> IR_Track / IR-Fast <=> IR-Track
RL	RL-Short <=> RL-Track

The last active measurement mode remains set when the instrument is switched off

Target Offset

If it is not possible to set up the reflector directly, or if it is not possible to aim the target point directly, the offset values (length, cross and/or height offset) can be entered. The values for the angle and distances are calculated directly for the target point.



MP: Measurement point

OP: Offset point

T_Off: Length offset L Off: Cross offset

Height Offset +: Offset point is higher than measurement

Enter offset values!

Trav. Offset: 0.600 m
Length Offset: 0.800 m
Height Offset: 0.500 m
Mode : Reset after REC ()

RESET CYLNDER OK

Procedure:

- Enter the offset values (length, cross and/or height) as per the sketch.
- 2. Define the period for which the offset is to apply.
- 3. [RESET]: Sets eccentricity to zero.
- (SET): calculates the corrected values and jumps to the application from which the offset

function was started. The corrected angle and distances are displayed as soon as a valid distance measurement has been triggered or exists.

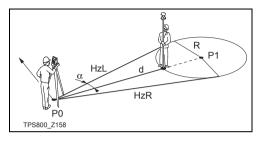
The period of applicability can be set as follows:

Reset after REC	The offset values are reset to 0 after the point is saved.		
Permanent	The offset values are applied to all further measurements.		

The offset values are always reset to 0 when the application is quit.

Cylinder Offset subapplication

Use [CYLNDER] to determine the coordinates of the centre point of cylindrical objects and their radius. Measure the horizontal angle to a point on the left and on the right side of the object as well as the distance to the object.



HZL: Horizontal angle to a point on the left side of the object

HZR: Horizontal angle to a point on the right side of the object

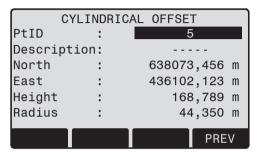
d: Distance to the object in the middle between HZL and HZR

Procedure:

$\overline{}$			
C	YLINDRIC	AL OFFSE	T
Hz Left	:	120.	4361 g
Hz Righ	t :	141.	4435 g
V	:	99.	4658 g
	:	15	5.398 m
▲ Hz	:	0.	.0000 g
PrismOffset:		0.030 m	
HzLeft	HzRight	ALL	EXIT

- 1 Enter the prism offset. This is the distance between the centre of the prism and the surface of the object to be measured. If the EDM mode is RL, the value is set to zero automatically.
- 2 Use the vertical hair, aim at the left side of the object, then press [HzLeft].
- 3 Use the vertical hair, aim at the right side of the object, then press [HzRight].
- 4 Rotate the instrument accordingly such that the
 ▲ Hz, the deviation angle, is zero.

5 [ALL] Completes the measurement and displays the results. That is the coordinates of the centre point of the cylindrical object and its radius.

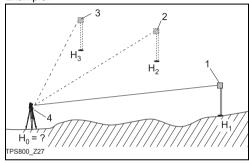


Main Settings

Enables you to change the most important settings.

Height Transfer

Example:



- 1) Reflector 1
- 2) Reflector 2
- 3) Reflector 3
- 4) Instrument

This function determines the height of the instrument from measurements to a maximum of 5 target points, with known heights, in two faces.

With measurements to several targets, the improvement is indicated in the "delta" value.

Procedure:

- 1. Select known point and input reflector height.
- After triggering the measurement with [ALL], the calculated height H0 is displayed.

[AddPt] Add another height of a known point.

[FACE] Measure to the same target in

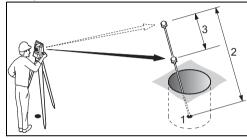
second face.

3. [SET] Save the changes and set the

station.

Hidden Point

Example:



- 1) E, N, H of Hidden Point
- 2) Rod Length
- 3) Distance R1-R2

The program allows measurements to a point that is not directly visible, using a special hidden-point rod.

Procedure:

1. Measure to first prism (P1).

[All] Starts measurement and proceeds

to step 2.

[ROD] Allows you to define the rod and the

EDM-Settings.

Rod Length

Total length of hidden-point rod.

Dist. R1-R2

Spacing between the centers of prism R1 and prism R2

Meas. Tol

Limit for the difference between the given and measured spacing of the prisms. If the tolerance value is exceeded, the program will issue a warning.

EDM-Mode

Changes the EDM-Mode.

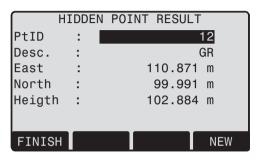
Prism type

Changes the prism type.

Prism Const

Displays the prism constant.

- 2. [All] Starts measurement and proceeds to the Result dialog.
- 3. Result is displayed.



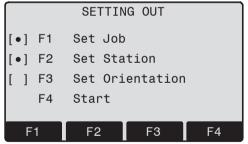
[NEW] Returns to step 1.

[FINISH] Returns to calling application.

Programs

Application pre-settings

These are programs that precede the application programs and are used to set up and organize data collection. They are displayed after selecting an application. The user can select the start programs individually.



- [] Settings made.
-] Settings not made.

Find further information about individual start-up programs on the subsequent pages!

Setting job

All data is saved in JOBS, like directories. Jobs contain measurement data of different types (e.g. measurements, codes, fixed points, stations,...) and are individually manageable and can be readout, edited or deleted separately.

[NEW] Creating a new job.

[SET] Setting the job and back to start-up

programs.

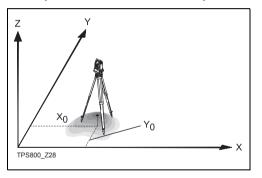
All subsequent recorded data is stored in this job/directory.

If no job was defined and an application was started or if in "Meas & Rec" [ALL] or [REC] was triggered, then the system automatically creates a new job and names it "DEFAULT".

Setting Station

Each coordinate computation relates to the currently set station.

At least plan coordinates (E, N) are required for the station. The station height can be entered if required. The coordinates can be entered either manually or read from the internal memory.



Known Point

- Select a PtID stored in internal memory.
- Input instrument height.
 Sets the station.

Set manually

- [ENH] Calls up manual point input dialogue.
- Input PtID and coordinates.
- 3. [SAVE] Saves station coordinates.

Continues to the input of the instrument height.

4. [OK] Sets the station.

If no station was set and no application started and if in "Meas & Rec" [ALL] or [REC] was activated, then the last station is set as the current station

Orientation

With the orientation, Hz-direction can be input manually or points with known coordinates can be set.

Method 1: Manual input

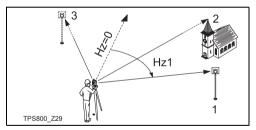
- 1. **[f]** To input a random Hz-orientation.
- 2. Input of Hz-direction, reflector height and PtID.
- 3. [ALL] Triggers measurement and sets orientation
 - [REC] Records Hz-direction and sets orientation

Method 2: With coordinates

To determine the orientation, a target with known coordinates can also be used.

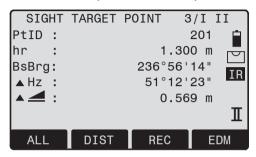
- 1. **F2** As orientation with coordinates.
- Input of the orientation point number and to determine the point found.
- 3. To input and confirm the reflector height.

For determining the orientation a maximum of 5 target points with known coordinates can be used.



- 1) 1. Target point
-) 2. Target point
- 3) 3. Target point

Orientation coordinates can be either obtained from the internal memory or entered manually.

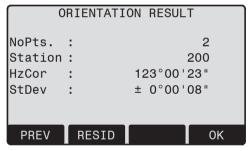


After each measurement you are asked wether to proceed or not. Answering with yes brings you back to the Measurement dialog, to take an additional measurement. Answering with no brings you to the Result dialog.

- 1/I Status indication; shows that first point was measured in telescope position I.
- 1/I II First point measured in telescope position I and II

- ▲Hz: After the first measurement the finding of other target points (or the same point when changing the telescope position) is easier by setting the indicated angle difference near to 0°00'00" by turning the instrument.

Display of computed orientation

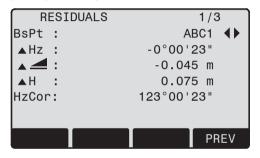


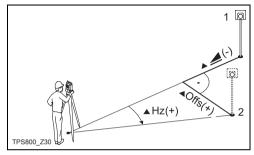
[OK] Set computed Hz-orientation.

If more than one target point is measured then the orientation is computed using the "least squares method".

Displaying residuals

[RESID] Display of residuals.





Actual
 Design

▲H: Height correction

▲ **__**: Correction of the horizontal distance

▲Hz: Correction of Hz-angle.

Useful information

- If the orientation is only measured in telescope position II, then the Hz-orientation is based on telescope position II. If measured only in telescope position I or mixed, then the Hz-orientation is based on telescope position I.
- The prism height may not be changed during measurements in the first and second telescope position.
- If a target point is measured several times in the same telescope position, then the last valid measurement is used for the computation.

If no orientation was set and an application was started resp. if in "Meas & Rec" [ALL] or [REC] was triggered, then the current Hz-direction and V-angle are set as orientation.

Applications

Introduction

Applications are predefined programs, that cover a wide spectrum of surveying duties and facilitate daily work in the field.

The following applications are available:

- Surveying
- Stake Out
- Tie Distance
- Area & Volume
- Free Station
- Reference Line/Arc
- Remote Height
- Construction
- Cogo
- Reference Plane
- Roadworks 3D (optional)
- TraversePRO (optional)

[MENU]

1. Press the [MENU] fixed key.

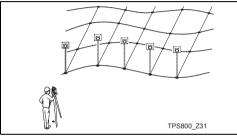
ED

2. Selecting the "Program" option.

F1 - **F4** 3. Calling up applications and activating start programs. [PAGE] Scroll to next page.

Surveying

With the program Surveying the measurement of an unlimited number of points is supported. It is comparable to "Meas & Rec", but includes stationing, orientation and quick coding.



Procedure:

- Input PtID, codes and the reflector height if desired.
- [ALL] Triggers and records measurements.

[IndivPt] Switches between individual and current point number.

Three coding methods are available:

- . Simple coding = remark: Input a code/remark in the relevant field. This text is stored with the corresponding measurment with [ALL]. The code is not related to a codelist, it is just a simple remark. A codelist on the instrument is not necessary.
- Expanded coding with codelist: Press the [CODE] softkey. The code that was input is searched for within the code list and it is possible to add attributes to the code.
- Quick coding: Press the [Q-Code] softkey and enter the shortcut to the code. The code is selected and the measurement starts

Codes are always stored as free codes (WI41-49), that means that codes are not directly linked to a point. Point codes(WI71-79) are not available

Stake out

This program calculates the required elements to stakeout points from coordinates or manually entered angles, horizontal distances and heights. Stake out differences can be displayed continuously.

Stake out coordinates from memory

Procedure:

Select the point.

[DIST] Starts measurement and calculation of the stake-out elements

[REC] Saves the displayed values.

[B&D] Input direction and Hz-distance of stake

out point.

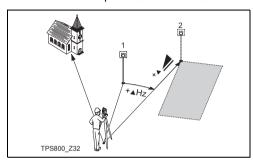
[MANUAL] Enables simplified input of a point

without PtID and without the possibility

of storing the data of the point.

Polar Stake out

Normal indication of polar stake out offsets.



- 1) Actual
- 2) Point to be stake out

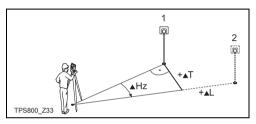
▲Hz: Angle offset: positive if point to be setout is to the right of the actual direction.

Longitudinal offset: positive if point to be stake out is further away.

▲ ▲I: Height offset: positive if point to be stake out is higher than measured point.

Orthogonal Stake out

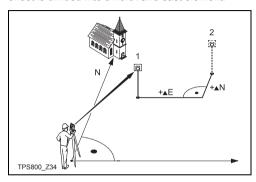
The position offset between measured point and stake out point is indicated in a longitudinal and transversal element.



- 1) Actual
- 2) Point to be stake out
- L: Longitudinal offset: positive if nominal point further away.
- ▲T: Transversal offset, perpendicular to line-of-sight: positive if nominal point is to the right of measured point.

Cartesian Stake out

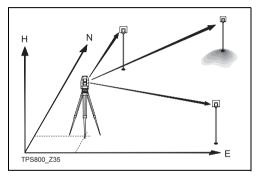
Stake out is based on a coordinate system and the offset is divided into a north and east element.



- 1) Actual
- 2) Point to be stake out
- ▲E Easting offset between stake out and actual point.
- ▲N Northing offset between stake out and actual point.

Free Station

The application "Free Station" is used to determine the instrument position from measurements to a minimum of two known points and a maximum of 10 known points.



The following measurements sequences to target points are possible:

- 1. Hz- and V-angles only (resection)
- Distance and Hz- and V-angle (3 point resection)
- 3. Hz- and V-angles to some point(s) and Hz- and V-angle plus distance to other point(s).

The final computed results are Easting, Northing and Height of the present instrument station, including the instruments Hz-circle orientation. Standard deviations and residuals for accuracy assessments are provided.

For the calculation of the station, measured target points can be re-measured, disabled and again enabled.

Measuring facilities

Single face I or II or dual face I + II measurements are always possible. No specific point sequence or specific face sequences are required.

Gross errors checks are made for dual face measurements to ensure the same point(s) are sighted with the other face.

If a target point is measured several times in the same telescope position the **last valid measurement** is used for computation.

Measurement restrictions:

- 2 face measurements
 When measuring the same target in both faces, the reflector height may not be altered when
 - changing the telescope position.

 Target points with 0.000 height

 Target points with 0.000 height are discarded for
 - height processing. If target points have a valid height of 0.000 m, use 0.001 m to enable it for height processing.

Computation procedure

The measuring procedure automatically determines the method of evaluation, e.g. resection, 3 point resection, etc.

If more than the minimum required measurements are performed, the processing routine uses a least squares adjustment to determine the plan position and averages orientation and heights.

- The original averaged face I and face II measurements enter the computation process.
- All measurements are treated with the same accuracy, whether these are measured in single or dual face.
- Easting and northing is determined by the method of least squares, including standard deviation and improvements for Hz-direction and horizontal distances.
- The final height (H) is computed from averaged height differences based on the original measurements.
- The Hz-circle orientation is computed with the original averaged face I and face II measurements and the final computed plan position.

Procedure:

FREE STATION

[•] F1 Set Job
F2 Set accuracy limit

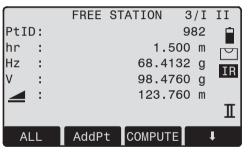
F4 Start

F2 Enables you to define an accuracy limit.

ACCURACY SETTING
Enter accuracy limit!
Status : on
St.dev.East : 0.005 m
St.dev.North : 0.005 m
St.dev.Height: 0.010 m
St.dev.Angle : 0.0020 g

Here you can enter a limit for the standard deviation values. If your computed deviation exceeds the limit a warning dialog appears, where you can decide wether to proceed or not.

- Input of the name of the station and the height of the instrument.
- 2. Input of the target PtID and the reflector height.



[ALL] Triggers angle and distance measurement (3 point resection).

[REC] Saves Hz-direction and V-angle (resection).

[AddPt] [COMPUTE]	Input another backsight point. Calculates and displays the station coordinates, if at least 2 points and a distance were measured.	
3/I	Indicates that the third point in tele-	
3/I II	scope position I was measured. Indicates that the third point in telescope positions I and II.	

Results

Displays calculated station coordinates:

ST	ATION	COORDINATES	3 ▼	
Station	:		100	
hi EO	:	1.500 100.506		
NO HO	:	100.040 99.999		
DDEV	DEOT	OtalDay	OK	
PREV	RESI	StdDev	0K	

[PREV] Switches to measurement display, to measure additional points.

[RESID] Displays residuals.

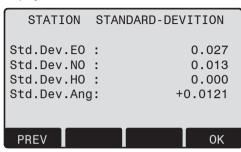
[StdDev] Displays standard deviation.

[OK] Sets the displayed coordinates and

instrument height as new station.

If the instrument height was set to 0.000 in the setup screen, then the station height refers to height of trunnion axis.

Displays standard deviations:

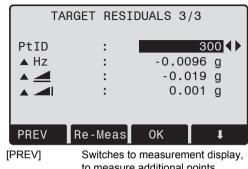


Std.Dev E0, N0, H0 Standard deviation of the station coordinates

Std.Dev Ang Standard deviation of the orientation

This dialog shows the computed residuals:

Residual = Calculated value - Measured value



[PREV] Switches to measurement display, to measure additional points.

[Re-Meas] Remeasures the displayed point.

[OK] Always sets the displayed coordinates and instrument height as new

station.

[Disable]/[Enable]

Excludes/includes the displayed point from/in the calculations. Recalculates the free station and displays the station standard deviation. Press [PREV] to display the new station coordinates.

[StdDev]

Displays standard deviation.



With the function keys, scroll between the residuals of the individual backsight points.

Warnings / Messages

Important messages	Meaning		
Selected point has no valid data!	This message occurs if the selected target point has no easting or northing coordinate.		
Max 10 points supported!	If 10 points have already been measured and another point is selected. The system supports a maximum of 10 points.		
Invalid data - no position computed!	The measurements may not allow final station coordinates (Eastings, Northings) to be computed.		
Invalid data - no height computed!	Either the target height are invalid or insufficient measurements are available to compute a final station height.		
Insufficient space in job!	The present selected job is full and does not allow further storage.		
Hz (I - II) > 0.9 deg, measure point again!	This error occurs if a point was measured in one face and the measurement in the other face differs by more than 180° ±0.9° for the horizontal angle.		
V (I - II) > 0.9 deg, measure point again!	This error occurs if a point was measured in one face and the measurement in the other face differs by more than 360° - V $\pm 0.9^\circ$ for the vertical angle.		
More points or distance required!	There is insufficient data measured to be able to compute a position. Either there are not enough points used or not enough distances measured.		

Reference Line/Arc

This program facilitates the easy stake out or checking of lines/arcs for buildings, sections of road, simple excavations, etc.

Reference Line

A reference line can be defined by referencing a known base line. The reference line can be offset either longitudinally, in parallel or vertically to the base line, or be rotated around the first base point as required.

Furthermore the reference height can be selected as first point, second point or interpolated along the reference line.

Procedure:

1. Definition of the Base line:

The base line is fixed by two base points that can be defined in three ways:

- Measured points
- · Enter coordinates using keypad
- · Select point from memory.

a) Measuring base points:

Input PtID and measure base points with [ALL] or [DIST] / [REC].

b) Base points with coordinates:

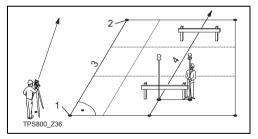
[FIND] Starts to search for the PtID

entered.

[ENH] Manually input coordinates.

[LIST] Displays the list of available points.

Analogue procedure for the second base point.



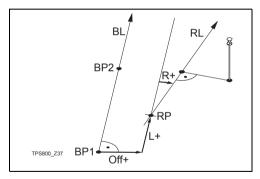
- 1) 1st base point
- 2) 2nd base point

3) Base line

4) Reference line

2. Shifting/Rotating the Base line

The base line can be offset longitudinally, parallel and vertically or rotated. This new line is called the reference line. All measured data refers to the reference line.



BP: Base point BL: Base line

RP: Reference point
RL: Reference line
Off: Parallel offset
L: Longitudinal offset
R: Rotation parameter

Input of the parameters:



Use the navigation keys to select the shifting and rotation parameters of the reference line

REFERENCE LINE - MAIN 1/2 Length : 14.872 m
Enter values to shift line:
Offset : 1.000 m
Line : 0.500 m
Height : 0.900 m
Rotate : 25.0000 m

The following entries are possible:

Offset+: Parallel offset of the reference line

to the right, referred to the direction of the base line (BP1-BP2).

Line+: Longitudinal offset of the start point

(=reference point) of the reference

line in the direction of base point BP2.

Rotate+: Rotation of the reference line clock-

wise around the reference point.

Height+: Height offset; the reference line is

higher than the selected reference

height.

REF. LINE/ARC - 2/2

Point 1 : 01

Point 2 : 02

Length : 14.872 m

Select Height Reference!

Ref.Hgt : Interpolated

NEW RESET SEGMENT

Ref.Hgt:

Point 1 Height differences are computed

relative to the height of the first refer-

ence point.

Point 2 Height differences are computed

relative to the height of the second

reference point.

Interpolated Height differences are computed

along the reference line.

No Height Height differences are not computed

and shown.

3. Selecting the subapplication

[MEASURE] Starts the subapplication to

measure Line & Offset (see issue

4).

[STAKE] Starts the subapplication to stake

out (see issue 5).

[GRID] Starts the subapplication to stake

out a grid relative to the reference

line (see issue 6).

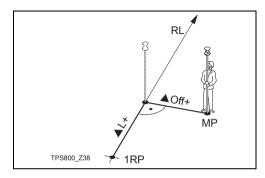
[SEGMENT] Starts the subapplication to subdivide a reference line into a definable

number of segments and stake out the new points on the line (see

issue 7).

4. "Line & Offset" subapplication

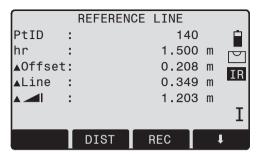
The "Line & Offset" subapplication calculates from measurements or coordinates longitudinal, parallel offsets and height differences of the target point relative to the reference line.



1RP: 1st reference point

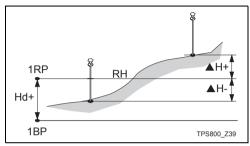
MP: Measured point
RL: Reference line
▲L: Longitudinal offset
▲Off: Parallel offset

The [L&O] function calculates from measurements or coordinates longitudinal, cross and height differences of the target point relative to the reference line.



The calculated height difference is relative to the selected reference height (**A**

Example "relative to first reference point"



1RP: 1st reference point

1BP: 1st base point RH: Reference height

Hd: Height difference between reference and

base point

▲H: Height difference from reference height

5. "Stake out" subapplication

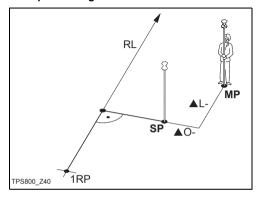
You can enter longitudinal, transverse and height offsets for the target points to be set-out relative to the reference line. The program calculates the difference between a measured point and the calculated point. The program displays the orthogonal (**\(\Delta \)**Line, **\(\Delta \)**Offset, **\(\Delta \)** and the polar (**\(\Delta \)**Hz, **\(\Delta \)**

▲ **I**) differences.

Procedure:

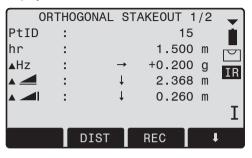
- 1. Input the orthogonal stake out elements.
- [OK] Confirm entry and start calculation.

Example "orthogonal Stake out"



1RP: 1st reference point
MP: Measured point
SP: Stake out point
RL: Reference line
AL: Longitudinal offset
AOff: Parallel offset

Display in "Stake out" measure mode:



▲ 0ffse	+•	→	2.040	m	
▲Line		i i	1.203		
	:	*			
		+	0.260	III	

The signs for the distance and angle differences are correction values (required minus actual).

+▲Hz Turn telescope clockwise to the stake out point.

+▲ 🚄

The stake out point is further away than the point measured.

+_

The stake out point is higher than the measured point.

6. "Grid" subapplication

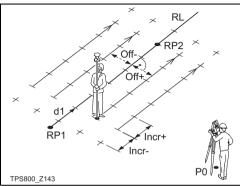
You can enter the chainage to begin with and the increment of grid points in length and cross direction of the reference line. The program calculates and displays the stake out elements for the points on the grid: polar (\triangle Hz, \triangle , \triangle) orthogonal (\triangle Offset, \triangle Line, \triangle).

The grid is defined without boundaries. It can be extended over the first and second base point of the reference line.

Procedure:

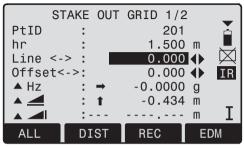
- Input the beginning grid and the values for incrementation and line offset.
- 2. [OK] Confirm entry and start staking out.

Example "Grid Stake out"



RP1: 1st reference point RP2: 2nd reference point RI Reference line d1 Begin grid Off+ Offset, positive Off-Offset, negative Incr+ Increment, positive Incr-Increment, negative

Display in "Grid Stake out" measure mode:



The signs for the distance and angle differences are correction values (required minus actual).

- +▲Hz Turn telescope clockwise to the stake out point.
- +Line<-> The stake out point is in the direction from the first to the second reference point.
- +Offset<-> The stake out point is to the right of the reference line.

+**A** The stake out point is further away than the point measured.

+A I The stake out point is higher than the measured point.

+▲Line Difference in length direction. The prism has to be moved further away.

+ ▲ Offset The prism has to be moved to the right, perpendicular to the line of sight, looking from station to the target.

[ESC] Quits the STAKE OUT GRID panel and returns to the previous panel.

7. "Line Segmentation" subapplication

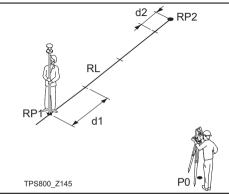
You can either enter the length of segments or the number of segments and define how the length of a remaining segment is treated. This misclosure can be placed at the start, at the end or distributed evenly. The program calculates and displays the stake out elements for the points along the line: polar (\triangle Hz, \triangle , \triangle I) and the orthogonal (\triangle Line, \triangle Offset, \triangle II).

Line Segmentation is limited to the reference line between the defined start and end point of the line.

Procedure:

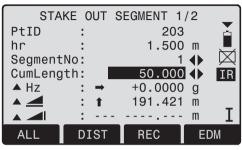
- Input the required segment length or the number of segments and select the method of distribution.
- 2. [OK] Confirm entry and start staking out.

Example "Line Segmentation Stake out"



RP1: 1st reference point
RP2: 2nd reference point
RL Reference line
d1 Segment length
d2 Misclosure

Display in "Line Segmentation Stake out" measure mode:



The signs for the distance and angle differences are correction values (required minus actual).

Segment No: The number of the calculated

segments including the misclosure

segment, if applicable.

Cum.Length: The sum of the segment lengths.

Changes with the current number of

segment.

+▲Hz Turn telescope clockwise to the

stake out point.

The stake out point is further away than the point measured.

The stake out point is higher than the measured point.

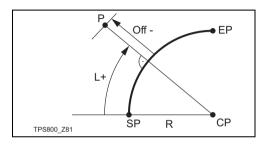
+▲Line Difference in length direction. The prism has to be moved further away.

+ ▲Offset The prism has to be moved to the right, perpendicular to the line of sight, looking from station to the target.

[ESC] Quits the STAKE OUT LSEG panel and returns to the previous panel.

Reference Arc

This application allows the user to define a Reference Arc and then measure or stake out with respect to the arc.



SP: Start point of arc
EP: End point of arc
CP: Centre point of circle

P: Point to stake
R: Radius of circle

L: Distance from start of arc, following curve

Off: Perpendicular distance from arc



All arcs are defined in clockwise direction.



All calculations are made in two dimensions.

Procedure:

1 Define the arc

When starting the application you were asked how to define the arc. You can define the arc by:

- a) Center Point & Start Point
- b) Start Point, End Point, Radius Depending from type you have chosen, you have to measure/select/enter the values to proceed to step 2.

2. Decide to Measure or to Stake Out

[MEASURE] Starts the subapplication to measure Line & Offset (See issue 3).

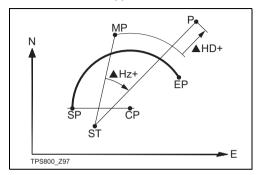
[STAKE] Starts

Starts the subapplication to stake out (See issue 4).

3. "Line & Offset" subapplication

Here you can measure or select points from memory and you will see Line and Offset referring to the arc.

4. "Stake Out" subapplication



SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

P: Point to stake out

ST: Station

MP: Measured point

▲Hz: Difference in horizontal angle

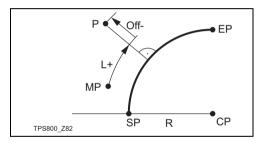
▲HD: Difference in distance measurement

It is not possible to stake out a negative

The application supports four ways to stake out.

a) Stake Out Point

This allows to stake out a point by entering a line and an offset value.



SP: Start point of arc
EP: End point of arc
CP: Centre point of circle
Point to stake out

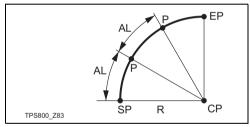
MP: Measured point R: Radius of circle

L: Line

Off: Perpendicular distance from arc

b) Stake Out Arc

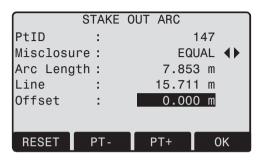
This allows to stake out a series of equidistant points along the arc.



SP: Start point of arcEP: End point of arcCP: Centre point of circleP: Point(s) to stake out

Arc length

AI ·



Display content:

Misclosure: If the entered arc length is not an integer of the whole arc, there will be a misclosure.

You have three options to distribute the misclosure:

- Start arc: All of the misclosure will be added to
 the first arc-section.
- II) No distribution:All of the misclosure will be added to the last arc-section

III) Equal: The misclosure will be equally distributed between all sections

Arc Length: Enter the length of the arc-segment

you want to stake out.

Line: Shows the line-value of the stake out point. This is calculated by the

sure distribution

Offset: Here you can enter the offset value.

arc length and the selected misclo-

[RESET] Sets the values to 0.

[PT +][PT -] Toggels through the calculated

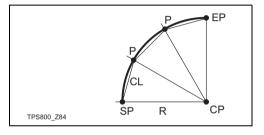
stake out points.

[OK] Proceeds to Stake Out Measure

dialog.

c) Stake Out Chord

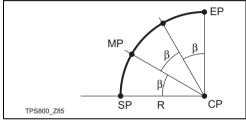
This allows to stake out a series of equidistant chords along the arc. The screen contents and the buttons shown, are the same as described in "Stake Out Arc" section.



CL: Chord length

d) Stake Out Angle

This allows to stake out a series of points along the arc defined by the angle substended at the center of the angle. The screen contents and the buttons shown, are the same as described in "Stake Out Arc" section.



β: Angle

Tie Distance

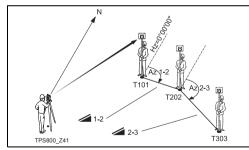
The application **Tie Distance** computes slope distance, horizontal distance, height difference and azimuth of two target points measured **online**, selected from the **Memory** or entered using the **Keypad**.

The user can choose between two different methods:

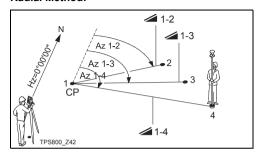
Polygonal (A-B, B-C)

F2 Radial (A-B, A-C)

Polygonal Method:



Radial Method:



CP: Centre point

In principal both methods are the same.

Any differences will be described.

Procedure:

1. Determine first target point.

[ALL] Starts measurement to the target

point.

[FIND] Searches internal memory for point

entered.

2. Determine second target point.

Proceed as with first target point.

3. Result is displayed.

Brg Azimuth between point1 and point2.

Slope distance between point1 and point2.

Horizontal distance between point1 and point2.

Height difference between point1 and point2.

Grade Grade [%] between point1 and point2.

Softkevs - polygonal method:

[NewPt 1] An additional missing line is

computed. Program starts again (at

point 1).

[NewPt 2] Point 2 is set as starting point of a

new missing line. New point (Pt 2)

must be measured.

[RADIAL] Switches to radial method.

Softkeys - radial method:

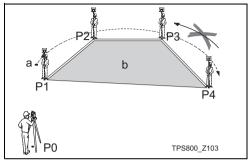
[NewPt 1] Determine new central point.

[NewPt 2] Determine new radial point.

[POLY] Switch to polygonal method.

Area & Volume

The application program Area is used to compute online areas of max. 50 points connected by straights. The target points have to be measured, selected from memory or entered via keyboard in clockwise direction. The calculated area is projected onto the horizontal plane (2D) or projected onto the sloped reference plane defined by 3 points (3D). Furthermore a volume with constant height can be calculated in relation to the area (2D/3D)



P0 Station P1 Start point P3 Target point P4 Target point

- P2 Target point
- a Perimeter, polygonal length from start point to the current measured point.
- b Calculated area always closed to the start point P1, projected onto the horizontal plane.

1 Determine area points

[ALL] Starts the measurement to the

point.

[FIND] / Searches for point in internal

[LIST] memory.

[ENH] For manual input of the coordinates.

[1PtBACK] Undo measurement or selection of last point.

The area (2D) is calculated and displayed once three points have been measured or selected. The area (3D) is calculated once the sloped reference plane is defined by three points.

2 Results

[Def. 3D] To define the sloped reference plane by selecting or measuring

three points.

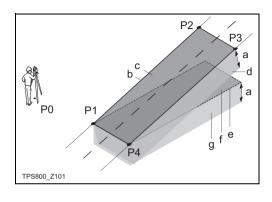
[VOLUME] To calculate a volume with constant height. The height have to be

entered or measured

[RESULT] To display and record additional results (perimeter, volume).

Perimeter and volume are updated if further area points are added.

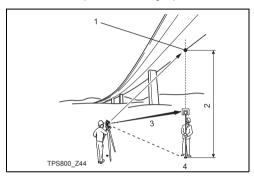
The graphic shows always the area projected onto the horizontal plane.



- P0 Station
- P1 Target point which defines the sloped reference plane
- P2 Target point which defines the sloped reference plane
- P3 Target point which defines the sloped reference plane
- P4 Target point
 - Constant height
- Perimeter (3D), polygonal length from the start point to the current measured point of the area (3D)
- Area (3D), projected onto the sloped reference plane
- d Volume $(3D) = a \times c$
- e Perimeter (2D), polygonal length from the start point to the current measured point of the area (2D)
- f Area (2D), projected onto the horizontal plane
- g Volume (2D) = f x a

Remote Height

Points directly above the base prism can be determined without a prism at the target point.



- 1) Remote point
- 2) Height diff.
- 3) Slope distance
- 4) Base point

Procedure:

I. Input PtID and reflector height

[ALL] Starts measurement to base point

and continues to 2.

[hr?] Starts the program that determines

an unknown reflector height.

2. Aim at inaccessible height point

[OK] Saves the measured data.

[Base] Input and measurement of a new

base point.

Construction

This application allows to define a construction site by combining set-up of the instrument along a construction line, measuring and stake out points in relation to the line.

After selecting the application you have two options:

- Defining a new construction site or
- b) Continue with previous site (skips set-up)

Procedure:

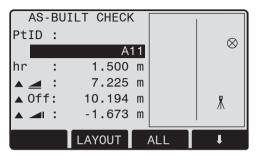
Defining new site:

- 1. Measure line Start point [ALL], [DIST]+[REC]
- 2. Measure second line point [ALL], [DIST]+[REC]

In case, you have entered coordinates by ENH and measured to known points a plausibility check informs you about the calculated line length, the actual length and the difference.

As built check:

This dialog shows you the ▲Line, ▲Offset and ▲Height of a measured point in relation to the line.



[ShiftLn]

Allows you to enter values for shifting the line.

[LAYOUT]

Switches to Layout-mode.

▲Line is positive:

Measured point is in direction from line start - to line end point.

▲Offset is positive:

Measured point is right of line.

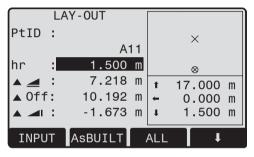
▲Height is positive:

Measured point height is above line start point's height.

The height of the line start point is always used as the reference height!

Layout

Here you can search or enter points for staking out related to the measured line.



[ShiftLn]

Allows you to enter values for shifting the line.

[AsBUILT]

Switches to AsBuilt-mode.

The graphics show you the position of the prism related to the stake out point. Below, the exact

values are displayed, combined with arrows to show the direction.

▲Line is positive (arrow up):

Target point is further away than the measured point.

▲Offset is positive (arrow right):

Target point is right of the measured point.

▲Height is positive (arrow up):

Target point is higher than the measured point.

The height of the line start point is always used as the reference height!

The graphics are scaled to give a better overview. Therefore it's possible that the station point moves in the graphics.

Be aware that the line start point and the line end point are measured in the previous coordinate system. When staking out this points they appear in the old system and appear as shifted.

During use of the application the previous Orientation and Station parameters will be replaced by the new calculated ones.

Roadworks 3D (optional)

General

The Roadworks 3D application program can be used to stake out points or for as built checks relative to a road alignment including slopes.

The application can be started in total 15 times for trial. Afterwards you have to enter the license code.

Overview

Roadworks 3D application program supports the following features:

- Horizontal alignments with the elements straight, curve, spiral (entry and exit as well as partial)
- Vertical alignments with the elements straight, curve and quadratic parabola
- Upload of horizontal and vertical alignments which are in gsi data format of Leica Road Line Editor
- Creation, view and deletion of alignments onboard
- Usage of design height of vertical alignment or manually entered height
- Sub application Check
- · Sub application Stake
- · Sub application Check Slope
- · Sub application Stake Slope
- Log file via Format manager of LGO Tools Version 5.0 or higher

Basic Terms - Elements of a Road Project

Road projects consist in general of a horizontal and a vertical alignment.

Any project point P1 has E, N and H coordinates in a determined coordinate system and has three positions.

P1'	Position on natural surface
P1 "	Position on vertical alignment
P1 ""	Position on horizontal alignment

With a second point P2 the alignment is defined.

P1 ' P2 ' Projection of the alignment onto the natural surface

P1 " P2 " Vertical alignment

P1 " P2 " Horizontal alignment

a Grade, angle between the vertical and horizontal alignment.

P2"
P2"
P2"
TPS800_Z104

a h c

- Natural Surface
- b Horizontal Alignment
- c Vertical Alignment

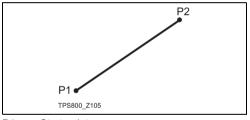
Basic Terms - Horizontal Geometry Elements

For onboard input Roadworks 3D supports the following elements for horizontal alignments:

1. Straight

A straight has to be defined by:

 Start point (P1) and end point (P2) with known easting and northing coordinates

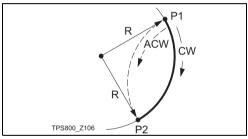


P1 Start point P2 End point

2 Curve

A circular curve has to be defined by:

- Start point (P1) and end point (P2) with known easting and northing coordinates
- Radius (R)
- Direction: Clockwise (CW) or Anticlockwise (ACW)



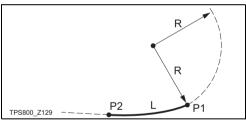
P1 Start point P2 End point R Radius

CW Direction clockwise
ACW Direction anticlockwise

3. Spiral/Clothoid

A spiral is a transition curve whose radius changes along its length. A spiral has to be defined by:

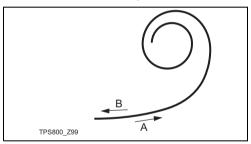
- Start point (P1) and end point (P2) with known easting and northing coordinates
- Radius at the start of the spiral (R)
- Spiral parameter ($A = \sqrt{L \cdot R}$) or length of the spiral (L)
- · Direction: Clockwise or Anticlockwise
- · Spiral type: Spiral In or Spiral Out



P1 Start point
P2 End point
R Radius
L Length

Spiral types:

- Entry spiral (Spiral in = A): Spiral with a radius of infinity at the start and a given radius at the end.
- Exit spiral (Spiral out = B): Spiral with a given radius at the start and radius of infinity at the end.
- Partial/Ovoid spiral: A spiral with a given radius at the start and another given radius at the end.



- A Entry spiral
- B Exit spiral

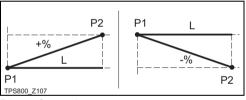
Basic Terms - Vertical Geometry Elements

For onboard input Roadworks 3D supports the following elements for vertical alignments:

1. Straight

A straight has to be defined by:

- Start Chainage and Start Height of P1
- End Chainage and End Height of P2 or Length (L) and Slope (%)

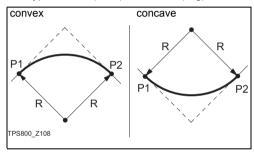


P1 Start point
P2 End point
L Length
Slope

2 Transition Curve

A circular curve has to be defined by:

- Start Chainage and Start Height of P1
- End Chainage and End Height of P2
- Radius (R)
- Type: convex (crest) or concave (sag)

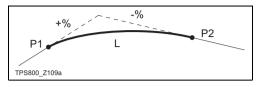


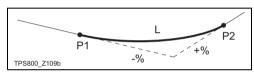
P1 Start point P2 End point R Radius

3. Quadratic parabola

A quadratic parabola has the advantage that the rate of change of grade is constant thus resulting in a "smoother" curve. A quadratic parabola has to be defined by:

- · Start Chainage and Start Height of P1
- End Chainage and End Height of P2
- Parameter
- or length (L), grade of entry straight (Grade In) and grade of exit straight (Grade Out)

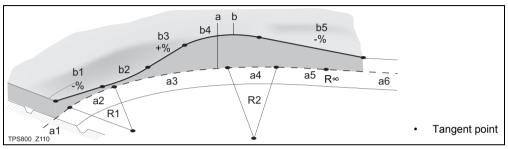




P1 Start point
P2 End point
L Length
Slope

Basic Terms - Horizontal and Vertical Geometry Elements combined

Start-/Endchainage and Tangent points can be different for the horizontal and vertical alignment.



a = Horizontal Alignment (top view)

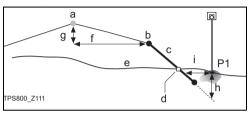
- R1 Radius 1
- R2 Radius 2
- a1 Straight
- a2 Curve with R1
- a3 Partial Spiral with R1 and R2
- a4 Curve with R2
- a5 Spiral Out with R2 and R=∞
- a6 Straight

b = Vertical Alignment (front view)

- b1 Straight
- b2 Curve
- b3 Straight
- b4 Parabola
- b5 Straight

Basic Terms - Slopes

1. Slope elements



P1 Measured point

- a Horizontal alignment
- b Hinge point
- c Slope
- d Catch point
- e Natural surface
- f Defined Offset
- g Defined Height Difference
- h Cut situation for defined slope
- i ▲Offset to catch point

Explanation of the slope elements:

Horizontal alignment at a defined chainage.

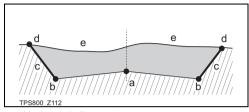
Hinge point, is defined by entered Offset Left/Right and Height Difference.

Slope = ratio.

Catch point, or daylight point, indicates the point of intersection between the slope and the natural surface. Both the hinge point and the catch point lie on the slope.

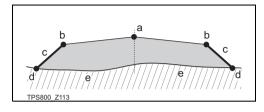
Natural surface, is the undisturbed surface before project construction.

2. Cut situation



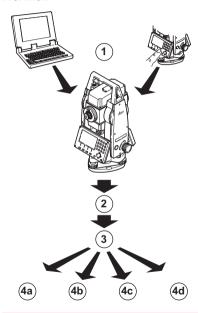
- a Horizontal alignment
- b Hinge point
- c Slope
- d Catch point
- e Natural surface

3. Fill situation



- a Horizontal alignment
- b Hinge point
- c Slope
- d Catch point
- e Natural surface

Workflow



- 1 Create or upload road alignments
- 2 Select horizontal and/or vertical alignment files.
- 3 Define stake/check/slope parameter
- 4a Sub application Check
- 4b Sub application Stake
- c Sub application Check Slope
- 4d Sub application Stake Slope

Important features:

- The data of the alignment files has to be in the data structure of Leica Road Line Editor as these gsi files have unique identifiers for each element which are used by the application program.
- The alignments must be continuous because geometrical gaps and chainage equations are not supported.
- The file name for horizontal alignment must have the prefix ALN, for vertical alignments PRF and can be 16 characters long, e.g. ALN_HZ_Axis_01.gsi and PRF VT Axis 01.gsi.
- The uploaded or created road alignments are permanent and stored even if the application is closed
- Road alignments can be deleted onboard or via Data Exchange Manager in LGO Tools Version 5.0 or higher.
- Road alignments cannot be edited onboard.
 This needs to be done via Leica Road Line
 Editor of LGO Tools

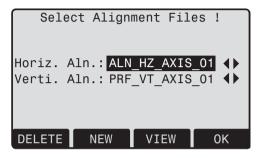
 The same part of the memory is reserved for jobs (fixpoint and/or measurement) and road alignments. The number of free road alignments depends on the number of jobs and vice versa.

1 Create or upload road alignments

Create horizontal and vertical road alignment files with Leica Road Line Editor and upload them onto the instrument using Data Exchange Manager of LGO Tools Version 5.0 or higher.

Alternatively, horizontal and vertical road alignments can be created onboard.

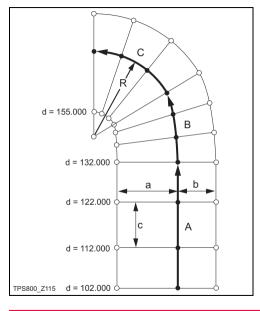
Select horizontal and/or vertical alignment files.



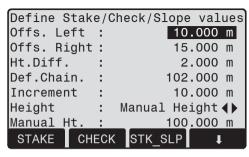
Using a horizontal alignment file is mandatory.

Using a vertical alignment file is not necessary. Alternatively, a height can be defined manually.

3 Define stake/check/slope parameter



- A Straight
- B Spiral
- C Curve
- Radius
- a Offset Left
- b Offset Right
- c Increment
- d Defined Chainage



CH_SLP	PREV	RESET	←

Offs. Left Horizontal offset from the horizontal alignment to the left side.

Offs. Right Horizontal offset from the horizontal alignment to the right side.

Ht. Diff. Vertical offset from the horizontal alignment up or down.

Def. Chain Defined Chainage for stake out. Increment Value by which 'Defined Chainage'

can be incremented/decremented in sub application Stake and Stake

Slope.

Heiaht Manual Height

> Height reference for height calculations. If < Manual Height> is enabled this height is used for all sub applications

Use Design Height

The height reference for height calculations is the selected vertical

alignment file.

[STAKE] [CHECK] ISTK SLP1

ICH SLP1

To start sub application Stake. To start sub application Check.

To start sub application Stake Slope.

To start sub application Check

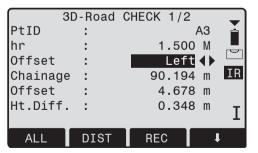
Slope.

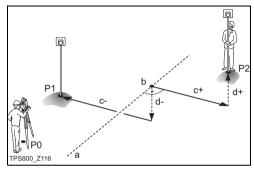
4 Select sub application Check, Stake, Check Slope or Stake Slope:

4a Sub application Check

The sub application **Check** is used for as-built checks. The points can be measured or selected from the memory. As result you will get Chainage and Offset values relative to an existing horizontal alignment and the Height difference relative to a vertical alignment or manually entered height.

Defined Chainage and Increment values will not be considered in the Check mode.

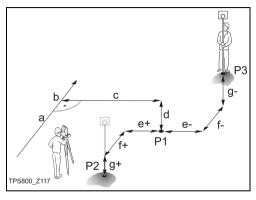




- P1 Target point
- P2 Target point
- a Horizontal alignment
- b Chainage
- c Offset, is positive on the right hand side of the alignment.
- d Height difference, is positive when target point is higher than the alignment.

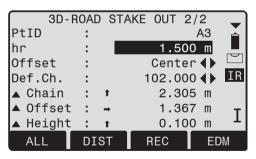
4b Sub application Stake

The sub application **Stake** is used to stake out points relative to an existing horizontal alignment.



- P1 Target Point
- P2 Measured Point
- P3 Measured Point
- a Horizontal alignment

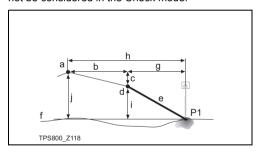
- b Defined Chainage
- Offset
- d Height Difference
- e AOffset, is positive when target point is on the right hand side of the measured point.
- f AChainage, is positive when target point is further away than the measured point.
- g AHeight, is positive when target point is higher than the measured point.



4c Sub application Check Slope

The sub application **Check Slope** is used for asbuilt checks and to get information about slopes in general, for example on natural surface. If the parameter Offset Left/Right and Height difference are not entered, the point on the horizontal alignment is the Hinge point.

Defined Chainage and Increment values will not be considered in the Check mode



- P1 Measured Point
- a Horizontal alignment
- b Defined Offset
- c Defined Height Difference
- d Hinge point
- e Actual Slope
- f Natural Surface
- g Offset to Hinge point
- h Offset to Alignment
- i Height Difference to Hinge point
- j Height Difference to Alignment

Description of fields

▲H Hna

SLOPE CH	ECK H	INGE	Value	s 1/3	3
PtID	:			P5	Ě
hr	:		1.50	OO M	ш
Offset	:		Lef	t ()	
Chainage	:		92.00	00 m	IR
Offs.Hng	:		-24.29	98 m	
▲ H Hng	:		17.55	54 m	т
Act. Slp	: 1	: '	1.384	v:h	
ALL	DIST		REC	1	,

Current measured chainage. Chainage Offs. Hng

Offset to Hinge, the current measured offset to horizontal alignment

including offset right and offset left.

Height difference to Hinge, the vertical offset between current defined height at current chainage and current measured position including defined height difference. ✓ Hna Slope distance to Hinge, the slope distance from the current measured point to the hinge point.

Offs Aln Offset to Alignment, the current measured offset to horizontal alignment excluding offset right and offset left

▲H Δln Height difference to alignment, the vertical offset between defined height at current chainage and current measured position excluding defined height difference.

Slope distance to Alignment, slope i Δln distance from the current measured point to the alignment.

Actual Slope, the current measured Act. Slp slope of the reflector position to the

hinge point.

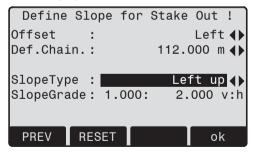
Height Height value of the current measured

4d Sub application Stake Slope

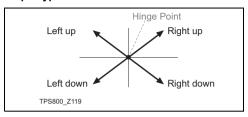
The sub application **Stake Slope** is used to stake out the catch point, that means the intersection point of a defined slope with the natural surface.

The slope is always defined as starting from a hinge point. If the parameter Offset Right/Left and Height difference are not entered the point at Defined chainage on the horizontal alignment is the hinge point.

Define slope parameter



Slope Type



Left down

creates a downward plane extending to the left of the defined hinge point.

Right down

creates a downward plane extending to the right of the defined hinge point.

Left up

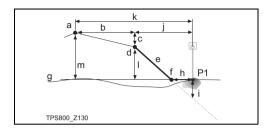
creates an upward plane extending to the left of the defined hinge point.

Right up

creates an upward plane extending to the right of the defined hinge point.

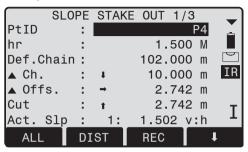
Slope Grade

Ratio of the slope. The unit for slope grade is defined in the Settings screen.



- P1 Measured Point
- a Horizontal alignment
- b Defined Offset
- c Defined Height Difference
- d Hinge point
- e Defined Slope
- f Catch point
- g Natural Surface
- h ▲Offset to Catch point
- i Cut/Fill to Catch point
- j Offset to Hinge point
- k Offset to Alignment
- I Height Difference to Hinge point
- m Height Difference to Alignment

Description of fields



▲Ch. Difference between defined chainage and current measured chainage.

▲Offs. Horizontal offset between catch point of defined slope and current measured position.

Cut/Fill Vertical offset between catch point of defined slope and current measured position. A cut is above the slope, a fill is below the slope.

Act. Slp Actual Slope, the current measured slope of the reflector position to the hinge point.

Offs. Hng Offset to Hinge, the current measured offset to horizontal alignment including offset right and offset left.

▲H Hng Height difference to Hinge, the vertical offset between current defined height at current chainage and current measured position including defined height difference.

Hng Slope distance to Hinge, the slope distance from the current measured point to the hinge point.

Height Height value of the current measured point.

Act. Ch. Current measured chainage.

Offset to Alignment, the current measured offset to horizontal alignment excluding offset right and offset left.

Offs. Aln

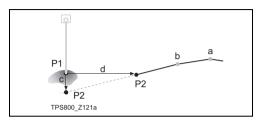
▲H AIn Height difference to alignment, the vertical offset between defined height at current chainage and current measured position excluding defined height difference.

Aln

Slope distance to Alignment, slope distance from the current measured point to the alignment.

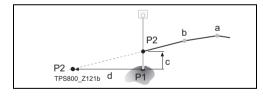
Sign convention

Cut situation



- P1 Measured point
- P2 Catch point
- a Horizontal alignment
- b Hinge point
- c Cut
- d ▲Offset to Catch point

Fill situation



- P1 Measured point
- P2 Catch point
- a Horizontal alignment
- b Hinge point
- c Fill
- d ▲Offset to Catch point

COGO

COGO is an application program to perform **co**ordinate **geo**metry calculations such as:

- · coordinates of points
- bearings between points
- · distances between points

The COGO calculation methods are:

- Inverse & Traverse
- Intersections
- Offset
- Extension

Softkeys:

[MEAS] Jumps to the Measurement dialog to

measure the point.

[Calc] Starts the calculation, when all required

data is entered

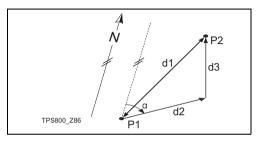
[STAKE] When the calculated point is displayed

you have the option to stake out this

point directly.

Inverse & Traverse

Inverse



Known

P1 First known point

P2 Second known point

Unknown

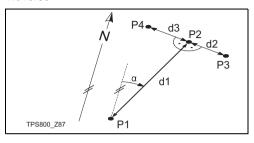
 α Direction from P1 to P2

d1 Slope distance between P1 and P2

d2 Horizontal distance between P1 and P2

d3 Height difference between P1 and P2

Traverse



Known

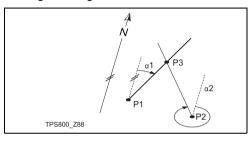
- P1 Known point
- α $\,$ Direction from P1 to P2 $\,$
- d1 Distance between P1 and P2
- d2 Positive offset to the right
- d3 Negative offset to the left

Unknown

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

Intersections

Bearing - Bearing



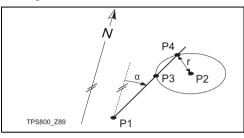
Known

- P1 First known point
- P2 Second known point
- α 1 Direction from P1 to P3
- α 2 Direction from P2 to P3

Unknown

P3 COGO point

Bearing - Distance



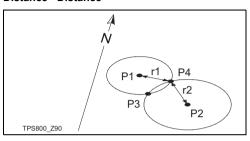
Known

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

Unknown

- P3 First COGO point
- P4 Second COGO point

Distance - Distance



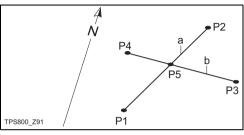
Known

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

Unknown

- P3 First COGO point
- P4 Second COGO point

By Points



Known

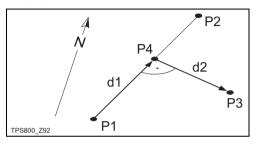
- P1 First known point
- P2 Second known point
- P3 Third known point
- P4 Fourth known point
- a Line from P1 to P2
- b Line from P3 to P4

Unknown

P5 COGO point

Offset

Distance - Offset



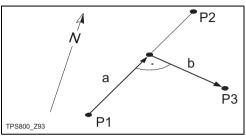
Known

- P1 Baseline start point
- P2 Baseline end point
- P3 Lateral point

Unknown

- d1 Difference in length/abzissa (HD)
- d2 Lateral deviation/ordinate (Offset)
- P4 Base point

Set Point by ...



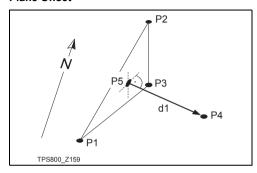
Known

- P1 Baseline start point
- P2 Baseline end point
- a Difference in length/abzissa (HD)
- b Lateral deviation/ordinate (Offset)

Unknown

P3 Lateral point

Plane Offset



Known

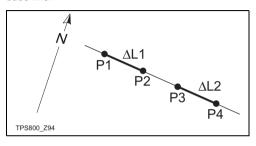
- P1 Point 1 which defines plane
- P2 Point 2 which defines plane
- P3 Point 3 which defines plane
- P4 Offset point

Unknown

- P5 COGO point
- d1 Offset

Extension

The "Extension" routine computes extend point from base line.



Known

P1 Baseline start point P3 Baseline end point

▲L1 or ▲L2 Distance

Unknown

P2. P4 Extended point

TraversePRO (optional)

The application TraversePRO can be trialed 15 times. Afterwards it is necessary to enter the license code.

The TraversePRO application is used to establish control networks whereby other survey operations such as topographic surveys or point stake outs can be completed.

The TraversePRO methods include:

- 2D Helmert transformation
 If you select 2D Helmert the traverse will be adjusted by a 2D Helmert transformation. Shift, Rotation and Scale factor will be computed and applied to the traverse.
- Compass rule If you select Compass Rule the coordinate misclosure will be distributed with respect to the length of the traverse legs. The Compass Rule assumes that the biggest error comes from the longest traverse observations. This method is

suitable when the precision of the angles and distances are approximately equal.

Transit rule
If you select Transit Rule the coordinate misclosure will be distributed with respect to the coordinate changes in Easting and Northing. Use this method if the angles were measured with a higher precision than the distances.

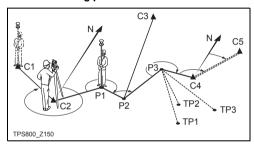
To begin a traverse you may:

- Start a traverse without a known backsight
- Start a traverse with a known backsight

If the coordinates of the start station are unknown, the Free Station application can be run before and by choosing "Start a traverse without a known backsight" the system azimuth can be overtaken. If the start azimuth is unknown and a Helmert transformation is performed in the end, then also use "Start a traverse without a known backsight".

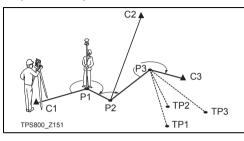
It is also possible to observe sideshots and check points during the traverse. However check points are not included in the traverse adjustment. At the end of the traverse, results are displayed and optionally an adjustment can be calculated.

Start on known point with known azimuth
Stop on known point and optionally measure to
a known closing point



C1, C2, C4, C5 C3 P1...P3 TP1...TP3 N Control Points
Check Point
Traverse Points
Topographic Points
North Direction

Start on known point without azimuth Stop on known point



C1, C3 Control Points
C2 Check Point
P1...P3 Traverse Points
TP1...TP3 Topographic Points

Procedure

1. Starting Traverse

It is not recommended to start a traverse if the memory is almost full. Doing so, may mean the traverse measurements and results cannot be saved. Accordingly, you will be informed by a message if less than 10% of the memory is free.

	TRAVERSE BEGIN		
[•]	F1 F2	Set Job Set Tolerance	
	F4	Start	

Enables you to select a job. Only one traverse per job is allowed. If an adjusted or finished traverse is already part of the selected job, then select another job.

Enables you to activate/deactivate the

You can enter a limit for horizontal direction (the difference between measured and calculated azimuth to the closing point), for distance (the distance between known and measured closing point), and for differences in Easting.

Northing and Height.

If the adjustment results or the deviation for a check point exceed these limits a warning dialog appears. You can then decide whether or not to proceed.

Enables you to configure and start the traverse

2. Configuring TraversePRO

The following entries are possible

Traverse ID: The name of the new traverse.

Method: B'F'B'' All points are measure

B'F'F''B'': All points are measured in face I, then measured in face II in

reverse sequential order. B'B"F"F": Backsight point is measured in face I immediately followed by face II. Other points are measured in alternating face order. B'F': All points are measured in face

I only.

Nr. of Sets: The number of sets is limited to 10.

Important when measuring with face I and II. This checks if both measurements are within a defined limit. When exceeding the limit, a warning message is displayed.

Face Tol.: The limit that will be used for

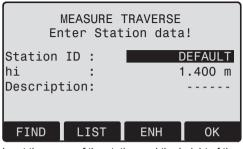
checking the face tolerance.

[OK] Enables you to enter the station

data.

3. Entering station data

Every Traverse must start on a known point.



Input the name of the station and the height of the instrument.

[FIND] Starts point search. Exact PtIDs can be entered or the * wildcard-criteria

used.

[LIST] Displays the list of available points.

[ENH] Opens the coordinate input mode. [OK] Enables you to select the traverse

method.

4. Selecting the starting method

Starts the traverse without a known

backsight. The measurements begin to a foresight point. See 6. Measuring a foresight point.

Starts the traverse with a known

backsight. See 5. Measuring a

backsight point.

5. Measuring a backsight point

Input the name of the station and the height of the reflector. Use the functions [FIND], [LIST] or [ENH] as described in 3. Entering station data.

[OK] To continue to the panel for

measuring a backsight point.

	Sight Back	sight!	1/1 🔻
Stat.	ID :	120	00
BS ID	:	100	01
hr	:	1.500	m 💢
Code	:		IR
Hz	:	0.0000	g
V	:	0.0000	g _T
_	:	0.0000	m I
ALL	DIST	REC	1

Measure the backsight point.

After the measurement with [ALL] or [DIST] + [REC], depending on the configured traverse method, either the Sight Backsight Point panel stays active for measuring the backsight point in a second face or the Sight Foresight Point panel appears for measuring the foresight point.

6. Measuring a foresight point

A point ID for the foresight point is suggested but can be changed.

Measure the foresight point.

After the measurement with [ALL] or [DIST] + [REC], depending on the configured traverse method, either the Sight Foresight Point panel stays active for measuring the foresight point in a second face or the Sight Backsight Point panel appears for measuring the backsight point is displayed.

7. Repetitive loop for the number of sets

Alternating between panels for the backsight and foresight measurements continues according to the configured number of sets.

The number of sets and the face are indicated in the top right corner of the panel. For example 1/I means set 1 in face I.

Interrupting a set

[ESC] Quits the backsight and foresight panel.

This panel is displayed:

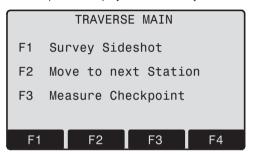
CONTINUE WITH... F1 Redo last measurement F2 Redo whole station F3 Exit Traverse F4 PREV F1 F2 F3 F4

- Redo the last measurement which can either be a backsight or a foresight point. The last measurement is not stored.
- Redo the whole station. The data from the last station is not stored.
- Exit the traverse. The traverse stays active and can be continued later. The data from the last station is lost.
- To return to the panel where [ESC] was pressed accidentally.

When the number of defined sets is achieved

The accuracy of the set measurements is checked. The set can be accepted or redone.

The next panel is displayed automatically.



- To measure a sideshot. See 7.1 Sideshot.
- To change to the next station. See 7.2 Next Station.
- To measure a check point. See 7.3 Check Point.
- [ESC] Quits the TRAVERSE MAIN panel. Decide what to do next:

Redo Last Station?

Measurements on this station
will be overwritten!

REDO EXIT PREV

[REDO] To redo the whole station. The data from the last station is not stored.

[QUIT] Goes to the Programs Menu. The traverse which was not finished can be continued or processed later by starting the program TraversePro again.

[BACK] To return to the TRAVERSE MAIN panel.

7.1 Sideshot

Enables the measurement of ordinary survey and topographic points. Measured points are stored with a TraversePRO flag. If the traverse is finally adjusted, these points will be updated.

[DONE]

Quits the Measure Sideshots dialog and returns to the TRAVERSE MAIN panel.

7.2 Next Station

Move to the next station. The instrument can either be left on or turned off.

The start panel for the next station is similar to the one in 3. Entering station data. The point ID of the foresight point of the last station is suggested as station ID automatically.

Run through the loop of backsight and foresight measurements until the number of sets is reached.

7.3 Check Point

A check point is excluded from the traverse calculation and adjustment. However all measurement data and results observed from a check point are stored.

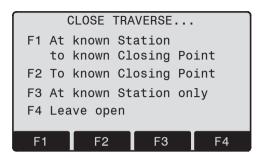
Input the name of the check point and the height of the reflector. Use the functions [FIND], [LIST] or [ENH] as described in 3. Entering station data. Press [OK] to go to the next panel.

Measure the check point. The deltas in Easting, Northing and Height are displayed.

If the tolerances defined in the TraversePRO configuration are exceeded, an information message is displayed.

8. Closing a traverse

Press [CLOSE] in the Sight Foresight Point panel before measuring a foresight point after a backsight point measurement.



The options for closing a traverse are:

- F
- Use when you are setup on the closing station, you know its coordinates and the coordinates of the closing point.
- 1. Input the data for both points.
- 2. Measure to the closing point.
- 3. The results are displayed.
- If you chose this method you are forced to do a distance measurement.

- Use when you are setup on an unknown station and only the coordinates of the closing point are known.
 - 1. Input the data for the point.
 - 2. Measure to the closing point.
 - 3. The results are displayed.
- Use when you are setup on the closing station and the coordinates for it are known.
 - 1. Input the data for the closing station.
 - 2. The results are displayed.
- Use when you would like to leave the traverse open. There is no last traverse station.
 - 1. The results are displayed.

If you started the traverse without a known backsight point and you selected the option of the option, then, for calculating results, you have the option to use the system azimuth saved in the instrument from another program, for example if Free Station was used before TraversePRO.

9. Results

1D Acc: Accuracy in 1D
2D Acc: Accuracy in 2D
L Err: Length/distance error
A Err: Azimuth closure error

[ADJUST] To calculate an adjustment.

open.

[EXIT] To end traverse without an adjust-

ment.

10. Adjustment

Angle misclosures are distributed equally.

Set the adjustment parameters.

Misc.-Distr.: For misclosure distribution either

COMPASS or TRANSIT-rule can

be chosen.

Hqt.-Distr.: The height error can be distributed

equally, by distance or not at all.

Scale: ppm value defined by the calculated

distance between start and end point divided by the distance

measured.

Use Scale: Do you want to use the calculated

ppm after finishing TraversePRO?

[OK] To proceed with the adjustment.

Depending on the number of measured points this may take some time. A message is displayed during the calculation. Adjusted points are stored as fixpoints with an additional prefix, for example point BS-154.B is stored as CBS-

154.B.

After the adjustment the

TraversePRO application is left and the system returns to the MAIN

MENU.

Warnings / Messages

Important messages	Meaning
Memory is almost full. Continue?	This message occurs if less than 10% of the memory is free. It is not recommended to start a traverse if the memory is almost full. If you do so, it may happen in the end that the traverse measurements and the results cannot be saved.
Current job contains an adjusted traverse. Select a different job.	Only one traverse per job is allowed. You must select another job.
Last traverse not yet finished or processed - continue?	The TraversePRO program was quit without closing a traverse. You can continue the traverse on a new station. You can leave the traverse unfinished. Or you can start a new traverse and the old traverse data is overwritten.
Do you really want to start a new traverse? All existing traverse data will be overwritten.	You can go back to the previous panel and decide again.
REDO last station? Measurements on this station will be overwritten.	Other options are to quit TraversePRO completely or to go back to the TRAVERSE MAIN panel and decide again.
QUIT Traverse Application? Current Station data will be lost.	You can either quit the application or go back to the previous panel and select another option.
Tolerances exceeded. Accept?	If you do not accept, the calculations can be redone.

Important messages	Meaning
Traverse points are recalculated and newly stored.	This is an information message displayed while the adjustment is calculated.

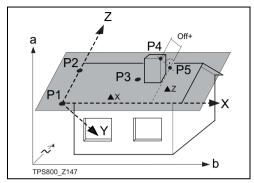
Reference Plane

The Reference Plane application is used to measure points relative to a reference plane. It can be used for the following tasks:

- Measuring a point to calculate and store the perpendicular offset to the plane.
- Calculating the perpendicular distance from the intersection point to the local X- and Z-axis. The intersection point is the footprint point of the perpendicular vector from the measured point through the defined plane.
- Viewing, storing and staking out the coordinates of the intersection point.

A reference plane is created by measuring three points on a plane. These three points define a local coordinate system:

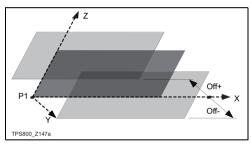
- The first point is the origin of a local coordinate system.
- The second point defines the direction of the local Z-axis.
- The third point defines the plane.



- P1 First point, origin of local coordinate system
- P2 Second point
- P3 Third point
- P4 Measured point. This point is probably not located on the plane.
- P5 Footprint point of the perpendicular vector from P4 to the defined plane. This point is definitely located on the defined plane.
- X X-axis of local coordinate system

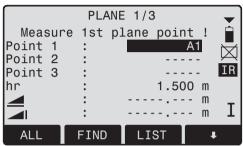
- Z Z-axis of local coordinate system
- Off+ Perpendicular distance from P4 to the plane
- ▲X Perpendicular distance from P5 to the local Z-axis
- ▲Z Perpendicular distance from P5 to the local X-axis

The perpendicular distance to the plane can be positive or negative:



Procedure

1. Measuring points defining the reference plane



Input the name of the first point on the reference plane and the height of the reflector. Measure the point.

Repeat this for the second and the third point on the reference plane.

[FIND] Starts point search. Exact PtIDs can

be entered or the * wildcard-criteria

used.

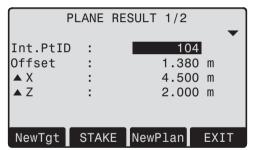
[LIST] Displays the list of available points.

[ENH] Opens the coordinate input mode.

2. Measuring target point

Measure a target point as you usually survey points.

3 Results



Int PtID: Point ID of the intersection point, the perpendicular projection of the target point on the plane.

Offset:

▲X:

Calculated perpendicular distance between target point and plane

(intersection point).

Perpendicular distance from the intersection point to the local Z-axis.

▲7· Perpendicular distance from the intersection point to the local X-axis.

The stake out point is higher than the origin of the coordinate system. Calculated perpendicular distance

between target point and plane (intersection point).

[NewTat]

To measure a new target point. To display stake out values for inter-[STAKE] section the point.

[New Plan] To define a new reference plane. [EXIT] Goes to the programs menu.

Leica TPS800-4.0.0en 130 **Programs**

Codina

Codes contain information about recorded points. With the help of coding, points can be assigned to a particular group simplifying later processing. More information on coding can be found under

GSI-codina

Info8:

Code: Code name

"Data management".

Desc : Additional remark Info1: more, freely editable

information lines

Codes are always stored as free codes (WI41-49), that means that codes are not directly linked to a point. They are stored before or after the measurement depending on the setting made. Point codes (WI71-79) are not available.

Procedure:

Select code from a codelist or enter new code [RECORD] The code is directly recorded without a measurement with [ALL]. [OK] The code is set. After a measure-

ment with [ALL] the code is

recorded

[AddList] Adds the entered code to the

codelist

Extending / editing code

Call available code from code list

Attributes can be overwritten freely.

Exceptions:

With the codelist editor of LGO a status can be assigned to the attributes.

- Attributes with "fixed status" (see LGO) are write-protected. They cannot be overwritten or edited
- For attributes with status "Mandatory" an input or a confirmation is required.
- Attributes with status "Normal" can be edited freely.

Quick Code

Using the quick code function, a predefined code can be called directly via the numeric keypad on the instrument. The code is selected by entering a two digit number, the measurement triggered and the measured data and code saved.

A total of 100 codes can be assigned.

Each code can be assigned a unique one or two digit number in the "Codelist Manager".

If no numbers are allocated to the codes in the "Codelist Manager", the code is selected in accordance with the order in which the codes were entered in the code list (01 -> first code in the code list ... 10 -> tenth code in the code list).

Procedure:

- Press the [Q-Code] button to activate Quick coding.
- Enter a two digit number on the numeric keypad
 -> code is selected, the measurement triggered
 and the measured data and code saved.

The name of the selected code is displayed after the measurement.

A two digit code must always be entered on the instrument's numeric keypad even if only a one digit code was assigned in the Codelist Manager.

For example: 4 -> enter 04.

To end Quick Coding press the [Q-Code] button again.

Warnings / Messages

Important Messages	Meaning
Attrib. cannot be changed !	Attribute with fixed status cannot be changed.
No codelist available !	No codelist in memory. Manual input for code and attributes are called automatically.
Entry required !	Code missing. Extend input.

Individually entered code blocks are not added to the code list.

Leica Geo Office Tools (LGO-Tools)

Codelists can be easily created and uploaded to the instrument using the supplied "LGO-Tools" Software.

Settings

This menu enables extensive user-specific settings in order to adapt the instrument to their own requirements.

Contrast

Setting the display contrast in 10% steps.

Trigger key

Configuration of the trigger key on side cover.

Off Trigger key deactivated.

ALL Trigger key with same function as

the [ALL]-key.

DIST Trigger key with same function as

the [DIST]-key.

USER Key

Configure the USER Key with a function from the FNC-menu

V-Setting

The "0"- orientation of the vertical circle can be either selected for the zenith, the horizontal plane or in %.

- Zenith:Zenith=0°: Horizon=90°
- Horizon: Zenith=90°: Horizon=0°
- V-(%): 45°=100%; Horizon=0°

The % value increases rapidly. "--.--%" appears on the display above 300%".

Tilt Correction

Off Tilting compensation switched off.

1-axis V-angles relate to the plumb line.

2-axis V-angle refer to the plummet line and the Hz-directions are corrected by the

standing axis tilt.

If the instrument is used on an unstable base (e.g. shaking platform, ship, etc.) the compensator should be switched off.

This avoids the compensator drifting out of it's measuring range and interrupting the measuring process by indicating an error.

The compensator setting remains active even after the instrument is switched off.

Sector Beep

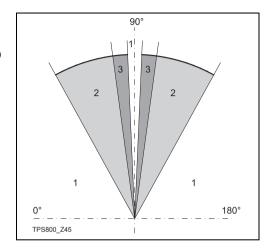
Off Sector Beep switched off

On Sector Beep sounds at right angles (0°,

90°, 180°, 270° or 0, 100, 200, 300 gon)

Example Sector Beep:

From 95.0 to 99.5 gon (or from 105.0 to 100.5 gon) a "Fast beep" sounds whilst from 99.5 to 99.995 gon (or from 100.5 to 100.005 gon) a "Permanent beep" sounds



- 1) No beep
- Fast beep (interrupted)
- 3) Permanent beep

Beep

The beep is an acoustic signal after each key stroke.

Off Beep switched off Normal Normal volume

Hz Incrementation

Right Set right Hz for "Clockwise direction

measurement".

Left Set left Hz for "Counter-clockwise direc-

tion measurement". "Counter-clock-wise" directions are only displayed but

saved as "Clockwise direction".

Reticle Illumination

The reticle illumination is only switched on if the

display illumination is on.

Low Low illumination

Medium Medium illumination

High High illumination

Display Heater

On Is automatically activated when the

display illumination is on and the instru-

ment temperature is ≤ 5 °C.

Language

The current loaded languages are shown.

Language choice

If two languages are loaded onto the instrument a dialog to choose the language can be shown directly after switching on the instrument.

On The language dialog is shown as

startup dialog.

Off The language dialog is not shown as

startup dialog.

Data Output

RS232 Data is recorded via the serial interface.

This setting in only required if an external storage device is connected and measurements are started at the TPS with DIST/REC or ALL. This setting

is not required if the TPS is totally

controlled by a datalogger.

Intern All data is recorded in the internal

memory.

GSI 8/16

Select GSI output format.

GSI 8: 81..00+12345678

GSI 16: 81..00+1234567890123456

Mask 1/2/3

Select GSI output mask.

Mask 1: PtID, Hz, V, SD, ppm+mm, hr, hi

 $\mbox{Mask 2:} \qquad \mbox{PtID, Hz, V, SD, E, N, H, hr}$

Mask 3: StationID, E, N, H, hi (Station) StationID. Ori, E, N, H, hi (Station

Result)

PtID, E, N, H (Control)
PtID. Hz. V (Set Azimuth)

PtID, Hz, V, SD, ppm+mm, hr, E, N, H

(Measurement)

Hz Collimation

On Hz Collimation is switched ON.
Off Hz Collimation is switched OFF.

If option "Hz Collimation ON" is active, each measured Hz-angle is corrected (depending on V-angle).

For normal operation the Hz-collimation remains switched on

More information on Hz-collimation can be found under "Adjustments".

Auto-OFF

Enable The instrument is switched off after 20

minutes without any action (= no key pressed; V and Hz angle deviation

 \leq ±3' / ±600cc).

Disable The instrument is switched on perma-

nently. Battery discharges quicker.

Sleep Economy mode. Instrument is recov-

ered by any key stroke.

Angle Unit

°'" (degree sexagesimal)

possible angle values: 0° to 359°59'59"

DD (degree decimal)

possible angle values:

0° to 359.999°

gon possible angle values:

0 gon to 399.999 gon

mil possible angle values:

0 to 6399.99mil

The setting of the angle units can be changed at any time.

The actual displayed values are converted according to the selected unit.

Min. Reading

The displayed angle format can be selected in three steps.

For 360°":

0° 00' 01" / 0° 00' 05" / 0° 00' 10"

Always " are indicated.

For 360°:

0.0005° / 0.001° / 0.0001°

· For gon:

0.0005 gon / 0.001 gon / 0.0001 gon

For mil:

0.01 mil / 0.05 mil / 0.10 mil

Distance Unit

meter Meter

ft-in1/16 US-feet-Inch-1/16 inch

US-ft US-feet

INT-ft International feet

Distance Decimals

3 Displays distance with three decimals

4 Displays distance with four decimals

Temperature

°C Degree Celsius °F Degree Fahrenheit

Pressure

mbar Millibar

hPa Hecto Pascal

mmHg Millimeter mercury column

inHg Inch mercury column

Slope Unit

h: v Horizontal: Vertical; for example 5: 1 v: h Vertical: Horizontal; for example 1: 5

% (v/h x 100), for example 20 %

Face I Definition

Defines the telescope face I in relation to the position of the Vdrive

Code Record

Sets if the codeblock is saved before or after the measurement (see chapter "Coding").

Identifier (only for stake out application)

The identifier with up to four characters is added in front of or at the end of the point number of a point to be staked

Pre-/Suffix (only for stake out application)

Prefix Adds the character entered for Identi-

fier in front of the original point number

of the point to be staked.

Suffix Adds the characters entered for Identi-

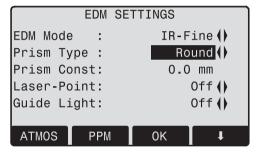
fier at the end of the original point number of the point to be staked.

OFF The staked point is stored with the same

point number as the point to be staked.

EDM Settings

The EDM-settings contain a detailed menu with selection boxes



EDM Mode

With TCR instruments different settings for measurements with reflectorless (RL) and reflector mode (IR) EDM type are available.

Depending on selected measuring mode the selection prism types are different.

IR-Fine	Fine measuring mode for high precision measurements with prisms (2mm + 2 ppm)
IR-Fast	Quick measuring mode with higher measuring speed and reduced accuracy (5mm + 2 ppm)
IR-Track	Continuous distance measuring (5mm + 2 ppm)
IR-Tape	Distance measurement using Retro targets (5mm + 2 ppm)

RL-Standard	For distance measurements without prisms (≤500m: 2mm + 2ppm >500m: 4mm + 2ppm)	
RL-Track	Continuous distance measure- ment without prisms (5mm + 3 ppm)	
RL-Prism	For distance measurements with prisms	

With the RL-EDM each object in the beam is measured (possibly also branches, cars, etc.).

Prism type

Calling the function in the EDM settings.

Leica Prisms	Constants [mm]	
Standard prism (Round) GPH1 + GPR1	0.0	50 04 98 27

Leica Prisms	Constants [mm]	
360° prism GRZ4	+23.1	98
360° Mini prism GRZ101	+30.0	15 15 15 15 100 100 100 100 100 100 100
Miniprism GMP101/102	+17.5	30 20 20 70 70
JPMINI	+34.4	Mini prism
Reflective targets	+34.4	
USER		is set at "Prismconst" (-mm + 34.4; e.g.: mm = 14 -> input = -14 + 34.4 = 20.4)
RL	+34.4	Reflectorless

Prism Constant

Calling the function in the EDM settings.

Entry of a user specific prism constant. Input can only be made in [mm].

Limit value: -999.9 mm to +999.9 mm

Laser Pointer

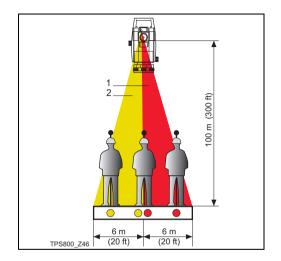
Off: Visible laser beam is switched off.

On: Visible laser beam for visualising the target

point is switched on.

Guide Light

The person at the prism can be guided by the flashing lights directly to the line of sight. The light points are visible up to a distance of 150 meters. This is useful when stake out points.



Flashing red diode

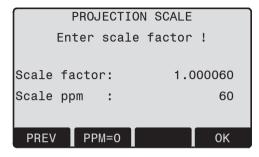
2) Flashing yellow diode

Operat. range: 5 - 150 m (15 -500 ft)

Divergence: 12 m (40 ft) at 100 m (330 ft)

[SCALE]

Scale of projection.



Scale factor:

Entering the scale of projection. Measured values and coordinates are corrected with the PPM parameter.

[PPM=0] Sets default parameters.

[PPM]

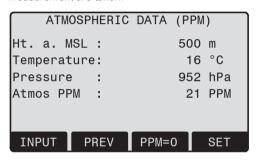
Input of individual scaling parameters.

[ATMOS]

Input of atmospheric parameters.

Atmospheric Parameters (ppm):

Distance measurement is influenced directly by the atmospheric conditions of the air in which distance measurement are taken.



In order to take into consideration these influences distance measurements are corrected using atmospheric correction parameters.

- Ht. a. MSL Height above sea level at instrument location.
- Temperature
 Air temperature at instrument location.
- Pressure
 Air pressure at instrument location.
- Atmos PPM: Calculated and indicated atmospheric PPM.
- Refr. Coeff: Input of refraction coefficient for the atmospheric conditions

Refraction correction

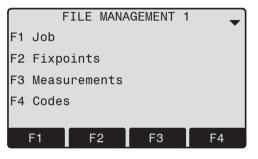
The refraction correction is taken into account in the calculation of the height differences and the horizontal distance

Signal

[SIGNAL] Displays EDM signal strength (reflection strength) in steps of 1%. Permits optimal aiming at distant barely visible targets.

File Management

The File Manager contains all functions for entering, editing and for checking data in the field.



FILE MANAGEMENT 2

F1 Initialize Memory

F2 Memory Statistic

.loh

Jobs are a summary of data of different types, e.g. fixed points, measurements, codes, results, etc.

The job definition consists of the input of job name and user.

Additionally, the system generates time and date at the time of creation.

Job search:

◄ Scrolling through jobs.

[DELETE] Deletes selected job.

[SET] Sets the selected job.

[NEW] Starts new job.

Fixpoints

Valid fixed points contain at least the PtID and the coordinates (E. N) or (H).

[DELETE] Deletes selected fixed point.

[FIND] Starts point search. Exact PtIDs can

be entered or the * wildcard-criteria

used.

[NEW] Opens input for PtID and coordi-

nates.

Measurements

Measurement data available in the internal memory can be searched and displayed or erased.

[FIND] Starts point search dialogue.
[VIEW] Displays all measurements.

Codes

To each code a description and a maximum of 8 attributes with up to 16 characters can be assigned.

INPUT CODELIST

Code : Nr01()

Desc.: border line
Info1: Nr. 123
Info2: 12.54
Info3:

OK PREV

[SAVE] Save data.

[VIEW] Starts search dialogue.
[ATTRIB] Input of attributes.

Initialize Memory

Deletes jobs, single data areas of a job or all data.

[DELETE] Starts deleting process within the

selected area.

[ALL] Deletes all data in memory. All data

will be lost!

Deleting the memory cannot be undone. After confirming the message all data is deleted

permanently.

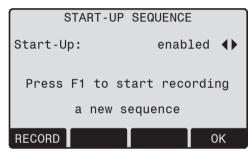
Memory Statistic

Displays job specific memory information such as:

- Number of stored fixpoints.
- Number of recorded data blocks (measured points, codes, etc.).
- Number of free or not defined jobs.

Start-up sequence

Sets the screen the instrument starts in when switched on. E.g. the electronic bubble can be displayed at every start.



[OK] Stores current settings.

[RECORD] Defines the key presses that are executed automatically upon start up.

Procedure:

After confirming the dialogue of notification, the "Meas & Rec" screen is displayed. A maximum of 16 of the next key presses are stored. The sequence is ended with [ESC]. If the start sequence is activated, the stored key presses are executed automatically when the instrument is switched on.

The automatic start sequence has the same effect as pressing the keys manually. Certain instrument settings can not be made in this way. "Relative entries" such as automatically setting "IR-FINE" upon switching on the instrument, are not possible.

Check & Adjust

Determining Line-of-sight error and V-Index

The adjustment contains the determination of the following instrument errors:

- Hz-collimation
- V-index (simultaneously electronic level)

For determining the Hz-collimation or the V-index it is necessary to measure in both telescope positions. The procedure can be started in any telescope position.

The user is guided clearly through the procedure. A wrong determination of instrument error is thus eliminated.

The instruments are adjusted in the factory prior to shipping.

Instrument errors can change with time and temperature.

These errors should be determined before the instrument is used for the first time, before precision surveys, after long periods of transport, before and after long periods of work, and if the temperature changes by more than 10°C (18°F).

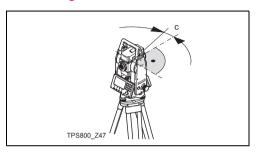


Before determining the instrument errors, level-up the instrument using the electronic bubble. The instrument should be secure and firm, and should be

protected from direct sunlight in order to avoid thermal expansion on one side only.

Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment but at least 15 min should be taken into account.

Line-of-sight error (Hz-collimation)

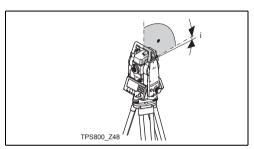


The line-of-sight error or collimation error (C) is the deviation from the perpendicular between the tilting axis and the line of sight.

The effect of the line-of-sight error to the Hz-angle increases with the vertical angle.

For horizontal aimings the error of Hz equals the line-of-sight error.

V-Index (Vertical index error)



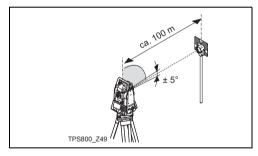
The vertical circle should read exactly 90° (100 gon) when the line of sight is horizontal. Any deviation from this figure is termed vertical index error (i). By determining the vertical index error the electronic level is adjusted automatically.

Procedures and conditions required to correct line-of-sight and height index errors are the same. Thus the procedure will only be described once.

- Hz-collimation
- F2 V-index
- Display adjustment value: Summarizes saved values.

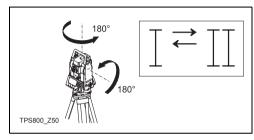
Procedure:

- Level instrument with electronic bubble.
- Aim at a point approximately 100m from the instrument which is within 5° of the horizontal.



- 3. [ALL]: Trigger measurement.
- 4. Change telescope position and aim to the point again.

For checking the horizontal aiming Hz and V are displayed.



- 5. [ALL]: Starts measurement
- 6. Displays the old and new calculated values.

[SET] Sets new adjustment data.

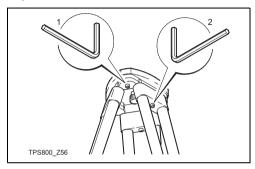
[ESC] Quits program without setting new

adjustment data.

Warnings / Messages

Important Messages	Meaning	Measures
V-Angle not suitable for adjustment (Check V-angle or face)!	Aiming tolerance not met or telescope position/face not changed.	Aim on the target point with an accuracy of min. 5 gon. The target point must be approximately in the horizontal plane. Confirmation of the message required.
Adjustment result out of tolerance. Previous values retained!	Computed values out of tolerance. Previous values retained.	Repeat measurements. Confirmation of the message required.
Hz-Angle out of limit!	Hz-angle in second face/telescope pos. deviates more than 5 gon from the target point.	Aim on the target point with an accuracy of min. 5 gon. Confirmation of the message required.
Measurement Error. Try again.	Measurement error appeared (e.g. instable set up or period between measuring in telescope position I and II too long).	Repeat the process. Confirmation of the message required.

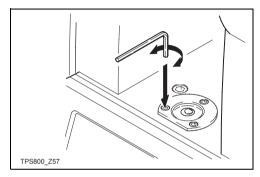
Tripod



The connections between metal and timber components must always be firm and tight.

- Tighten the Allen screws (2) moderately.
- Tighten the articulated joints on the tripod head (1) just enough to keep the tripod legs open when you lift it off the ground.

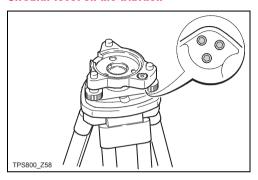
Circular level



Level-up the instrument in advance with the electronic level. The bubble must be centered. If it extends beyond the circle, use the Allen key supplied to center it by turning the adjustment screws.

After adjustment no screw must be loose.

Circular level on the tribrach



Level the instrument and then remove it from the tribrach. If the bubble is not centred, adjust it using the adjusting pin.

Turning the adjustment screws:

- to the left: the bubble approaches the screw
- to the right: the bubble goes away from the screw.

After adjustment no screw must be loose.

Laser plummet

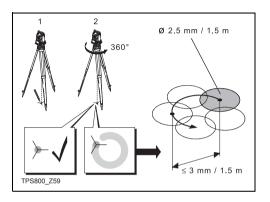
The laser plummet is integrated into the vertical axis of the instrument. Under normal circumstances setting of the laser plummet is not necessary. If an adjustment is necessary due to external influences the instrument has to be returned to any Leica service department.

Checking by turning the instrument by 360°:

- Install the instrument on the tripod approx. 1.5 m above ground and level up.
- Switch on laser plummet and mark the centre of the red spot.
- Turn instrument slowly by 360° and observe the red laser dot.

Inspecting the laser plummet should be carried out on a bright, smooth and horizontal surface (e.g. a sheet of paper).

If the centre of the laser dot makes a clearly circular movement or if the centre of the point is moving away more than 3 mm from the first marked point an adjustment is possibly necessary. Call your nearest Leica service department.



Depending on brightness and surface the size of the laser dot can vary. At a distance of 1.5 m an average value of 2.5 mm diameter must be estimated.

The maximum diameter of the circular movement described by the centre of the laser point should not exceed 3 mm at a distance of 1.5 m.

COMM Parameters

For data transfer between PC and instrument the communication parameters of the serial interface RS232 must be set.

Leica Standard setting

19200 Baud, 8 Databit, No Parity, 1 Stopbit, CR/LF

Baudrate

Data transfer speed 2400, 4800, 9600, 19200 [bits / second]

Databits

- 7 Data transfer is realized with 7 databits. Is set automatically if parity is "Even" or "Odd".
- 8 Data transfer is realized with 8 databits. Is set automatically if parity is "None".

Parity

Even Even parity
Odd Odd parity

None No parity (if data bit is set to 8)

Endmark

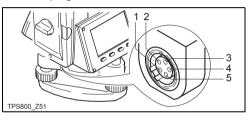
CRLF Carriage return; line feed

CR Carriage return

Stopbits

Fixed setting 1.

Interface plug connections:



- 1) External battery
- 2) Not connected / inactive
- 3) GND
- Data reception (TH_RXD)
 - Data transfer (TH_TXD)

TH ... Theodolite

Data Transfer

With this special function measured data can be transfered via the serial interface to a receiver (e.g. a Laptop). Using this type of transfer the success of the transfer is **not** checked.

Job: Selection of job from which data should

be transfered.

Data: Select the data range to be transferred

(measurements, fixed points)

Format: Select output format. Select Leica-GSI-

format, or your own format created in the "Format Manager" and transfer to

the LGO.

[SEND] Starts the transmission.

Example:

Within the "data" setting "MEASUREMENTS" a data set could be shown as follows:

11....+00000D19 **21**..022+16641826 **22**..022+09635023 **31**..00+00006649 **58**..16+00000344 **81**..00+00003342 **82**..00-00005736 **83**..00+00000091

87 10+00001700

If the receiver is to slow in processing data the data could be lost. With this type of data transfer the instrument is not informed about the performance of the receiver (no protocol).

		` . ,
GSI-ID's		
11	≙	PtID
21		Horizontal direction
22		Vertical angle
25		Orientation
31		Slope distance
32		Horizontal distance
33		Height difference
41-49		Codes and attributes
51		ppm [mm]
58	≙	Prism constants
81-83		(E, N, H) Target point
84-86		(E, N, H) Stand point
87		Reflector height
88		Instrument height

System Info

Displays helpful information and date / time are set.

Battery

Remaining battery power (e.g. 40%).

· Instr.Temp.

Measured instrument temperature.

Date

Displays the current date.

Time

Displays current time.

[DATE] Change date and format.

Format: There are three display formats:

DD.MM.YYYY MM.DD.YYYY YYYY.MM.DDT

Date: Input date

[TIME] Set time.

The software of the instrument is composed of different software packages. Depending on the package, different versions are possible.

Op-System: Operating System

App.-SW: Applications, functions

and menu

Layout: User displays

[SW-Info]

Instrument Protection with PIN

The instrument can be protected by a Personal Identification Number. If the PIN protection is activated, the instrument will always prompt for a PIN code entry after starting up. If a wrong PIN has been typed in five times, a Personal UnblocKing code is required which can be found on the instrument delivery papers. If the PUK code entered is correct then the old PIN code is set to default value "0" and the PIN protection is deactivated.

Procedure:

- 1. [MENU] > [PIN]
- 2. Activate PIN by setting <Use PIN Code>: On.
- Enter your desired personal PIN Code (max. 6 character numeric) and accept with [OK].

Now the instrument is protected against unauthorized use. After switching on the instrument the PIN Code entry is necessary.

If the PIN protection is activated you can furthermore lock the instrument from any application by pressing [FNC] > Lock with PIN without switching off the instrument.

Care and Transport

Transport

Transport in the field

When transporting the equipment in the field, always make sure that you

- either carry the product in its original transport container,
- or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.





TPS800_Z52

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration

Shipping, transport of batteries

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

Field adjustment

After transport inspect the field adjustment parameters given in this user manual before using the product.

Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "Technical Data" for information about temperature limits.

Field adjustment

After long periods of storage inspect the field adjustment parameters given in this user manual before using the product.

Batteries

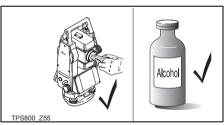
- Refer to "Technical Data" for information about storage temperature range.
- A storage temperature range of 0°C to +20°C / +32°F to +68°F in a dry environment is recommended to minimize self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 10% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.

Cleaning and Drying

Objective, eyepiece and prisms

- · Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol.

Do not use other liquids; these may attack the polymer components.



Fogging of prisms

Reflector prisms that are cooler than the ambient temperature tend to fog. It is not enough simply to wipe them. Keep them for some time inside your jacket or in the vehicle to allow them to adjust to the ambient temperature.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C / 108°F and clean them. Do not repack until everything is completely dry.

Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

Safety Directions

The following directions should enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

Intended Use

Permitted use

- Measuring horizontal and vertical angles.
- Measuring distances.
- Recording measurements.
- Computing by means of software.
- Visualizing the aiming direction and vertical axis.

Adverse use

- Use of the product without instruction.
- Use outside of the intended limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is specifically permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.

- Use of products with obviously recognizable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Aiming directly into the sun.
- Inadequate safeguards at the working site, for example when measuring on roads.
- · Deliberate dazzling of third parties.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.

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Warning

Adverse use can lead to injury, malfunction and damage.

It is the task of the person responsible for the equipment to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed on how to work with it

Limits of Use

Environment

Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.



Danger

Local safety authorities and safety experts must be contacted before working in hazardous areas, or in close proximity to electrical installations or similar situations by the person in charge of the product.

Responsibilities

Manufacturer of the product

Leica Geosystems AG, CH-9435 Heerbrugg, hereinafter referred to as Leica Geosystems, is responsible for supplying the product, including the user manual and original accessories, in a completely safe condition.

Manufacturers of non Leica Geosystems accessories

The manufacturers of non Leica Geosystems accessories for the product are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica Geosystems product.

Person in charge of the product

The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to safety and accident prevention.

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- To inform Leica Geosystems immediately if the product and the application becomes unsafe.

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Warning

The person responsible for the product must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the product and for the safety of the equipment in use.

Hazards of use

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Warning

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with farreaching human, material, financial and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.

♠ Caution

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

Precautions:

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been

subjected to abnormal use and before and after important measurements.

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Danger

Because of the risk of electrocution, it is very dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.







MARNING WARNING

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.

Precautions:

Do not use the product in a thunderstorm.

Caution

Be careful when pointing the product towards

the sun, because the telescope functions as a magnifying glass and can injure your eyes and/or cause damage inside the product.

Precautions:

Do not point the product directly at the sun.

↑ Warning

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

Precautions:

The person responsible for the product must make all users fully aware of the existing dangers.

Warning

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:

Always ensure that the survey site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

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Warning

If computers intended for use indoors are used in the field there is a danger of electric shock.

Precautions:

Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica Geosystems products.



Caution

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people may sustain injury.

Precautions:

When setting-up the product, make sure that the accessories are correctly adapted, fitted, secured,

and locked in position. Avoid subjecting the product to mechanical stress

Caution

During the transport, shipping or disposal of batteries it is possible for inappropriate mechanical influences to constitute a fire hazard

Precautions:

Before shipping the product or disposing of it. discharge the batteries by running the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.

Warning

Using a battery charger not recommended by Leica Geosystems can destroy the batteries. This can cause fire or explosions.

Precautions:

Only use chargers recommended by Leica Geosystems to charge the batteries.

Warning

High mechanical stress, high ambient temperatures or immersion into fluids can cause leackage, fire or explosions of the batteries.

Precautions:

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids

Warning

Short circuited battery terminals can overheat and cause injury or fire, for example by storing or transporting in pockets if battery terminals come in contact with jewelry, keys, metallized paper or other metals

Precautions:

Make sure that the battery terminals do not come into contact with metallic objects.

MARNING

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorized persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.
- Improper disposal of silicone oil may cause environmental contamination.

Precautions:



The product must not be disposed with household waste. Dispose of the product appropriately in accordance with the national regulations in force in your

country. Always prevent access to the product by unauthorized personnel.

Product specific treatment and waste management information can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/treatment or received from your Leica Geosystems dealer.

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Warning

Only Leica Geosystems authorized service workshops are entitled to repair these products.

Laser Classification

General

The following directions (in accordance with the state of the art - international standard IEC 60825-1 (2007-03) and IEC TR 60825-14 (2004-02)) provide instruction and training information to the person responsible for the product and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

Products classified as laser class 1, class 2 and class 3R do not require:

- · laser safety officer involvement,
- · protective clothes and eye wear,
- special warning signs in the laser working area

if used and operated as defined in this user manual due to the low eye hazard level.

Products classified as laser class 2 or class 3R may cause dazzle, flash blindness and afterimages, particularly under low ambient light conditions.

Distancer, Measurements with Reflectors (IR mode)

The EDM module built into this product produces a visible laser beam which emerges from the telescope objective.

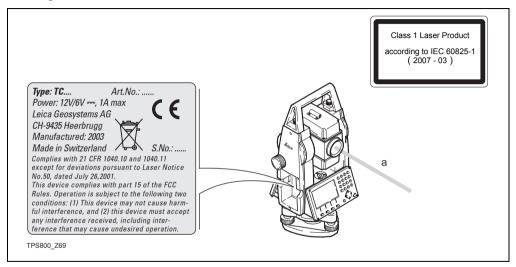
The laser product described in this section is classified as laser class 1 in accordance with:

 IEC 60825-1 (2007-03): "Safety of laser products"

Class 1 laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this user manual.

Description	Value
Maximum average radiant power	0.33 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm

Labelling



a) Laser beam

Distancer, Measurements without Reflectors (RL mode)

The EDM module built into the product produces a visible laser beam which emerges from the telescope objective.

The laser product described in this section, is classified as laser class 3R in accordance with:

 IEC 60825-1 (2007-03): "Safety of laser products"

Class 3R laser products:

Direct intrabeam viewing may be hazardous (low-level eye hazard), in particular for deliberate ocular exposure. The risk of injury for laser class 3R products is limited because of:

- unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
- inherent safety margin in the maximum permissible exposure to laser radiation (MPE).

 natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value (R400/R1000)
Maximum average radiant power	5.00 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25s	80 m / 262 ft



Warning

From a safety perspective class 3R laser products should be treated as potentially hazardous.

Precautions:

Prevent direct eye exposure to the beam. Do not direct the beam at other people.

Marning

Potential hazards are not only related to direct

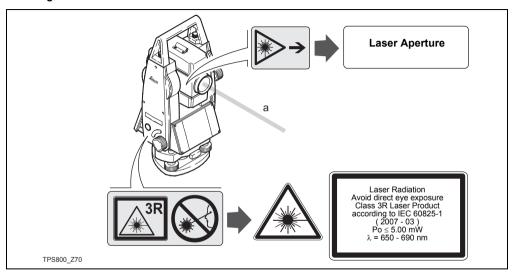
beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces etc.

Precautions:

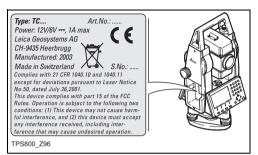
Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections

Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on, in laser pointer or distance measurement mode. Aiming at prisms is only permitted when looking through the telescope.

Labelling



a) Laser beam



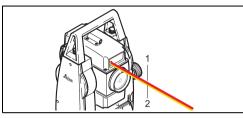
Electronic Guide Light EGL

The integrated Electronic Guide Light produces a visible LED beam from the front side of the telescope. Depending on the type of telescope the EGL may be designed differently.

The product described in this section, is excluded from the scope of IEC 60825-1 (2007-03): "Safety of laser products".

The product described in this section, is classified as exempt group in accordance with IEC 62471 (2006-07) and does not pose any hazard provided that the product is used and maintained in accordance with this user manual.

Labelling



- LED beam red
- 2) LED beam yellow

Laser plummet

The laser plummet built into the product produces a visible red laser beam which emerges from the bottom of the product.

The laser product described in this section, is classified as laser class 2 in accordance with:

 IEC 60825-1 (2007-03): "Safety of laser products".

Class 2 laser products:

These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam.

Description	Value
Maximum average radiant power	1.00 mW
Pulse duration	C.W.
Pulse repetition frequency	C.W.
Wavelength	620 nm - 690 nm

Warning
From a safe

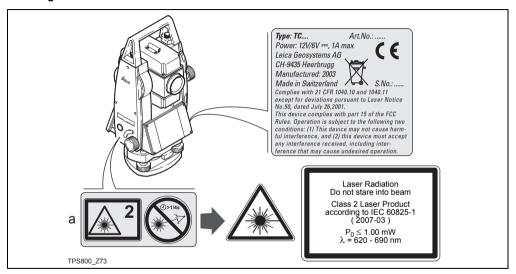
From a safety perspective class 2 laser prod-

ucts are not inherently safe for the eyes.

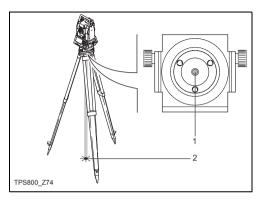
Precautions:

Avoid staring into the beam or pointing the beam at other people.

Labelling



a) Will be replaced by a Class 3R warning label if applicable



- 1) Exit for laser beam
- Laser beam

Electromagnetic Compatibility EMC

The term Electromagnetic Compatibility is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

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∖ Warning

Electromagnetic radiation can cause disturbances in other equipment.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.



Caution

There is a risk that disturbances may be caused in other equipment if the product is used in conjunction with accessories from other manufac-

turers, for example field computers, personal computers, two-way radios, non-standard cables or external batteries.

Precautions:

Use only the equipment and accessories recommended by Leica Geosystems. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers and two-way radios, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

Caution

Disturbances caused by electromagnetic radiation can result in erroneous measurements. Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by very intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators

Precautions:

Check the plausibility of results obtained under these conditions.

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Warning

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.

Precautions:

While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

FCC Statement, Applicable in U.S.

Marning (

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

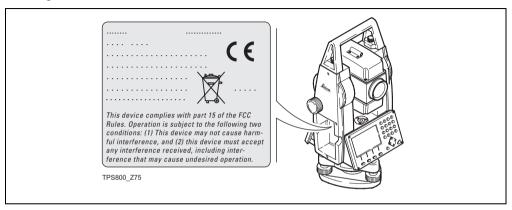
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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Warning

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Labelling:



Technical Data

Telescope

•	Transit fully	
•	Magnification:	30x
•	Image:	upright
•	Free Objective aperture	:40 mm
•	Focusing:	1.7 m (5.6 ft) to infinity
•	Field of view:	1°30' (1.7gon)
	Field of view at 100m	2.6 m

Angle measurement

- absolute, continuous,
- · Updates each 0.3 seconds
- Units selectable 360° sexagesimal, 400gon, 360° decimal, 6400 mil. V%, ±V

Accuracy standard deviation Hz, V

•	Display resolution	
	gon	0.0001
	360d	0.0001
	360s	1"
	mil	0.01

Level sensitivity

Circular level: 6'/2 mm

Compensator

- · 2-axis-oil compensator
- Setting range±4' (0.07 gon)
- Setting accuracy
 0.5" (0.2 mgon)

 TC(R)803
 1" (0.3 mgon)

 TC(R)805
 1.5" (0.5 mgon)

Laser plummet

- Location:in vertical axis of instrument
 Type:visible red laser class 2

(2 sigma) at 1.5 m instrument height	Dimensions Instrument:
Diameter of laser point:2.5 mm / 1.5 m	Height (including tribrach and carrying handle):
Keyboard . Tilt angle:	- with tribrach GDF111
	Power supply • Battery GEB111: NiMh Voltage: 6V Capacity: 2100 mAh • Battery GEB121: NiMh Voltage: 6V Capacity: 4200 mAh

External supply
(via serial interface)
If an external cable is used
then the voltage range must lie
between 11.5V and 14V

No. of measurements (angle + distance)

- GEB111: approx. 4000
- GEB121: approx. 9000

Temperature range:

Туре	Operating temperature	Storage temperature
TPS800	-20°C to +50°C / -4°F to +122°F	-40°C to +70°C / -40°F to +158°F
Battery internal	-20°C to +50°C / -4°F to +131°F	-40°C to +55°C / -40°F to +131°F

Automatic corrections

•	Line-of-sight error	Yes
•	Vertical-index error	Yes
•	Earth curvature	Yes
•	Refraction	Yes
_	Tilt correction	Voc

Recording

•	RS232 interface	Yes
•	Internal Memory	Yes
	Total capacity	768 KB
	≈ 12500 ı	measurements or
		≈ 18000 fixpoints

Distance measurement (IR: Reflector mode):

Principle: Phase measurement Type: Coaxial, visible red laser

Class 1

Carrier wave:

658 nm

Measuring system: System analyser basis

100 MHz - 150 MHz

EDM measuring program	Accuracy* (Standard deviation acc. to ISO 17123-4)	Time per measure- ment
IR_Fine	2 mm + 2 ppm	typ. 2.4 s
IR_Fast	5 mm + 2 ppm	typ. 0.8 s
Tracking	5 mm + 2 ppm	typ. < 0.15 s
IR Tape	5 mm + 2 ppm	typ. 2.4 s

^{*} Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.

	Range: (normal and rapid measurement)					
	Standard prism	3 prisms (GPH3)	360° reflector	Tape 60mm x 60mm	Mini prism	360° Mini prism
1	1800 m	2300 m	800 m	150 m	450 m	450 m
	(6000 ft)	(7500 ft)	(2600 ft)	(500 ft)	(1500 ft)	(1500 ft)
2	3000 m	4500 m	1500 m	250 m	800 m	800 m
	(10000 ft)	(14700 ft)	(5000 ft)	(800 ft)	(2600 ft)	(2600 ft)
3	3500 m	5400 m	2000 m	250 m	1000 m	1000 m
	(12000 ft)	(17700 ft)	(7000 ft)	(800 ft)	(3500 ft)	(3500 ft)

- Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
- Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
- Overcast, no haze, visibility about 40km; no heat shimmer

Distance measurement (RL: Reflectorless mode)

Measuring system: System analyser basis

100 MHz - 150 MHz

Type: Coaxial, visible red laser

Class 3R

Carrier wave: 658 nm

Distance measurement RL-Prism (with reflector)

- Range of measurement:from 1000m up
- Display unambiguous: to 12 km

Ultra&Power: Range (with reflector)			
Atmospheric conditions	Standard- prism	Reflector tape 60 x 60	
1	2200 m (7200 ft)	600 m (2000 ft)	
2	7500 m (24600 ft)	1000 m (3300 ft)	
3	> 10000 m (33000 ft)	1300 m (4200 ft)	

- Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
- 2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
- Overcast, no haze, visibility about 40km; no heat shimmer

Distance measurement (without reflector)

· Range of measurement:

Power	1.5 m to >400 m
Ultra	1.5 m to >1000 m

- Display unambiguous:....to 760 m
- Prism constant (additive constant):.+ 34.4 mm

Power: Range (without reflector)			
Atmospheric conditions	No reflector (white target)*	No reflector (grey, albedo 0.25)	
4	200 m (660 ft)	100 m (330 ft)	
5	300 m (990 ft)	150 m (430 ft)	
6	>400 m (>1310 ft)	>200 m (>660 ft)	

Ultra: Range (without reflector)				
Atmospheric conditions	No reflector (white target)*	No reflector (grey, albedo 0.25)		
4	600 m (1970 ft)	300 m (990 ft)		
5	800 m (2630 ft)	400 m (1310 ft)		
6	>1000 m (>3280 ft)	>500 m (>1640 ft)		

- Kodak Grey Card used with exposure meter for reflected light
- 4) Object in strong sunlight, severe heat shimmer
- 5) Object in shade, or sky overcast
- 6) Day, night and twilight

EDM measuring program	Accuracy	Time per measurement
Standard**		
0 - 500 m	2 mm + 2 ppm	typ. 3 - 6 s max. 12 s
> 500 m	4 mm + 2 ppm	max. 12 s
Tracking***	5 mm + 3 ppm	typ. 0.25 s

^{**} Standard deviation acc. to ISO 17123-4; beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.

^{***} Accuracy and measure time depend on atmospheric conditions, target object and observation situation.

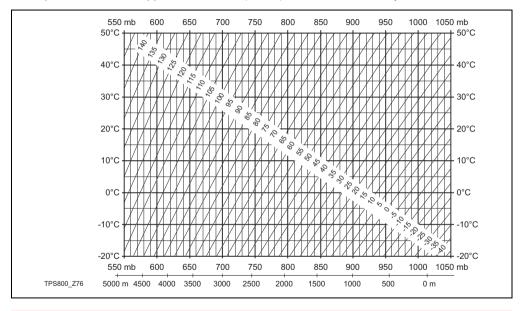
Atmospheric correction

The distance displayed is correct only if the scale correction in ppm (mm/km) which has been entered corresponds to the atmospheric conditions prevailing at the time of the measurement.

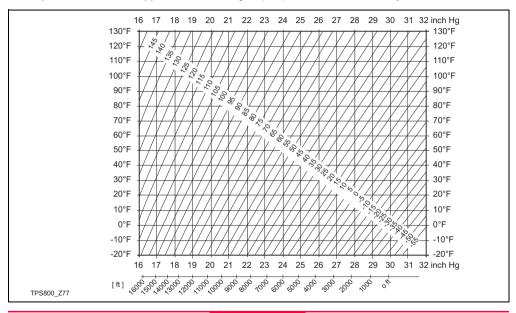
The atmospheric correction takes air pressure and air temperature into account.

For utmost precision in distance measurements, atmospheric correction must be determined with 1 ppm accuracy, air temperature to 1°C and air pressure to 3mb accuracy.

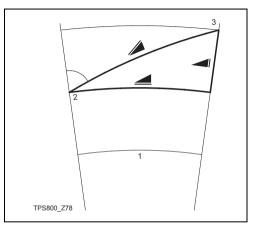
Atmospheric correction in ppm with °C, mb, H (metres) at 60% relative humidity



Atmospheric correction in ppm with °F, inch Hg, H (feet) at 60% relative humidity



Reduction formulae



Height measurement

- 1) Mean sea level
- 2) Instrument
- 3) Reflector

The instrument calculates slope distance, horizontal distance and height difference in accordance with the following formula. Earth curvature and mean refraction coefficient (k = 0.13) are taken into account automatically. The calculated horizontal distance relates to the station height, not to the reflector height.

$$= D_0 \cdot (1 + ppm \cdot 10^{-6}) + mm$$

= displayed slope distance [m]

D₀ = uncorrected distance [m]

ppm = scale correction [mm/km]

mm = prism constant [mm]

$$| = X + B * Y^2$$

= horizontal distance [m]

= height difference [m]

$$\zeta$$
 = vertical-circle reading

A =
$$\frac{1 - k/2}{R}$$
 = $1.47 \cdot 10^{-7}$ [m⁻¹]

B =
$$\frac{1-k}{2R}$$
 = 6.83 \cdot 10⁻⁸ [m⁻¹]

$$k = 0.13$$

$$R = 6.37 \cdot 10^6 \text{ m}$$

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- when it has to be right

