TPS700 Performance Series

User Manual TC(R)702/703/705

Version 1.1
English

Leica
MADE TO MEASURE

Electronical Total Station

Congratulations on your purchase of a new Leica Geosystems Total Station.

This manual contains important safety directions (refer to section *"Safety directions"*) as well as instructions for setting up the instrument and operating it. Please read this User Manual carefully to achieve maximum efficiency from your instrument.

Product Identification

The type and the serial number of your instrument are indicated on the label inside the battery compartment. Write the type and serial number of your instrument in the space provided below, and always quote this information when you need to contact your agency or service workshop.

Type: _____ Serial no.: _____

Symbols Used in this Manual

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

DANGER:

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

WARNING:

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

CAUTION:

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

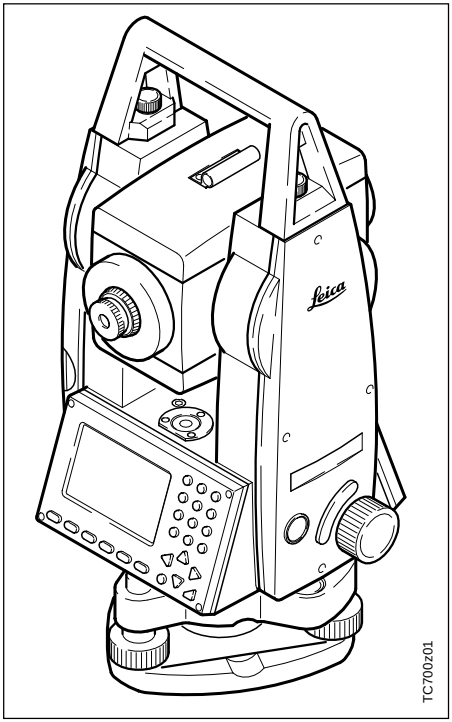
Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Contents

The Leica Geosystems TC(R)702/ 703/705 is a high quality electronic total station designed for the construction site.
Its innovative technology makes daily surveying jobs easier.

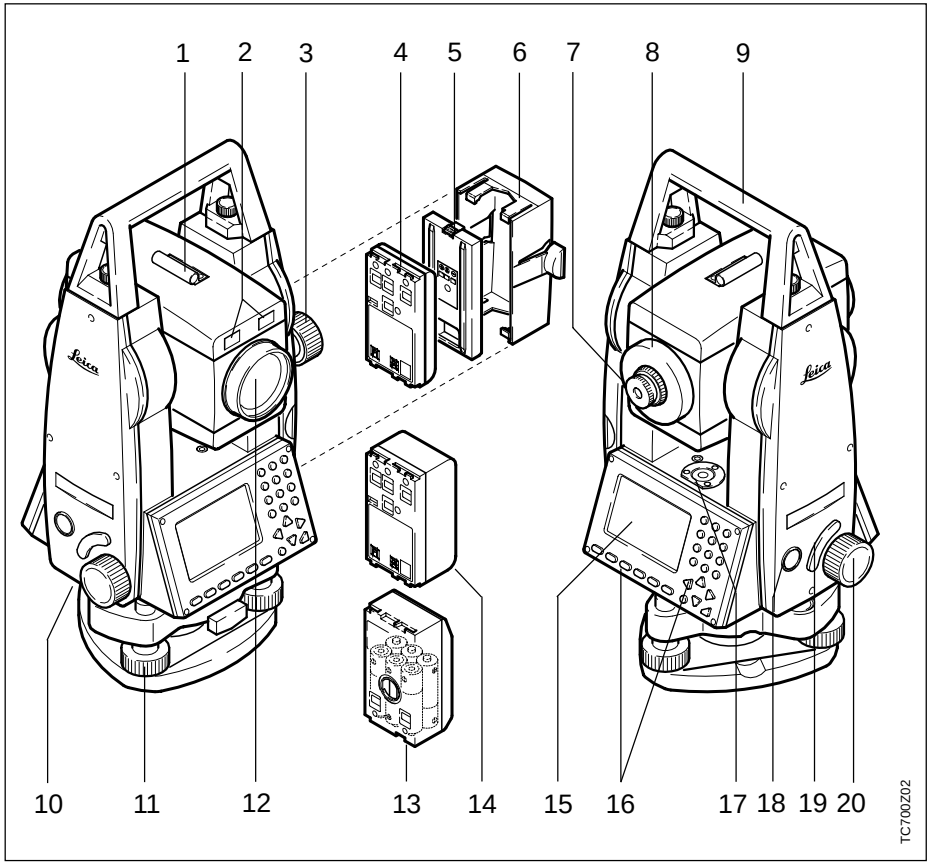
The instrument is ideally suited for simple construction surveys and setting out tasks.

The operation of the instrument's functions can be learned easily in a short space of time.

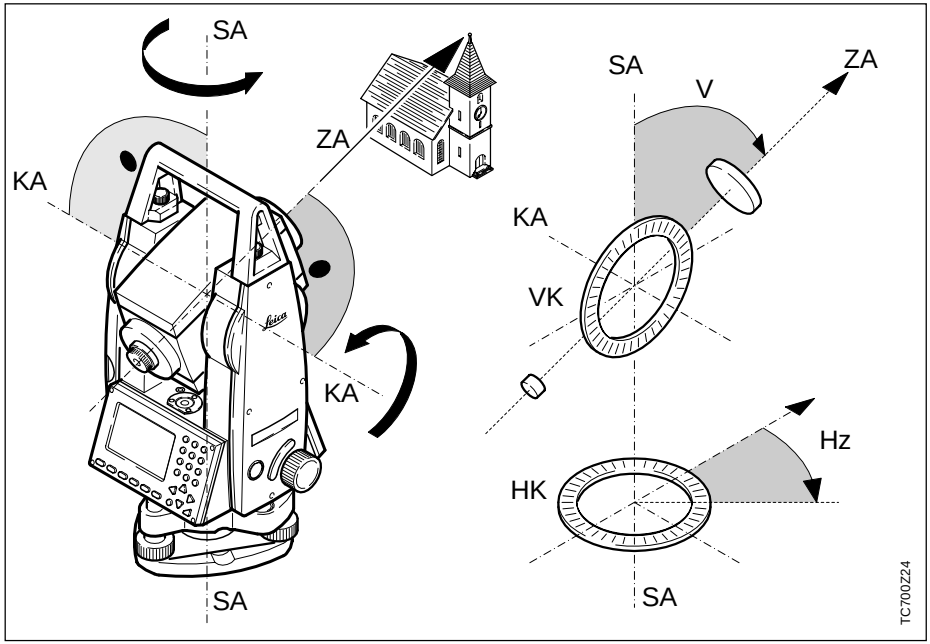


Special Features

- Reflectorless measuring EDM
- Large display, alphanumeric keypad
- Endless drive
- Laser plummet
- Two axis compensator
- Camcorder batteries
- Light, slender construction
- On-board software and data memory



1 Optical sight
2 Integrated guide light EGL (optional)
3 Vertical drive
4 Battery GEB111 (optional)
5 Battery spacer for GEB111
6 Battery holder for GEB111/ GEB121/GAD39
7 Eyepiece; focussing graticule
8 Telescope focusing ring
9 Detachable carrying handle with mounting screws
10 Serial interface RS232
11 Foot screws
12 Objective with integrated **E**lectro-optic **D**istance **M**eter (EDM)
13 Battery adapter GAD39 for 6 single cells (optional)
14 Battery GEB121 (optional)
15 Display
16 Keypad
17 Circular level
18 On/Off key
19 Trigger key
20 Horizontal drive



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 total station.

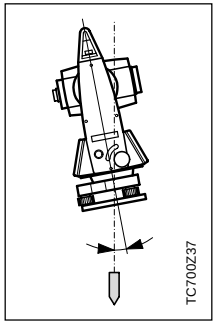
KA = Tilting axis
Horizontal rotation axis of the telescope (Trunion axis).

V = Vertical angle / zenith angle

VK = Vertical circle
With graduated scale for reading the V-angle.

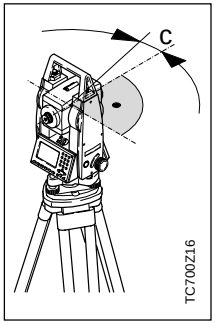
Hz = Horizontal angle

HK = Horizontal circle
With graduated scale for reading the Hz-angle.



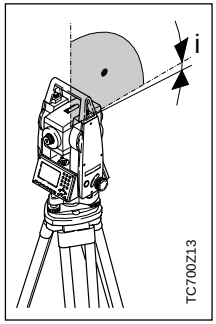
Standing axis nclination

Angle between plumb line and standing axis.



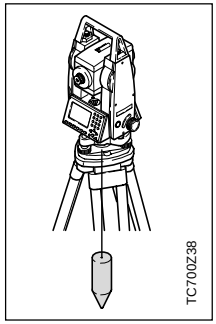
Line-of-sight error (Hz-collimation)

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



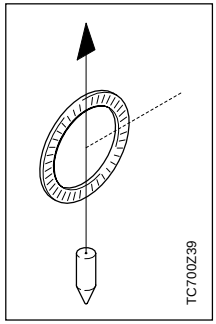
V-index (Vertical index error)

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



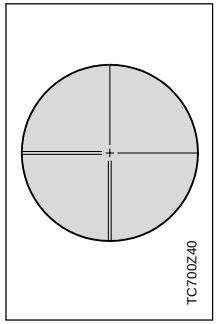
Plumb line / Compensator

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



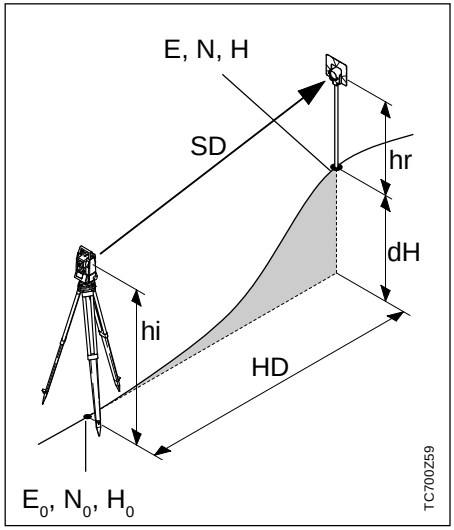
Zenith

Point on the plumb line above the observer.



Reticle

Glass plate within the telescope engraved with the cross hair lines.



SD	Indicated meteorological corrected slope distance between instrument tilting axis and centre of prism/laser spot (TCR)
HD	Indicated meteorological corrected horizontal distance
dH	Height difference between station and target point
hr	Reflector height above ground
hi	Instrument height above ground
E0	Station coordinate (Easting)
N0	Station coordinate (Northing)
H0	Station height
E	Easting of target point
N	Northing of target point
H	Height of target point

Area of Applicability

This User Manual is valid for all instruments in the TPS700 Performance Series.

TC Instruments are equipped with an invisible infrared EDM. The TCR Instruments are also equipped with a visible red laser for reflectorless measuring.

Sections only valid for TCR instruments are marked accordingly.

The software package Leica SurveyOffice is used to exchange data between the TPS700 and the PC. It contains several auxiliary programs to support your use of the instrument.

Installation on the PC
The installation program for the Leica SurveyOffice can be found on the CD-ROM supplied. Please note that the Leica SurveyOffice can only be installed under the operating systems MS Windows 95, Windows 98 and Windows NT4.0.

To install, start the program "**setup.exe**" in the directory **\SOffice\"Language"\Disk1** on the CD-ROM and follow the installation program prompts. When using TPS700 instruments, select the option "Standard" or "User defined" and also select TPS700 Tools.

Program content

After successful installation the following programs appear:

- **Data Exchange Manager**:
  For data exchange of coordinates, measurements, codelists and output formats between instrument and PC.
- **Codelist Manager**:
  For creating and processing of codelists.
- **Software Upload**:
  For loading/deleting system software, application programs and EDM-software as well as system/application texts.

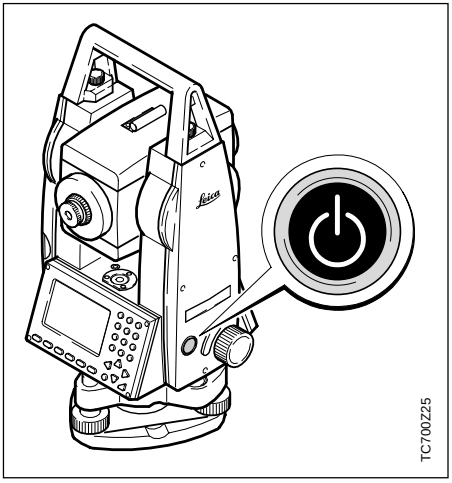

Before the Software Upload, always insert a charged battery into the instrument.

- **Coordinate Editor**:
  Import/Export, creation and processing of co-ordinate files.
- **Settings**:
  General settings for all SurveyOffice applications (e.g. interface parameter).
- **External Tools**:
  Access to Format Manager (user-defined output formats) and TPS Setup (user-defined basic settings). Additional software packages can be called directly from here.
- **Exit**:
  Quits the SurveyOffice.
- **Register**:
  Register type of instrument and additional objects (e.g. formats) or programs.


For more information about Leica SurveyOffice, please refer to the comprehensive *Online Help*.

Keypad

The **On/Off key** is located on the side cover of the TC(R)702/703/705 to avoid inadvertently switching the instrument off.



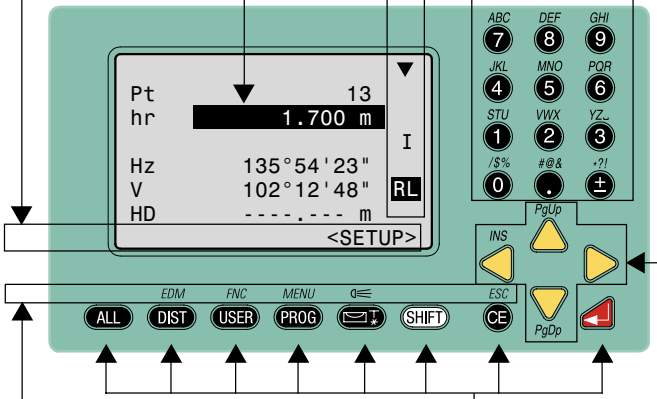
All displays shown are examples. Local software versions may differ from the basic version.

Buttons

Symbols

Focus bar
Currently processed field or button

Data entry keys
Entry of numbers, letters, and special characters



Navigation keys
The navigation keys have different functions depending on the application.

Fixed keys - 2nd level
Functions on second key level. Can be activated by pressing SHIFT and the corresponding fixed keys.

Fixed keys
Keys with permanently defined functions (e.g. ENTER, SHIFT).

Fixed keys

Measure distance and angles; record measured values.

Measure distance and angles; display measured values without recording.

Key, programmable with function from the FNC menu.

Starts application programs.


Switches the electronic level on/off. The laser plummet is automatically switched on with the electronic level.

Switches to the second key level (EDM, FNC, MENU, illumination, ESC) and switching between alphanumeric/numeric character set.

Deletes character/field; stops EDM.


Confirms an entry; continue to the next field.

Key combinations

EDM -> 

+ 

Access to distance measuring functions and distance corrections (ppm).

FNC -> 

+ 

Quick-access to measurement-supporting functions.

MENU -> 

+ 

Access to Data Manager, instrument settings and adjustments.

 -> 

+ 

Switches the display illumination on and off and activates the display heating if the instrument temperature is less than -5°C).

ESC -> 

+ 

Quit a dialog or the edit mode with activation of the "previous" value. Return to next higher level.

PgUP-> 

+ 

"Page Up" = scrolling upwards if several displays are available in one dialog.

PgDN-> 

+ 

"Page Down" = scrolling downwards if several displays are available in one dialog.

Navigation keys

The navigation keys can take on a range of functions depending on the context in which they are used:

- Control of the focus
- Control of the cursor
- Page through a selection
- Selection and confirmation of parameters

Data entry keys

Entry of numbers and letters/special characters.

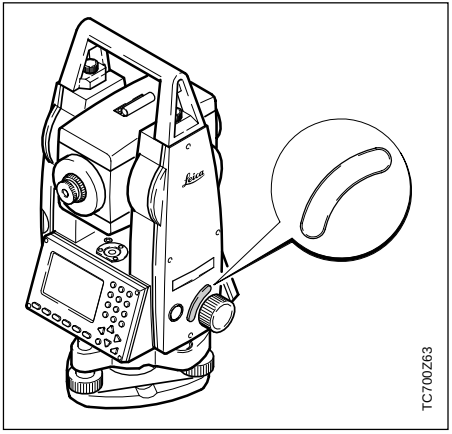
Entry of the decimal point and special characters.

Change between positive/ negative sign; entry of special characters.

When a data entry key is pressed, the corresponding number is called. In alphanumeric data entry mode, each key is used for the entry of 3 letters and a digit.
If the key is repeatedly pressed quickly, the next character (letter, special character, number) is called. If the key is not pressed again within approximately 1 second, the character is applied as an entry.

The exact function of these keys will be covered in more detail at the appropriate points in the *User Manual*.

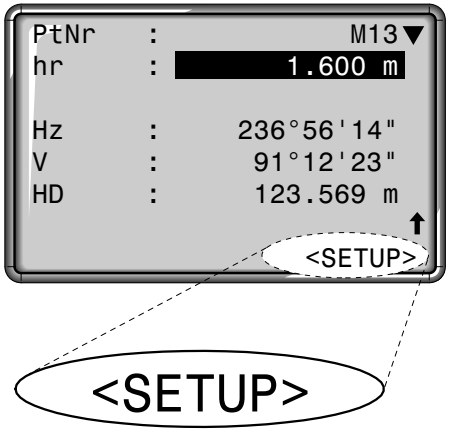
Trigger Key



Three settings are possible for the trigger key. It can be assigned the function **ALL** or **DIST**, or it can be **disabled**.

The key can be activated in the configuration menu (see section "*Menu/System settings*").

Buttons



Buttons are a range of commands appearing in the bottom line of the display. They can be selected with the navigation keys and activated with . Other buttons may become available depending on the active function or application.

Important buttons :

SET	Sets displayed value and leaves dialog.
OK	Accepts message displayed or dialog and leaves dialog.
EXIT	Leaves a function/ application or menu prematurely. Changed values are not set.
PREV	Back to last active dialog.

Menu/application-specific buttons are explained in the relevant sections.

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

◀ ▶ A double arrow indicates selection fields.

The desired parameter can be selected using the navigation keys  .
Selection fields can be left with  as well as with  or  .

▲,▼,▲▼ Indicates that several pages are available which can be selected with  and  .

I, II Indicates telescope face I or II *(refer also to "System settings").*

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

 Compensator status: Compensator switched on, 1 axis or 2 axes.

 Compensator switched off.

Status symbol "EDM type"

IR **Infrared EDM** (invisible) for measuring with prisms and reflective targets.

RL **Reflectorless EDM** (visible) for measuring with 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 "Shift"

  was pressed or switching between alphanumeric /α numeric N character set.

SHIFT + PROG

```
        MENU
QUICK SETTINGS
ALL SETTINGS
DATA MANAGER
CALIBRATION
SYSTEM INFO

<EXIT>
```

Opening an menu item

1 .. 5 Shortcut by pressing the corresponding data entry key.

or

Menu selection.

Execute.

<EXIT> Leave the menu. Back to "Measure".

```
  QUICK SETTINGS

Contrast    :      50% ◀ ▶
Tilt Corr   :    1-Axis ◀ ▶
USER-Key    :  IR<=>RL ◀ ▶
TRIGGER-Key:       ALL ◀ ▶
```

```
    SETTINGS

1 SYSTEM SETTING
2 ANGLE SETTING
3 UNIT SETTING
4 EDM SETTING
5 COMMUNICATION
6 DATE/TIME
```

```
    DATA MANAGER

1 VIEW / EDIT DATA
2 INITIALIZE MEMORY
3 DATA DOWNLOAD
4 MEMORY STATISTIC
```

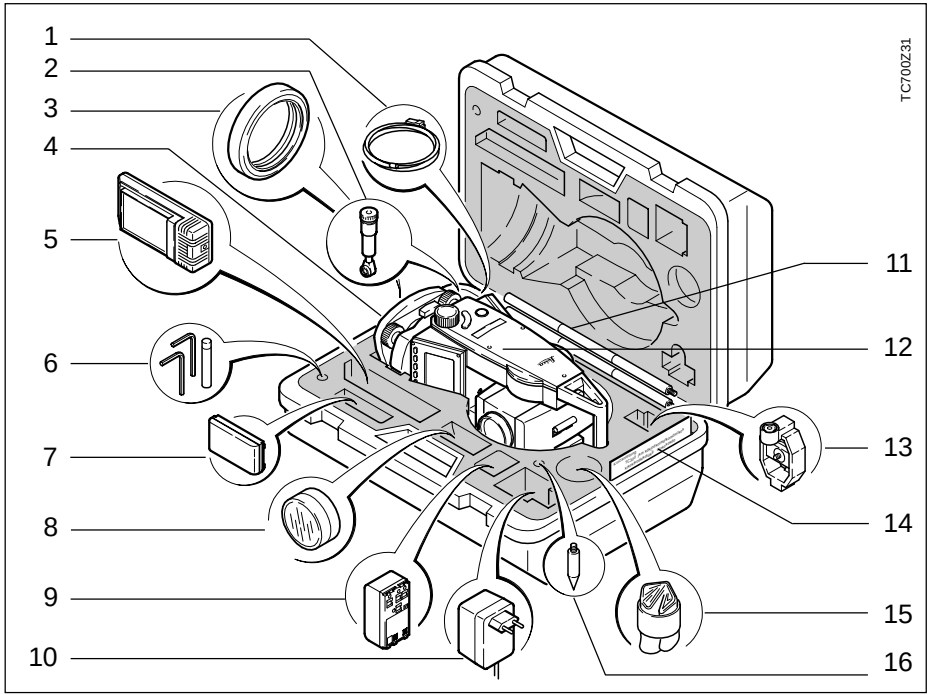
```
      CALIBRATION

1 HZ-COLLIMATION
2 V-INDEX
```

```
  SYSTEM INFO
Free Jobs      :         3
Tilt Corr.     :       Off
USER-Key       :       REC
TRIGGER-Key    :      DIST
Battery        :       50%
Instr. Temp    :      21°C
DSP Heater     :       Off
   Calibration Values
Hz-Coll.       :   -0.015g
V-Index        :   +0.008g
                       <SW>
```

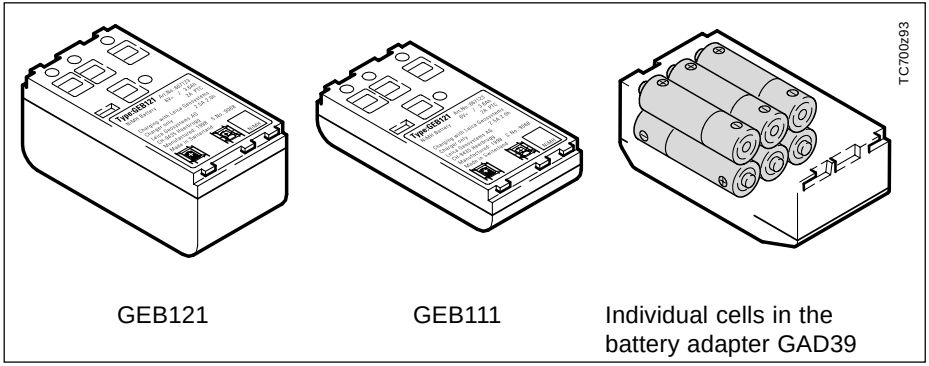
Depending on the user interface the sequence and arrangement of menu items may be different.

Unpacking

Remove TC(R)702/703/705 from transport case and check for completeness:



1 Data cable Lemo0/RS232 (optional)
2 Zenith eyepiece or eyepiece for steep angles (optional)
3 Counterweight for eyepiece for steep angles (optional)
4 Removable tribrach GDF111/ GDF121(optional)
5 Battery charger and accessories (optional)
6 Allen key (2x)
Adjusting pins (2x)
7 Battery GEB111 (optional)
8 Sun filter (optional)
9 Battery GEB121 (optional)
10 Mains adapter for battery charger (optional)
11 Mini prism rod (optional)
12 Total station
13 Mini prism + holder (optional)
14 Mini target plate (only for TCR instruments)
15 Protective cover / Lens hood
16 Tip for mini prism (optional)



GEB121 GEB111 Individual cells in the battery adapter GAD39

Only use batteries, battery chargers and accessories recommended by Leica Geosystems.

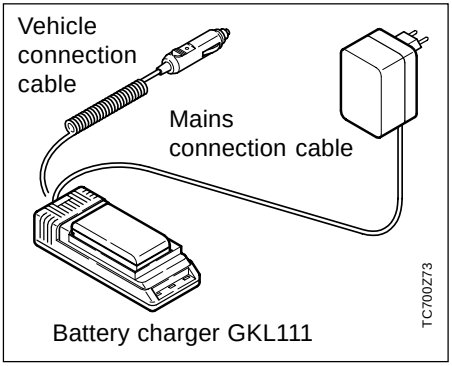
Your Leica Geosystems instrument is operated with rechargable plug-in batteries. The Pro battery (GEB121) or the Basic battery (GEB111) is recommended for TPS700 Performance Series instruments. As an option, six individual cells can be used with the appropriate battery adapter GAD39.

Six individual cells produce a voltage of 9 Volts. The battery indicator in the display is designed for a voltage of 6 Volts (internal battery GEB111/ GEB121) and a voltage of 12 Volts (external battery). For this reason the charge state of individual cells is not indicated correctly. The battery adapter with individual cells should therefore be used as a backup. The advantage of individual cells is the low self-discharge rate - even over longer periods of time.

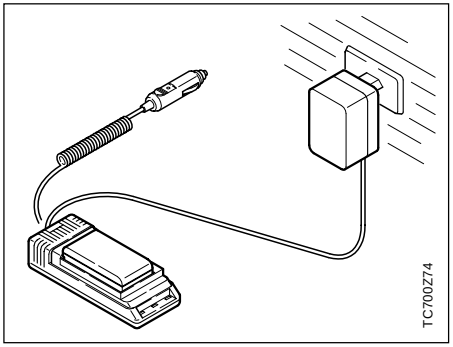
The battery chargers GKL111 or GKL122 are used to charge the batteries. Please refer to the corresponding battery charger user manual for more information.

In order to fully extend battery capacity it is absolutely necessary to carry out 3 to 5 complete charging/discharging cycles with the new GEB111/ GEB121 batteries.

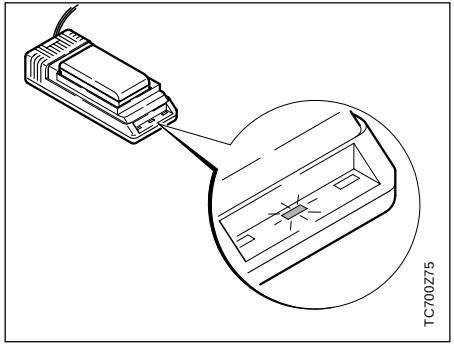
Battery Charger GKL111



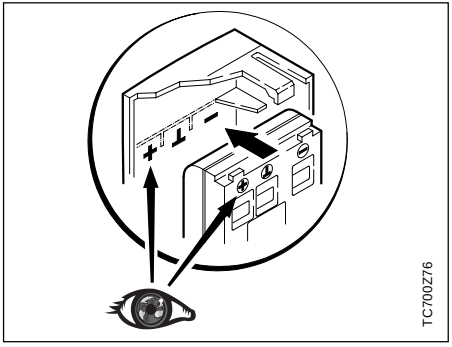
Using the Basic battery charger GLK111 one Basic / Pro battery can be charged. Charging can be carried out via a mains socket using the power supply unit or via the vehicle connection cable inside vehicles (12V or 24V).



Connect battery charger GKL111 to mains or inside the vehicle.
Insert battery GEB111/GEB121 into the charger so that the metal contacts of the charger and of the battery connect and the battery is locked in place.
The continuously lit green lamp indicates the charging process.

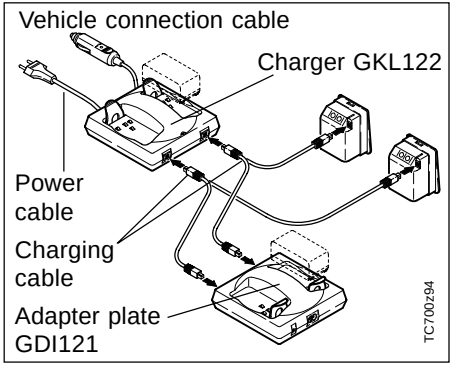


As soon as the green lamp is flashing the battery is charged and can be removed from the charger. Charging time is 1 to 2 hours.
Insert charged battery into the battery holder of your instrument. Pay attention to the correct polarity (corresponding to the diagram in the battery cover).

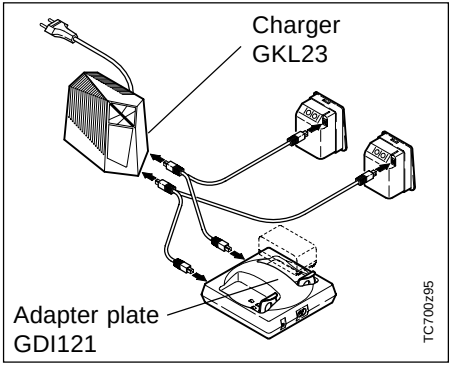


Slide battery holder with inserted battery into the instrument. Now the instrument is ready for measuring and can be switched on.

Find more information in section *"Inserting / Replacing Battery"* or the instruction leaflet for the charger GKL111.



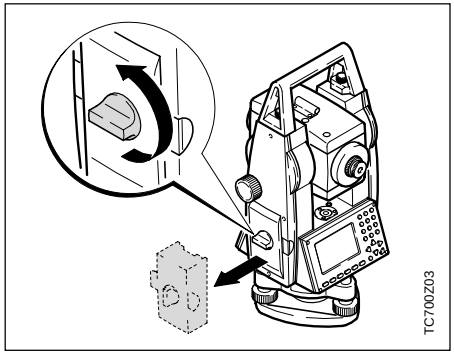
The Professional charger (GKL122) will charge up to four batteries, either from a 220V or 110V mains using the mains plug or from the 12V or 24V source provided by the cigarette lighter in a vehicle. At any one time, either two Pro / Basic batteries and two batteries with 5-pin sockets can be charged or, by using the adapter plate (GDI121), four Pro / Basic batteries.



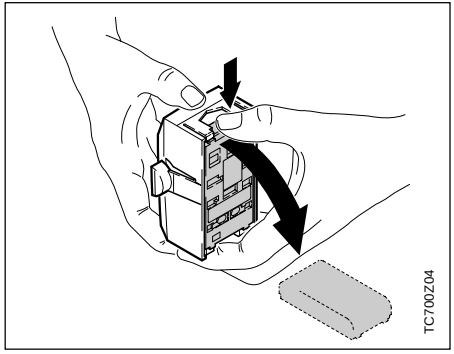
The adapter plate can be connected to the Pro charger (GKL122) or to the GKL23 charger, and enables two Pro / Basic batteries to be charged simultaneously.

For instructions on how to use the charger, refer to the user manual on the charger.

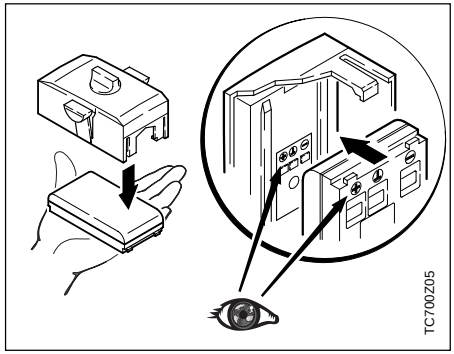
The battery chargers are intended for indoor use only. Use a battery charger in a dry room only, never outdoors. Charge batteries only at an ambient temperature between 10°C and 30°C (50°F to 86°F). We recommend a temperature of 0°C to +20°C (32°F to 68°F) for storing the batteries.



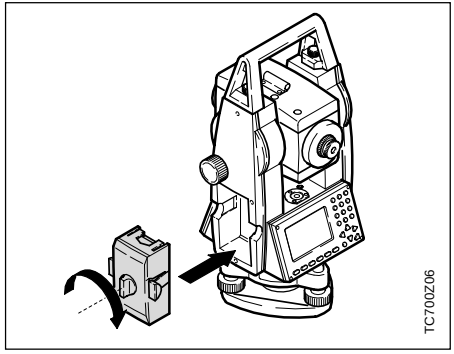
1. Remove battery holder.



2. Remove battery and replace.



3. Insert battery into battery holder.



4. Insert battery holder into instrument.

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

- For type of battery see section *"Technical Data".*

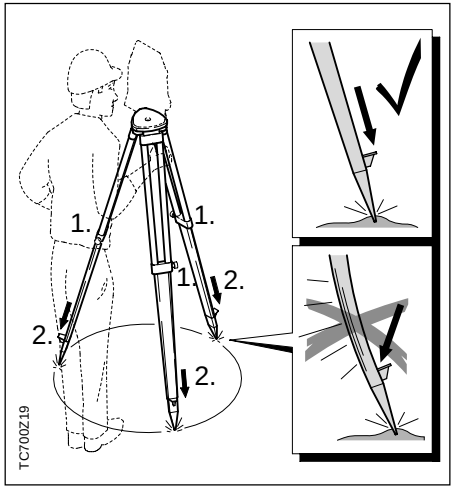
If the battery GEB121 or the battery adapter GAD39 for six individual cells is used, the spacer for the GEB111 must be removed from the battery holder prior to inserting the battery.

To comply with electromagnetic compatibility (EMC) requirements when supplying the TC(R)702/703/705 instruments from an external power supply, it is necessary to fit a so-called ferrite core to the cable used to connect the instrument to the external power supply.

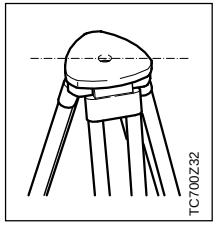
The Lemo connector with the ferrite core must always be at the instrument end of the lead.

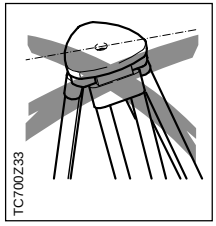
The cables supplied by Leica Geosystems are fitted with a ferrite core as standard. If you intend to use older cables that are not fitted with a ferrite core, the cables must be fitted with a ferrite core prior to use.
You can order ferrite cores from your Leica Geosystems representative (spare part number for the ferrite core: 703707).

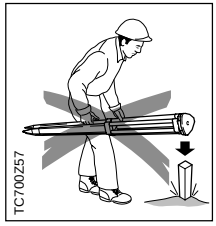
To fit the core, open it and clip it onto the cable close to the Lemo connector before the cable is used with a TC(R)702/703/705 instrument (approx. 2 cm from the Lemo connector).

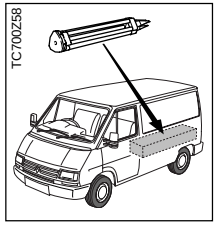


1. Loosen the clamping screws on the tripod legs, pull out to the required length and tighten the screws.
2. In order to guarantee a firm foothold sufficiently press the tripod legs into the ground.
   When pressing the legs into the ground note that the force must be applied along the legs.







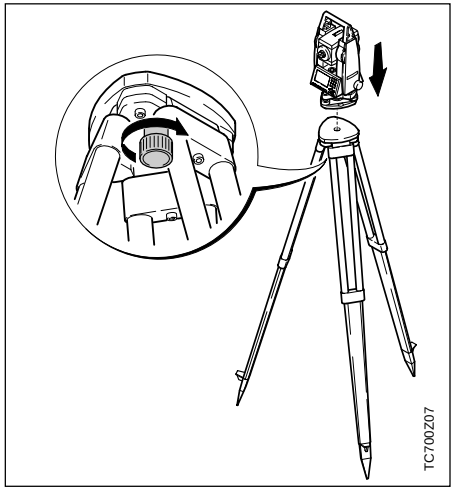


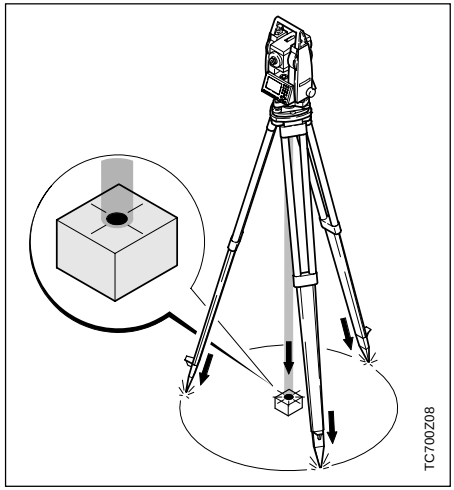
When setting up the tripod pay attention to a horizontal position of the tripod plate.

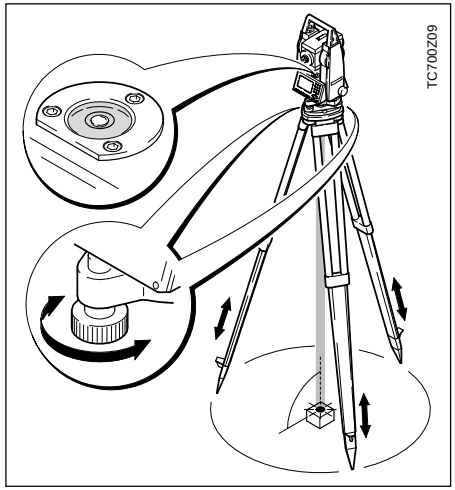
Heavy inclinations of the tripod plate must be corrected with the tribrach footscrews.

Careful handling of tripod

- Check all screws and bolts for correct fit.
- During transport always use the cover supplied.
  Scratches and other damages can result in poor fit and measuring inaccuracies.
- Use the tripod only for surveying tasks.

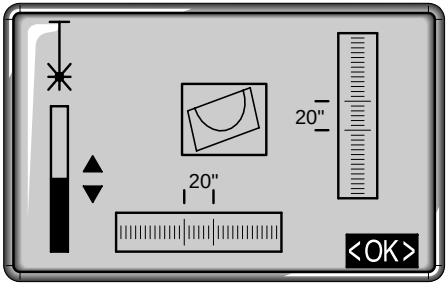




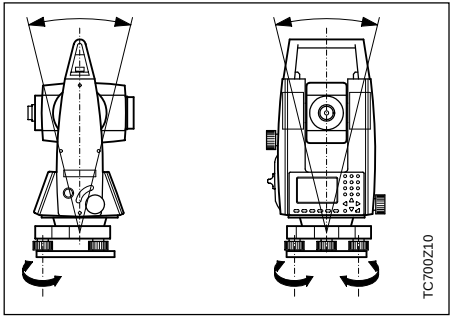


1. Place the instrument onto the tripod head. Tighten central fixing screw of tripod slightly.
2. Turn footscrews of tribrach into its centre position.
3. Switch on laser plummet with  The electronic level appears in the display.
4. Position tripod legs so that the laser beam is aimed to the ground point.
5. Firmly press in tripod legs.
6. Turn the footscrews of the tribrach to centre the laser beam exactly over the ground point.
7. Move the tripod legs to centre the circular level. The instrument is now roughly levelled-up.

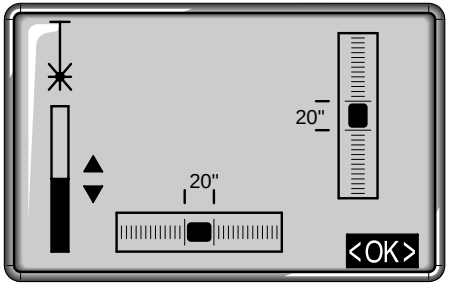
1. Switch on electronic level with
   In the case of insuffient levelling-up an inclined level symbol appears.



2. Centre the electronic level by turning the footscrews.



If the electronic level is centered the instrument is levelled-up.

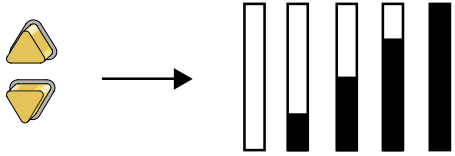


3. Check centring with the laser plummet and re-centre if necessary.

4. Switch off the electronic level and the laser plummet with or .

Changing the laser intensity

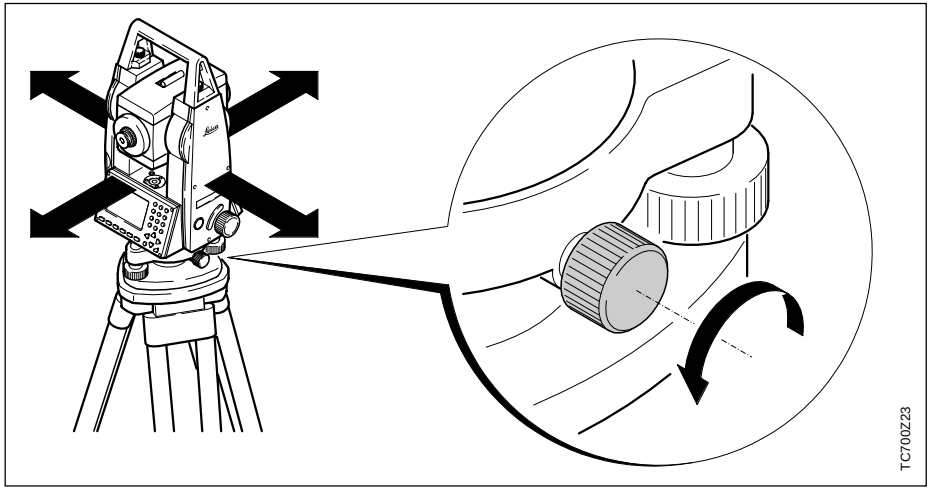
External influences and the surface conditions may require the adjustment of the intensity of the laser. The intensity of the laser plummet can be adjusted in 25% steps as required.



Min. 50% Max

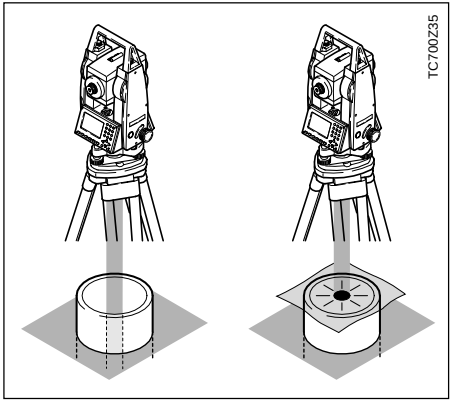
5. The indicated laser intensity is set, and the function terminated, with the <OK> button .

Laser plummet and electronic level are activated together with .



If the instrument is equipped with a shifting tribrach it can be aligned to the ground point by slight shifting.

1. Loosen screw.
2. Shift instrument.
3. Fix instrument by turning screw.



Positioning over pipes or depressions

In some circumstances, the laser spot is not visible (e.g. over pipes). In this case, the laser spot can be made visible by placing a sheet of transparent material over the end of the pipe.

Entry of Numeric Values

Numeric fields can contain only numeric values, the negative sign and the decimal point. Examples of numeric fields are: Hz (horizontal angle), E (Easting coordinate), hi (instrument height).

Numeric values can be entered in two ways:

1. Enter new value

Replace value displayed by new value:
Move the focus to the required input field using the navigation keys ( and ). Type the numeric value and the decimal point using the numeric keys. The sign can be changed from positive to negative and vice versa at any time during data entry using the (±) key.  concludes the entry and the focus jumps to the next input field.

2. Edit value displayed

Changing only a few digits in the value displayed:
Move the focus to the required input field using the navigation keys ( and ) . The  key opens Edit mode and places the cursor on the character on the extreme right of the field. The  key opens Edit mode and places the cursor on the character on the extreme left of the field. Move the cursor to the character to be changed using the  and  keys. Type the required digit.  concludes the entry and the focus jumps to the next input field. If the entry is not to be confirmed, press   and the old value will be recalled.

Alphanumeric fields can contain both numeric and alphanumeric entries. Examples of alphanumeric fields are: PtID, Code, Attribute.
Alphanumeric entries can be made in two ways as for numeric values: Make a new entry or edit an existing entry (for a description see numeric values).

To make it possible to enter alphanumeric characters (letters, special characters), the SHIFT key must be used to switch to the α data entry mode. The α icon appears in the display. In α data entry mode, each key is used to enter 3 letters and one digit.

For example, the (1) key is used to enter the letters S, T and U.
Press 1 once to enter S, twice for T, three times for U and four times for 1. If the required letter is missed, simply keep pressing the key, S appears again after 1, then T, and so on. (see section *"Character set"*).

When edit mode is active, it is possible to insert single characters in existing entries using SHIFT .

If a character is missed during data entry, (e.g. 15 instead of 125), then the missing character can be inserted later.

1. Position the cursor on the "1" digit using the / keys.
   -15
2. SHIFT inserts a character (0 in numeric fields, a space in alphanumeric fields) to the right of the "1" digit.
   -105
3. 2 key inserts the required digit.
   -125
4. Confirm entry/change with .

When edit mode is active, individual characters in an entry can be deleted using the CE key.

Example:

1ABC32 → CE → 1AB32

The cursor jumps to the next character. If you press CE repeatedly, character after character is deleted until the input field is empty.

Pressing CE again restores the entry as it was prior to editing.

Numeric values are displayed in a fixed format with digits after the decimal point, even if the digits are zero. Digits after the decimal point are not deleted by CE, but set to zero.

If the focus is on an input field, but edit mode is not active, CE deletes the entire entry. If CE is pressed again, the old value is restored.

	Numeric Character Set	Alphanumeric Character Set			
Key	Numeric	Alpha1	Alpha2	Alpha3	Alpha4
0	0	/	$	%	0
.	.	#	@	&	.
±	+/-	*	?	!	-
1	1	S	T	U	1
2	2	V	W	X	2
3	3	Y	Z	[space]	3
4	4	J	K	L	4
5	5	M	N	O	5
6	6	P	Q	R	6
7	7	A	B	C	7
8	8	D	E	F	8
9	9	G	H	I	9

In data fields where searches are performed for point numbers or codes, it is also possible to enter the "*" character.

Sign

+/- In the alphanumeric character set, "+" and "-" are treated as normal alphanumeric characters. i.e. they have no mathematical function.

Special characters

***** Place holder for WILDCARD point searches (see section *"Wildcard Search"*).

"+" / "-" appears only in the first position of an entry.

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

The point search is a global function used by applications to search for internally stored measuring points or coordinates.
It is possible for the user to limit the point search to a particular job or to search the whole memory.

Fixed points are always displayed first matching the relevant search criteria. If several points meet the search conditions then the points are arranged depending on "age". The instrument always finds the current fixed point first.

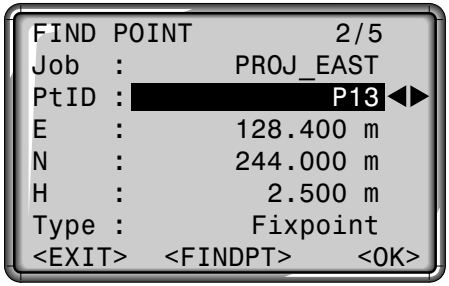
Direct search

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

Example:

Input: "P13"

As an example, 2 fixed points and 3 measurements are found. You can page through the match selection using  . As an example, a possible sequence is shown below.



Fixpoint	The point found is a fixed point.
Measurement	The point found is a measured point.
2/5	The point found is point number 2 of a total of 5 points in this relevant job.
	Scroll within all points matched.
<FINDPT>	Re-enter the search criteria.

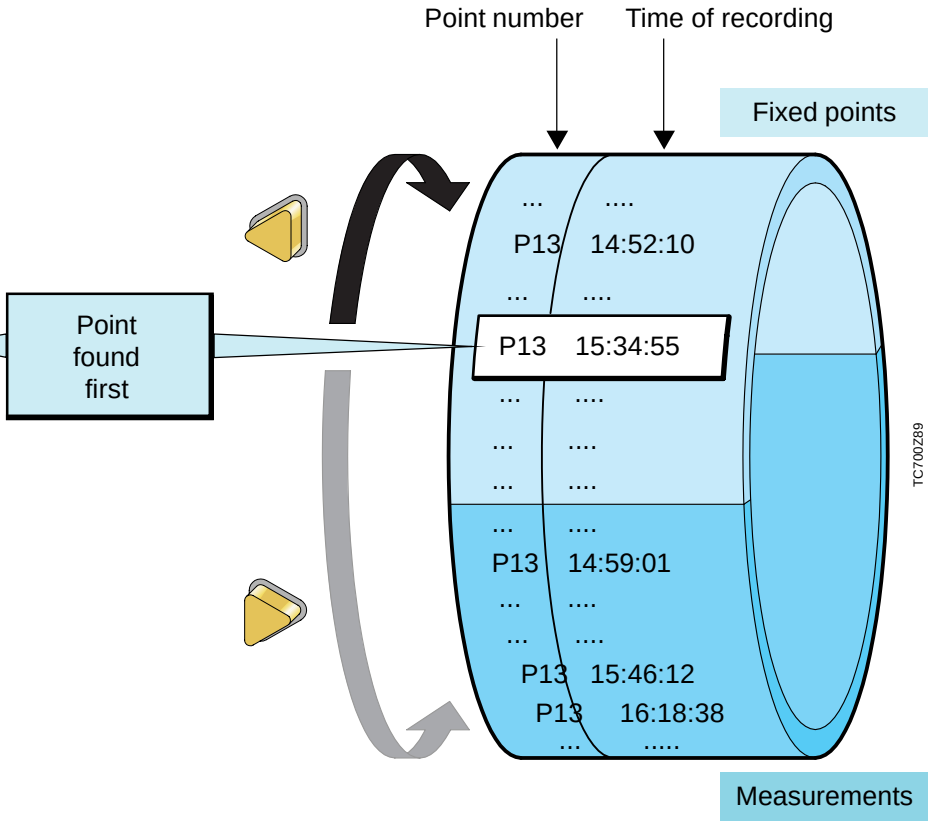
If no suitable point can be found the user is notified by the error message "Point not found" or "Database empty".

Point search is always started with the last recorded point.
The last entered/measured points are displayed first; fixed points before measured points.

Scroll through the list of points found.

Found:

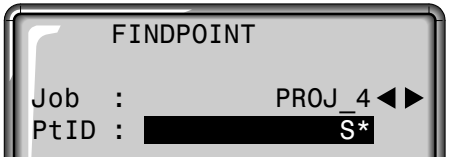
- P13, fixed point, time: 15:34:55
- P13, measurement, time: 14:59:01
- P13, measurement, time: 15:46:12
- P13, measurement, time: 16:18:38
- P13, fixed point, time: 14:52:10
- to start of list !



At the end of the measured points the search returns to the beginning of the fixed points.

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.

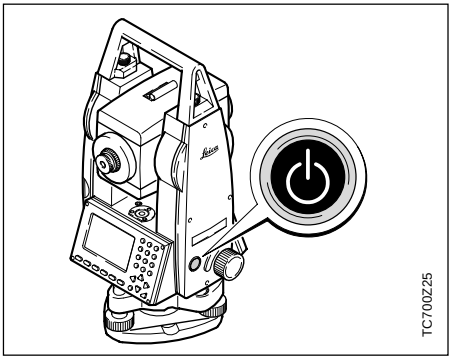
Examples:

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

Definitions

Fixpoint	The point found is a fixed point.
Measurement	The point found is a measured point.
2/5	The point found is point number 2 of a total of 5 points in this relevant job.
	Scroll within all points found.
<FINDPT>	Re-enter the search criteria.

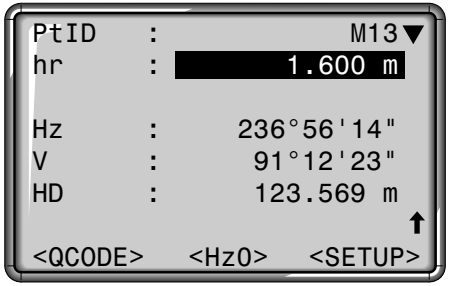
After switching on and setting up correctly, the total station is immediately ready for measuring.



In the measuring display calling all functions/applications under FNC, EDM, PROG, MENU, LIGHT, LEVEL- and LASER-PLUMMET is possible.

All displays shown are examples. Local software versions may differ from the basic version.

Example of a possible measuring display:



Displays

▼ Indicates further displays with additional data (e.g. dH, SD, E, N, H, ...)

SHIFT : Changes the display.

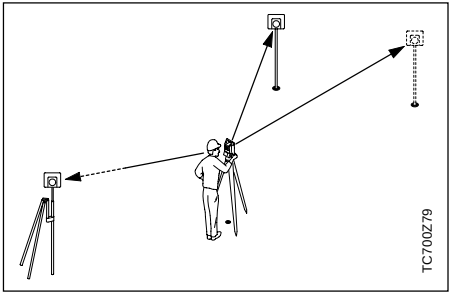
<Hz0> Set the Hz-orientation to 0°00'00" / 0 gon.

ALL Angles are permanently displayed. At the time of pressing the key a distance measurement is triggered. The angle values and distance are stored in the internal memory or downloaded via serial interface.

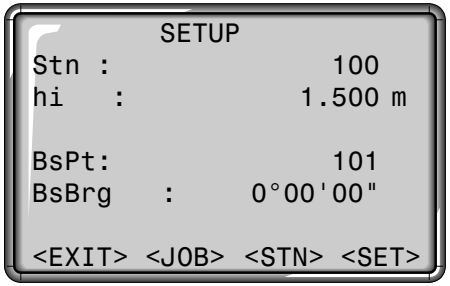
DIST Triggers a distance measurement and shows this on the display. Angles are displayed independently of the distance measurement. The displayed distance remains valid until it is replaced by a new distance measurement.

This dialog generates a station block without co-ordinates which can be evaluated by software.

In the data output the data is made available depending on the evaluation possiblitie. The orientation is manual.



Procedure:
<SETUP> This button in the measuring display activates the definition of station and orientation.



Station:
The station can be defined with a station name.

1) Move cursor to "Stn" and enter station number as well as instrument height "hi". Close entry with  .

Orientation:
The orientation is designated with the number and description of the target point.

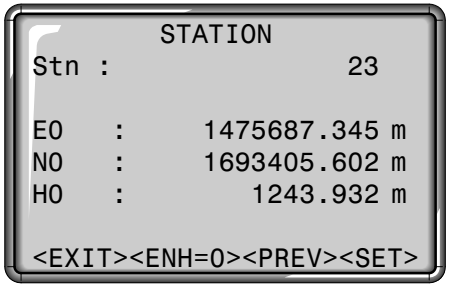
2) Move cursor to "BsPt" and enter orientation point number. Close entry with  .
3) Manual input of a Hz value as orientation or set <Hz0>.

The orientation is continuously displayed but can be modified in the edit mode.

Buttons:
<SET> The entries are registered and the measuring display is activated again.
<STN> Starts manual input of the station coordinates.

Manual input of the station coordinates:

Within this dialog, the name, the height and the station co-ordinates of the instrument can be set manually.



1. Move cursor to the required line.
   Close entry with  .

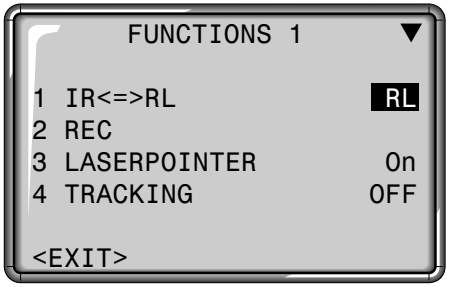
2. <SET>: The entries are registered and the measuring display is activated again.

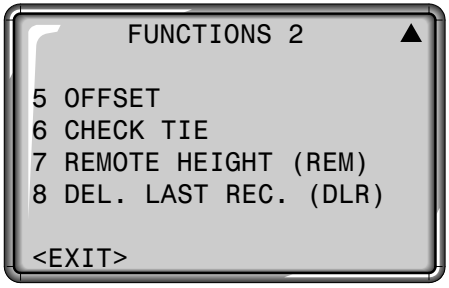
<ENH=0> The station co-ordinates are set to (0/0/0).

<EXIT> Back to measuring display without saving.

<PREV> Back to setup display.

With "FNC" (SHIFT + USER) different functions are available.





Application of individual functions are described in this section.

Functions can also be started directly from the different applications.

Each function from the FNC menu can be assigned to the USER key (see section *"Menu/ Settings"*).

Each function can be started either using the shortcut with the corresponding data entry key or selected with ▲ / ▼ and the selection confirmed with ↵. In this User Manual only the shortcut method of starting the functions is given.

1 Shortcut to the function "IR<=>RL".

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

IR: Infrared: Distance measurements with prisms.

RL: Visible laser: Distance measurements without prisms up to 80m; with prisms from 1 km.

Find more information in section *"EDM Settings"*.

REC (Storing)

Shortcut to the function "REC".

Actual measured data is stored by "REC" to the internal memory or via the serial interface.

By activating "REC" the following actions are carried out:

- Recording a measurement block.
- Incrementing of current point number.

Laser Pointer

Shortcut to the function "LASERPOINTER".

Switches on or off the visible laser beam for illuminating the target point. The new setting is displayed for approx. one second and then set.

Tracking

Shortcut to the function "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.

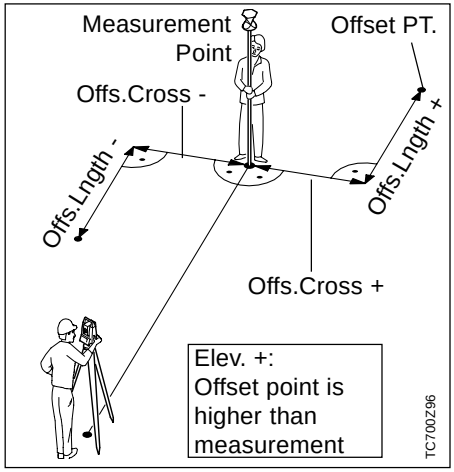
The following options are available:

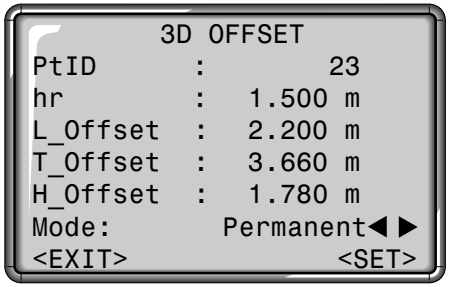
EDM Type	Tracking measurement mode Off <=> On
IR	IR-Fine <=> IR_Track IR-Fast <=> IR-Track
RL	RL-Short <=> RL-Track

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

Shortcut to the function "OFFSET".

If it is not possible to set up the reflector directly, or 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.





Procedure:

1. Enter the point ID and the reflector height
2. Enter the offset values (length, cross and/or height) as per the sketch
3. Define the period for which the offset is to apply.
4. <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.

<EXIT> Leaves the function and returns to the application from which the function was started.

SHIFT Changes to 2D target offset (without entry of the height offset).

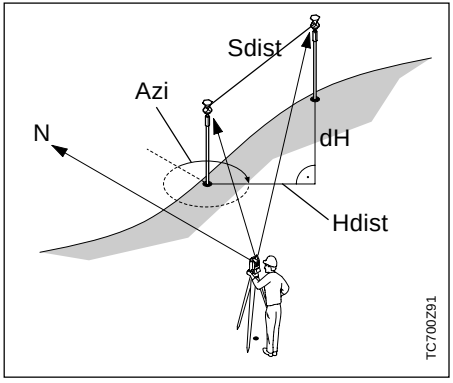
The period of applicability can be set as follows:

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 function can only be started in the applications "Measuring" and "Surveying". The offset values are always reset to 0 when the application is quit.

6 Shortcut to the function "CHECK TIE".

Calculation and display of the slope and horizontal distance, height difference, azimuth, and co-ordinate differences between the last two measured points. Valid distance measurements are required for the calculation
(ALL, DIST).

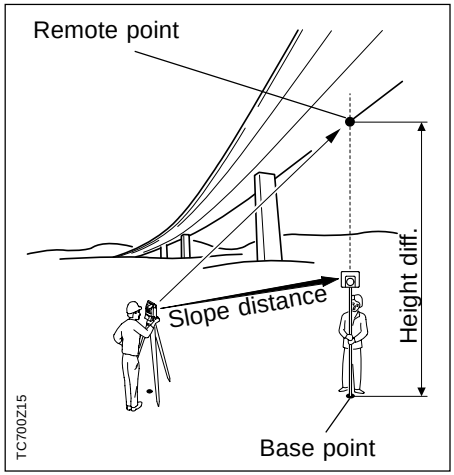



```
        CHECK TIE
Brg   :          85°19'35"
Hdist:             9.011 m
Sdist:             9.059 m
dE    :             8.768 m
dN    :             2.077 m
dH    :             0.939 m
<EXIT>
```

The function can only be started in the "Measuring" and "Surveying" applications. New measurements must be made after changing to a different application.

Important Messages	Meaning
Check tie not possible!	The function can only be activated in the "Measuring" and "Surveying" applications.
Less than 2 valid measurements!	The values cannot be calculated as there exist less than 2 valid measurements.

7 Shortcut to the function "REMOTE HEIGHT (REM)".



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

Measure base point:

1. Enter point number and prism height.

```
     BASE POINT Pt1

Pt1   :              100
hr    :          1.600 m
HD    :       ----.--- m


<EXIT>              <MEAS>
```

2. Trigger distance measurement and indication of horizontal distance (HD) with <MEAS>.

<MEAS> Measure and record the base point.

Determine remote point:

3. Aim at the remote point with the telescope .

```
   REMOTE POINT Pt2
Pt1   :              100
Pt2   :              101
dH    :        8.346 m
H     :      512.042 m
HD    :       70.571 m

<EXIT> <NEWBASE>   <MEAS>
```

4. Store with <MEAS> measured data of the remote point. No new distance measurement is carried out.

Height (H) and height difference (dH) as function of actual V-angle and measured distance to base point are computed and displayed immediately.

<NEWBASE> Enter and measure a new base point.

8 Shortcut to the function "DEL. LAST REC. (DLR)".

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

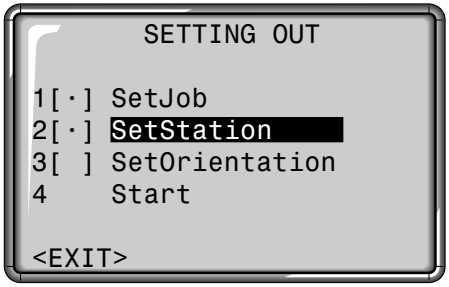
Deleting the last record **is not reversible** !

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

Important messages	Meaning
Not permitted to delete record outside "Surveying" or in "MEASURING"	Function "DELETE LAST RECORD" is only active in applications "Surveying" and "MEASURING".
Output set to RS232	Current setting for data storage is "RS232" (see section "*Configuration"*). Measured data has been output via interface and so cannot be deleted in the field memory.
Not permitted to delete this record	Record cannot be deleted because last data set was not registered either in "Surveying" nor in "MEASURING".
Last record has been deleted	The last record has been already deleted. Function cannot be activated any more.

Start-up programs are a set of functions for successful stations setup and data management. The user can select start-up programs individually.

PROG Opens the program menu, execute an application with ↵.



A "•" indicates that a job is set and that in the job set the last station/ orientation in the memory correspond to the actual station/orientation.

1 .. 4 Shortcut to a start-up program by pressing the corresponding data entry key

or

Select or skip a start-up program. The selection is marked by the black bar.

↵ Execute the marked start-up program.

<EXIT> Quits the start-up programs and returns to the program menu or selection of a new application.

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

Error messages:

"SET A JOB FIRST"
"NO JOB IN SYSTEM"
- No valid job set.

> Carry out "SET JOB" and select a valid job or generate a new one.

"SET A STATION FIRST"
"NO STATION IN SYSTEM"
- No valid station defined in the job.

> Carry out "SET STATION" and define a valid station. Note that a job was already set.

"SET ORIENTATION FIRST"
"NO ORIENTATION IN SYSTEM"
- No orientation set in the job.

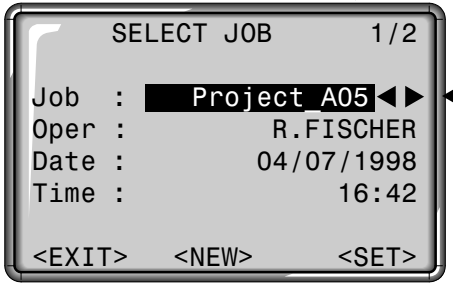
> Carry out "SET ORIENTATION" and make sure that JOB and STATION are valid.

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.

If a job was not yet defined and ALL or REC is activated in "MEASURE" the system automatically generates a job with name "DEFAULT".
Using the SurveyOffice software package TPS300/700 Tools "TPS setup" the number of available jobs can be either set to 8 (mixed data management: measurements and fixed points) or to 16 (only measurements or only fixed points).

Remarks

1/2 Job no 1 of a total of two available jobs.



Selection
Using the arrow keys you can scroll within the available jobs. Select the desired job.

Re-enter Job

<NEW> Defines a new job. Activates a display for input of a new job name and user.

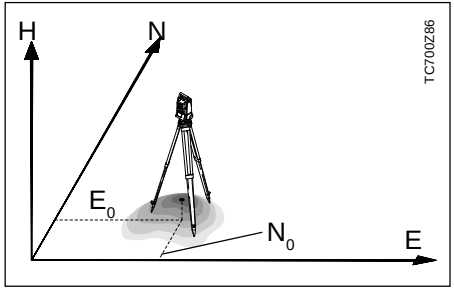
<SET> Sets job and returns to start-up program overview.

<EXIT> Back to start-up program overview.

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

Date and time are automatically placed by the system and cannot be changed.

Each co-ordinate computation relates to the currently set station.
Therefore, at least station point plan co-ordinates (E0, N0) are required. The station height can be entered optionally. The co-ordinates can be entered either manually or read from the internal memory.



Known Point

```
    SET STATION          ▼
Stn.:                  200
hi   :             1.600 m

E0   :          1000.000 m
N0   :          1000.000 m
H0   :          1000.000 m
<EXIT> <H0-TRANS>  <SET>
```

1. Enter a point number from the memory.
2. <SET>
   Sets and records station co-ordinates. Return to start-up program overview.
3. Wildcard search enables the global search for points in the complete memory (all jobs).

SHIFT : Extends the display.

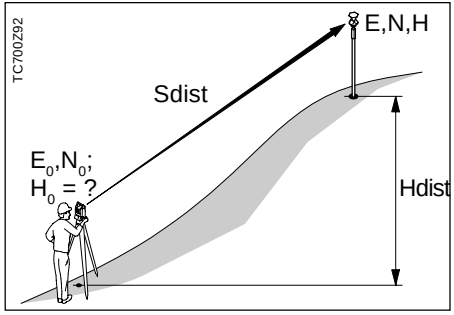
<H0-TRANS> Starts the "HEIGHT TRANSFER" function.

Set Manually

If an entered point number cannot be found in the internal memory then the manual input is activated automatically.

1. Enter Point ID.
2. Enter co-ordinates and height.
3. <OK> : Sets and records station co-ordinates. Return to "SET STATION".

The height transfer function defines the height of the position of the instrument from measurements to a target point of known height.




```
 HEIGHT TRANSFER          ▼
PtID:                     *
                       PF22 ◄►
              Measurement
hr   :             1.670 m
HD   :           ---.--- m
dH   :           ---.--- m
<EXIT>    <RES>      <MEAS>
```

SHIFT Expands the display.
<MAN> Opens manual height entry.

Procedure:

1. <H0-TRANS> in the "SET STATION" display starts the height transfer and carries out a point search using the wildcard criterion (*), i.e. the last point measured/ entered is displayed first, fixed points before measurements.
2. Enter the required point number for the target point or page through the list of points found using .
3. ALL / DIST / <MEAS>: Measurement to the selected target point.
4. <RES>: display of the results.

```
          RESULTS
Stn  :                  STN1
PtID :                  PF22
H0 I :           436.719 m
H0 II:           435.065 m
Mean :           435.892 m

<EXIT><PREV> <NEW>  <OK>
```

The following are displayed:

- Station name
- Point ID of the target point
- Calculated station height (H0) from measurement in the corresponding telescope face. If measurements are performed in both telescope face, the measurements are averaged.

If the calculated values for H0 in the first and second telescope face vary by more than 10cm, an error message is displayed. The measurement does not need to be repeated, H0_MEAN is calculated in any case.

<OK>	Back to the SET STATION display, H0 is set and only saved with <SET>.
<NEW>	Starts a new measurement
<EXIT>	Ends the height transfer, returns to SET STATION display (H0 is not set).
<PREV>	Back to the measurement dialog.

This program enables an orientation angle to be entered manually, or for the orientation to be determined by measurement to points with known co-ordinates.

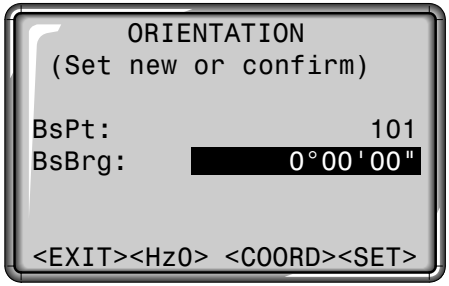
Orientation co-ordinates can be either obtained from the internal memory or entered manually. Using button <Hz0> the orientation can be set to 0.000 quickly and easily.

The system offers the following possibilities:

- Set any Hz-value manually.
- With <Hz0> set Hz=0.000.
- Orientation to target points with known co-ordinates.

Set any Hz-orientation

By entering the Hz-angle the user can set any Hz-orientation.



Moves cursor to input field "BsBrg".

Enters new angle.

Deletes field or sets to 0°00'00".

Set Hz0

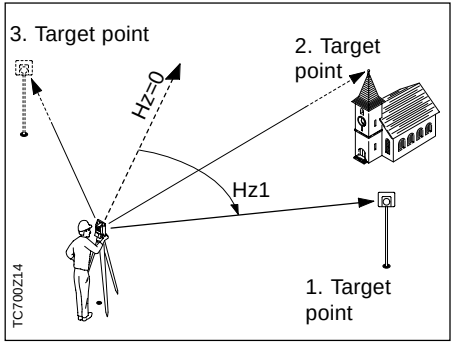
Using button <Hz0> the orientation can be set to 0.000 quickly and easily.

<Hz0> Set Hz-orientation to 0°00'00".

<SET> Confirms the orientation if no entry has been made, or sets and records the new orientation if a new point ID has been entered, or a new Hz-angle has been set.

Optionally, an alphanumeric point number and a description can be added to the orientation block.

For determining the orientation, a maximum of 5 target points with known co-ordinates can be used.



Orientation co-ordinates can be either obtained from the internal memory or entered manually.

If an orientation point number cannot be found in the internal memory then the instrument automatically activates the manual entry of the co-ordinates.

<COORD> Activates input/edit mode for entry of a known orientation point.

SHIFT Dialog for orientation to several target points.

```
ORIENTATION 1/I II
BsPt :              201
hr   :        1.300 m
BsBrg:     236°56'14"
dHz  :     +51°12'23"
dHD  :        0.569 m

          <MEAS>    <SET>
```

<MEAS> An angle and a distance measurement is triggered. If no distance can be measured only an angle measurement is made.

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

dHz:	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.

dHD:	Difference between horizontal distance to target point computed from co-ordinates and the measured distance.

Display of Computed Orientation

<SET> Displays orientation results if several target points are measured.

```
ORIENTATION RESULT

NoPts :                2
Stn   :              200
HzCor .      123°00'23"
StDev :      ± 0°00'08"

<EXIT>    <RESI>     <OK>
```

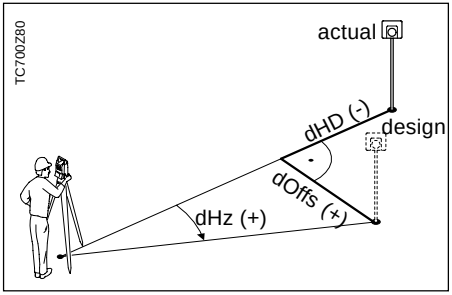
<OK> Sets computed Hz-orientation.

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

Displaying Residuals

<RESI> Displays residuals.

```
RESIDUALS          1/3

BsPt :             ABC1 ◄►
dHz  :           0°00'23"
dHD  :           -0.045 m
dH   :            0.075 m

<EXIT>   <PREV>     <OK>
```



dH: Height residuals
dHD: Correction on the horizontal distance
dHz: Correction on Hz-angle.

Useful Information

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

Introduction

Depending on local software versions the contents of the displays (lines) described in this section can differ. However, the function of the relevant display remains the same.

Before starting an application, make sure the instrument is perfectly levelled up and the station data is correctly set.

Button functions

DIST — Triggers a distance measurement.

ALL — Measures **and** records the measured values.

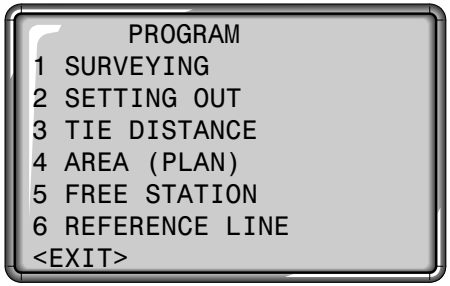
When starting an application the dialog with the Start-up programs is called automatically (see section *"Start-Up Programs"*).

With these onboard applications the functionality of the TC(R)702/703/705 instruments is improved considerably. As a result, the functionality is extended and the daily surveying fieldwork is made easier. By using internally recorded values the user is mainly protected from entering incorrect data. Points with given coordinates as well as measured points can be used within the programs.

The following programs are available in the internal memory:

- Surveying
- Setting Out
- Tie Distance
- Area
- Free Station
- Reference Line

PROG — Opens the program menus.



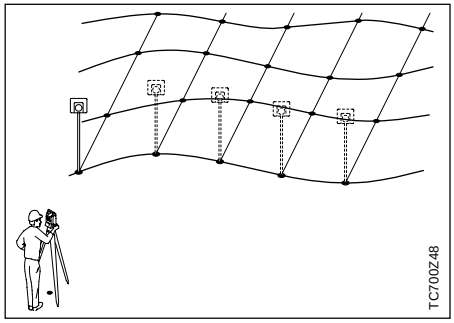
1 .. 6 — Start the required application directly by pressing the corresponding data entry key.

Or

Selects the desired application.

Opens the application and activates the Start-up programs.

With the program "Surveying" the measuring of an unlimited number of points is supported. The program can be compared to simple measuring. Only the guided stationing or orientation (see section *"Start-Up Programs"*) and the additional display for target co-ordinates are different.



Measured data can either be recorded in the internal memory or output via serial interface RS232 (see *"Configuration / Interface Parameter"*).

Procedure:

1. Input of point number.
2. Input of code, if required (see also *"CODING"*)
3. Enter new reflector height or change the existing height.
4. Trigger and record measurements with ALL, DIST or USER (if REC is assigned).

<QCODE> Start the "Quick Code" function

Find further information about coding or about quick code in section *"CODING"*.

With SHIFT / you can switch quickly and easily between different displays.

Measuring display 1

```
    SURVEYING 1          ▼
PtID :              AB-12
hr   :           1.600 m
Code :              Baum
Hz   :         123°12'34"
V    :          79°56'45"
HD   :          412.883 m
<EXIT>            <QCODE>
```

Measuring display 2

```
Hz   :         123°12'34"
SD   :          406.542 m
dH   :           72.081 m
<EXIT>            <QCODE>
```

Measuring display 3

```
E    :         1739.420 m
N    :          932.711 m
H    :          456.123 m
<EXIT>            <QCODE>
```

The application computes setting-out elements for the **polar, cartesian** or **orthogonal** setting out of points using either co-ordinates or manually entered angle, horizontal distance and height. Setting out differences can be displayed continuously.
In the Setting out program three different displays are available showing setting out values corresponding to the relevant method.

Switches the display and method.

A point search with the wildcard criterion (*) is automatically performed on starting setting-out, i.e. the last point measured/entered is displayed first, fixed points before measurements. Points can be easily selected by scrolling through with  /  .

Additionally, the type of the point found (fixed point or measured point) is displayed.

Setting Out Coordinates from Memory

Input a point number.
If the desired point number could not be found the system opens the manual co-ordinate entry automatically (see example).

```
    2D-SET OUT          ▼
PtID :                C1*
                    P100◀▶
                   Fixpoint
Dist :             10.200 m
dHz  :           +30°25'14"
dHD  :              4.782 m
<EXIT>               <B&D>
```

<B&D> Switches the instrument to "Manual input of setting out values".

Changes to 3D set out.

Manual Input of Setting Out Values

1. Enter direction (Brg), horizontal distance (Dist) and height (H) of setout point.

```
    BEAR & DIST ENTRY

PtNr :                ABC1
Azi  :          123°12'36"
Dist :           123.569 m
H    :            12.456 m

<EXIT>   <PREV>      <SET>
```

2. <SET> : The entered data is set. Calling the setting out dialog.
3. Trigger measurement with 

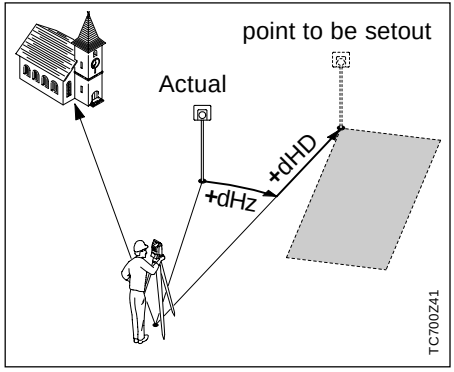
or 

.
4. The setout offsets are displayed in the same way as with the polar setout.

<PREV> Changes to 2D/3D setting out (ref. to section "Setting out co-ordinates from memory").

Polar Setout

Normal indication of polar setout offsets dHz, dHD, dH.



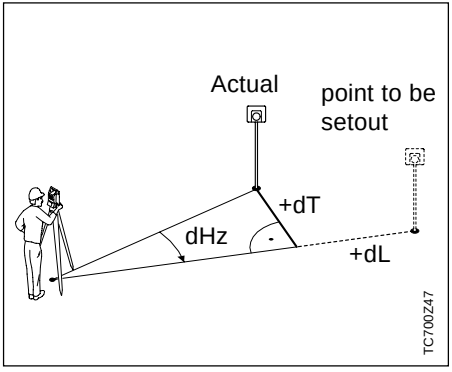
dHz: Angle offset: positive if point to be setout is to the right of the actual direction.

dHD: Longitudinal offset: positive if point to be setout is further away.

dH: Height offset: positive if point to be setout is higher than measured point.

Orthogonal Setout

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

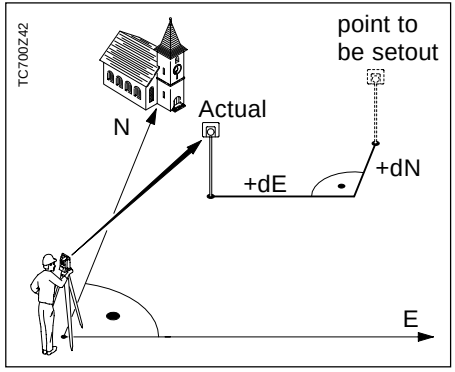


dL: Longitudinal offset: positive if nominal point further away.

dT: Transversal offset, perpendicular to line-of-sight: positive if nominal point is to the right of measured point.

Cartesian Setout

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

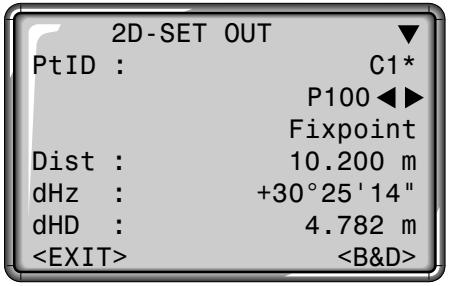


dE Easting offset between setout and actual point.

dN Northing offset between setout and actual point.

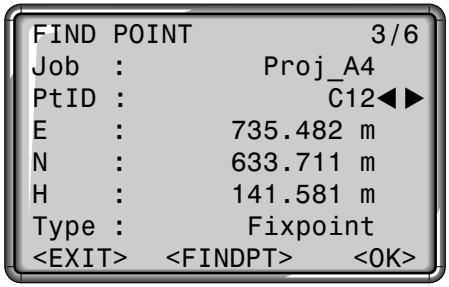
Example

By entering a wildcard (*), a group of points can be found easily and set out one after the other.



Procedure:

1. Enter "C1*" in the "PtID" field.
2. starts the point search and finds all points that meet the search criterion (e.g. C10, C11, C12, ...)
3. Using you can page quickly through the points found.



<EXIT> Leaves point search without selecting a point. Back to setting-out.

<FINDPT> Re-enter the search criteria.

4. <OK> Selects the required point and returns to setting-out.

Errors

No or invalid PtId or coords:

- The point number entered is not available.

> Re-enter point number/co-ordinates.

Invalid entries of data:

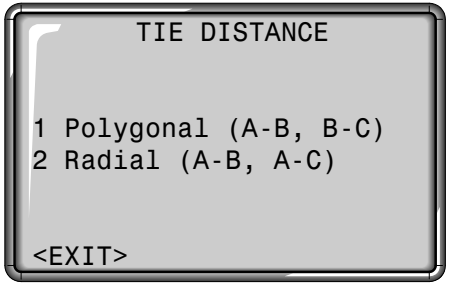
- Manually entered setting out data is incomplete (e.g. setting out distance missing).

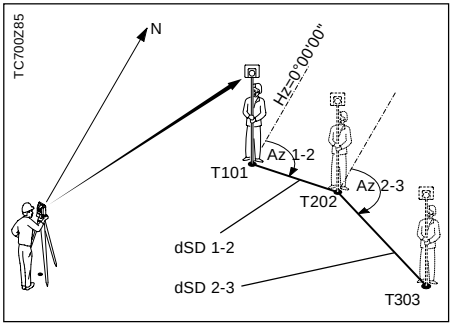
> Check setout parameter and re-enter.

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**.

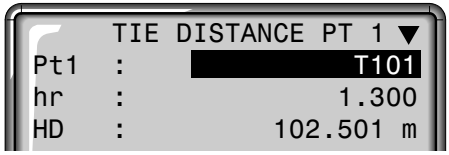
Distances and directions between two successive points are determined and can be saved in the internal memory (e.g 3 to 4).

The user can choose between two different methods:





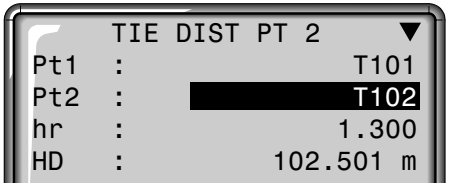
1. Enter desired point number and reflector height for the first target point.



2. Aim on target point and measure.
(ALL, DIST / REC, <MEAS>)

2.1 Variant on 2: instead of measuring the target point, it can also be selected from the memory or entered using the keypad. (<COORD>)

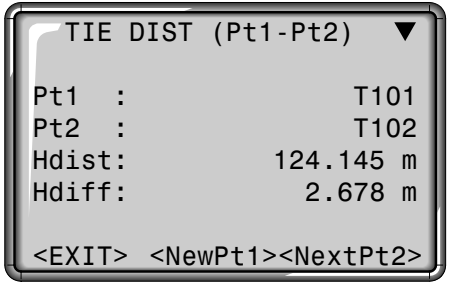
3. Enter desired point number and reflector height for the second target point. The previously measured point number is displayed.



4. Aim on target point and measure.
(ALL, DIST / REC, <MEAS>)

Results

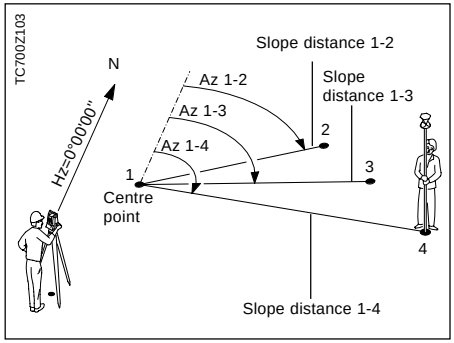
Finally, the results are displayed.



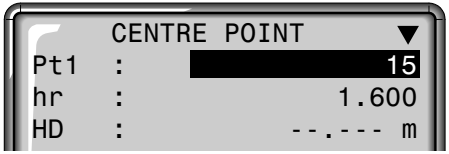
Hdist	Horizontal distance between point1 and point2.
Hdiff	Height difference between point1 and point2.
Sdist	Slope distance between point1 and point2.
Brg	Azimuth between point1 and point2.

<NewPt1> An additional missing line is computed. Program starts again (at point 1).

<NextPt2> Point 2 is set as starting point of a new missing line. New point (Pt 2) must be measured.



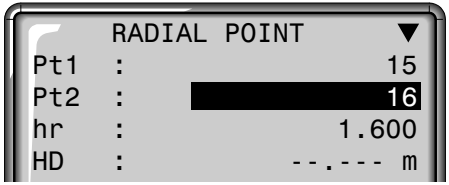
1. Enter desired point number and reflector height for the first target point.



2. Aim on target point and measure. (ALL, DIST / REC, <MEAS>)

2.1 Variant on 2: instead of measuring the target point, it can also be selected from the memory or entered using the keypad. (<COORD>)

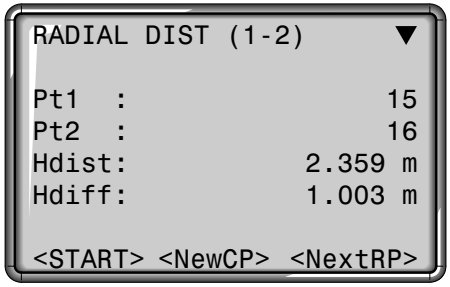
3. Enter desired point number and reflector height for the second target point. The previously measured point number is displayed.



4. Aim on target point and measure. (ALL, DIST / REC, <MEAS>)

Results

Finally, the results are displayed.

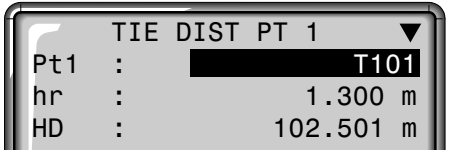


<NewCP> Measure new centre point. Program starts again (at point 1).

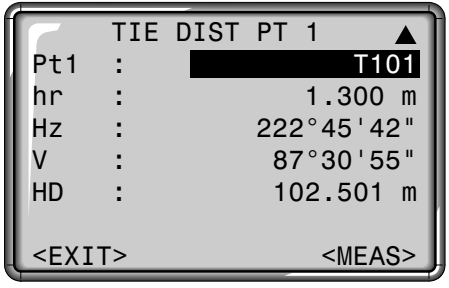
<NextRP> Measure new radial point (centre point Pt. 1 is retained)

Extended Display

On the measurement of the target points and when displaying results, additional angle and distance information can be displayed.



SHIFT Changes between displays shown above and below.



Error

Error message
"No Distance measured"

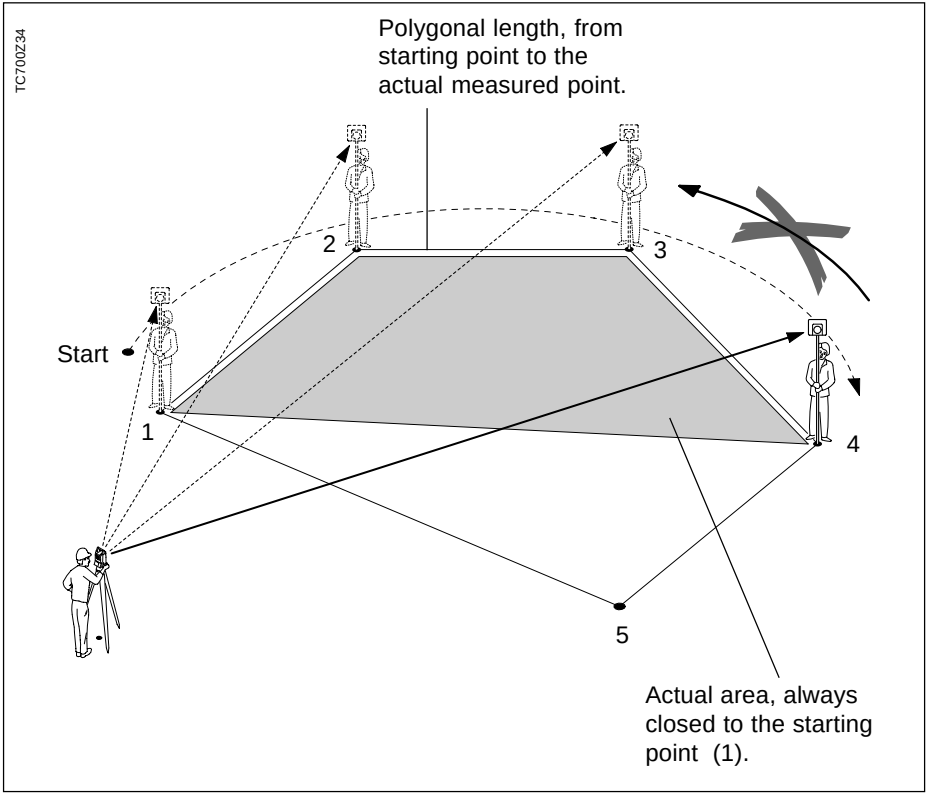
- Distance measurement has not been carried out or not saved.

> Make the measurement again.

The application areas (plane) computes online areas from an unlimited number of points connected by straight lines.

From three measured points the area is computed and displayed on-line. By activating <RESULT> the number of points used, the computed area and the closed polygonal length (e.g. line 1-2-3-4-1) are displayed.

The points can be measured optionally in the first or second telescope face. Between the individual points the telescope face can be changed. One distance must always be measured.



1. Input of point number.

2. Trigger a distance measurement: This can be achieved in the following ways:

<MEAS> Triggers and records a measurement. Point counter and point number are incremented.

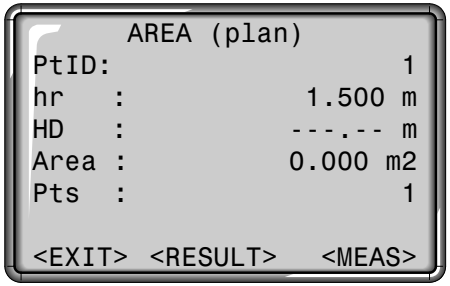
ALL Same function as <MEAS>.

DIST Triggers and displays a distance measurement.

REC Save with REC if key USER is assigned accordingly.

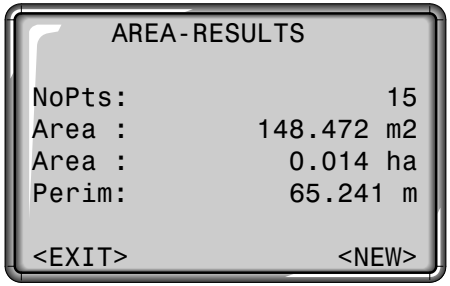
<RESULT> Records areas, perimeter and point counter.

Measuring display



The area is always displayed according to the onboard unit setting (m², hectare).

Results

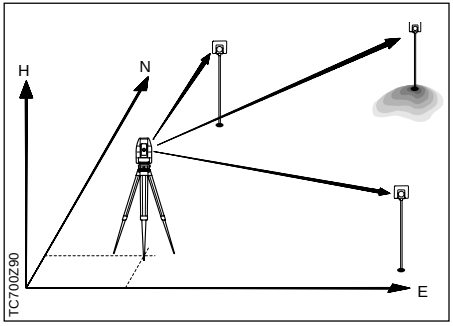


Displayed are:
- area
- number of measured points
- circumference of closed area/ length of closed polygon.

<NEW> Starts a new area computation. The counter is set to "0" again.

<EXIT> Quits the program area computation.

The application "Free Station" is used to determine the instrument position from measurements to a minimum of two known points and a maximum of five known points.
It supports measurements to points using either distances and Hz- and V-angles (typical 2 point resection) or angles only (typical 3 point resection) or a combination of angles and distances to different points.



The following measurements sequences to target points are possible:
1. Hz- and V-angles only,
2. Distance and Hz- and V-angle,
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 additionally.

The station coordinates and orientation can be finally set active to the system.

Measurements and results (position, standard deviations and residuals) are always recorded to the internal memory, provided the internal memory is set as the Data Storage media.

All displays shown are examples. Local software versions may differ from the basic version.

The points can be measured in telescope face **I** or **II**, or a mixture (**I** + **II**), the sequence is of no significance. E.g. first point in telescope face **II**, last point in telescope face **I** + **II**, second point in face **I**, etc.

Measurements made in both telescope faces are checked for gross errors to ensure that the same point has been aimed at.

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

Measurement restrictions:

- **2 face measurements**
  For measurements in 2 faces, the reflector height, the refCoeff and the **must** be kept the same for both faces for the same target point, although it is permissible to change these parameters between different target points. An error message will be generated if the reflector height changes between face I and face II while measuring to the same target point.

- **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.

The computation procedure automatically defines the calculation method, e.g. 2 point resection, 3 point resection with angles only, 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.

1. The original averaged face I and face II measurements enter the computation process. In case of multiple measurements to the same target point, only the last measurement for each face enter the computation process.

2. All measurements are treated with the same accuracy, whether these are measured in single or dual face.

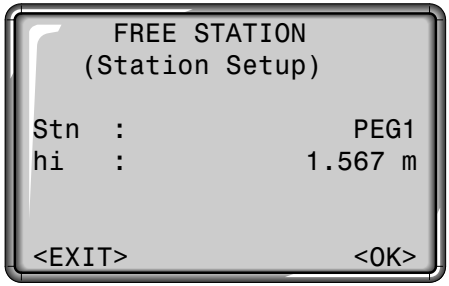
3. The final plan position (E, N) is computed from a least squares adjustment, including standard deviations and residuals for Hz-angle and horizontal distances.

4. The height of the station (H) including the standard deviation and residual is calculated from the averaged heights (based on the original measurements).

5. The Hz-circle orientation is computed with the original averaged face I and face II measurements and the final computed plan position.

Set the occupied station name and instrument.

Procedure:
1. Enter the station name (Stn)
2. Enter the instrument height (hi)



<OK> Proceeds to the measurement screen.
<EXIT> Back to start-up program overview.

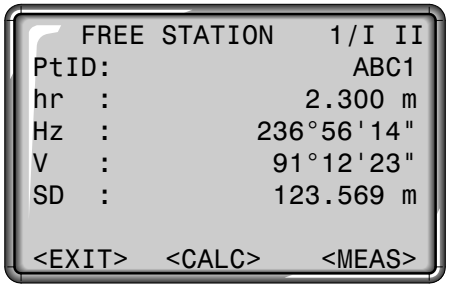
Free Station methods:

- **2 point resection**
  => **always** use the ALL-key or the Button <MEAS>
- **3 point resection with angles only**
  => Always use the REC-command under the FNC-menu or the USER-key if REC is assigned to it.
- **Mix of distances and angles**
  => Use either ALL-key or the Button <MEAS> for distances and angles or REC-command for angles only.

Procedure:

1. Enter the target point number (PtID).
   If the desired point is not found within the internal memory, the system automatically opens the manual coordinate entry.

2. Enter the reflector height (hr).



<MEAS> Button initiates measurements.
a) If the target is a prism, the angles (Hz and V) and distance are automatically measured and recorded.
b) If the target is not a prism or the reflectorless EDM cannot measure a distance, only Hz- and V-angles are measured and recorded.

ALL — Measures and records the Hz- and V-angles and the distance.

REC — Measures and records Hz- and V-angles.

<CALC> — Computes and displays the instrument position if at least 2 points in single face with at least one distance are measured

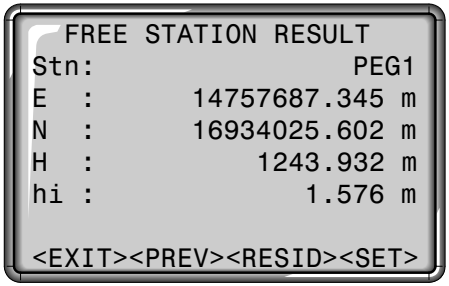
<EXIT> — Back to the start-up program overview.

1/I — Status indication; shows that first point was measured in telescope face I.

1/I II — Shows that first point was measured in telescope face I and II.

This dialog shows the final computed station co-ordinates and instrument height.

1st page (display of station co-ordinates and instrument height)



Stn = Name of occupied station
E = Computed station Easting
N = Computed station Northing
H = Computed station Height
hi = Instrument height

<SET> Sets the displayed co-ordinates and instrument height as a new station.
<RESID> Displays the residuals.
<PREV> Returns to the measuring screen for more points to measure.
<EXIT> Quits the application "FREE STATION" without setting the new station data to the system.

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 (2nd page)

```
FREE STATION RESULT ▲
Pts      :          2
s.Dev E  :      0.012 m
s.Dev N  :      0.120 m
s.Dev H  :      0.035 m
s.DevAng :    0°00'23"

<EXIT><PREV><RESID><SET>
```

Pts = Number of measured points
s.Dev E = Standard deviation Station Easting
s.Dev N = Standard deviation Station Northing
s.Dev H = Standard deviation Station Height
s.DevAng = Standard deviation circle orientation

<SET> Sets the displayed co-ordinates and instrument height as a new station.
<RESID> Displays the residuals.
<PREV> Returns to the measuring screen for more points to measure.
<EXIT> Quits the application "FREE STATION" without setting the new station data to the system.

This dialog shows the computed residuals.
The residuals always show computed value (given data) minus measured value.

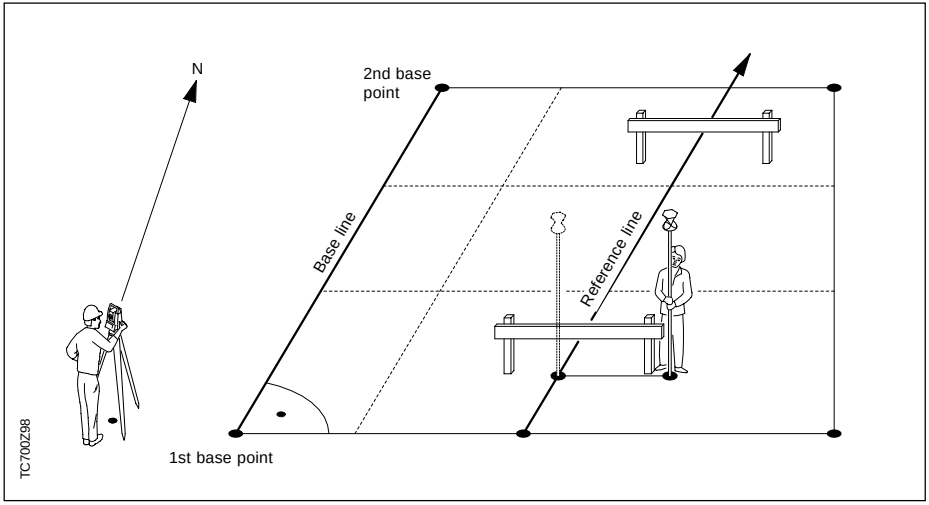
```
RESIDUALS          1/3
PtID:              ABC1 ◀▶
dHz :          -0°00'23"
dHD :            -0.045 m
dH  :             0.075 m


<EXIT>   <PREV>
```

<PREV> Returns to the result screen
<EXIT> Quits the application "FREE STATION" without setting the new station data to the system.


Use the cursor keys to change between the display of residuals for the various measured points.

Important messages	Meaning
Selected point has no valid data	This message occurs if the selected target point has no easting or northing coordinate
Max 5 points supported	If already 5 points are measured and a further point is selected . The system supports maximum 5 points
Bad data - no position computed	The measurements may not allow to compute final station coordinates (Easting, Northing)
Bad 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. This error could occur either with measurements or when the system stores result data, such as station results, standard deviations or residuals.
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 circle
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 180° ±0.9° for the vertical angle reading
More points or distance required	There are insufficient data measured to be able to compute a position. Either there are not enough points used or not enough distances measured.

This program facilitates the easy setting out or checking of lines for buildings, straight sections of road, simple excavations, etc. A reference line can be defined with reference to a known base line, which, e.g. has been defined based on an existing site boundary. The reference line can be offset either longitudinally or in parallel to the base line, or be rotated around the first base point as required.



Definition of the Base Line

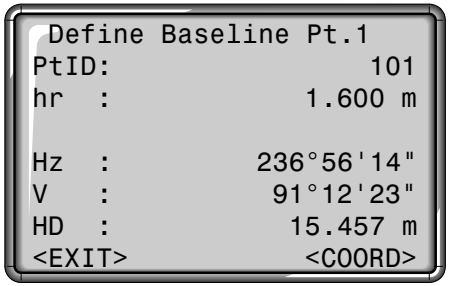
The base line is given by two base points. The base points can be defined in three ways:

- Measure point
- Enter co-ordinates using keypad
- Select point from memory.

Definition of the base points:

a) Measuring base points:
Input a point number and independent measurement of the base points using ALL or DIST/ REC.

b) Base points with co-ordinates:
Input a point number. The search for associated points in the memory can be initiated using <COORD>. If the required point is not in memory or there are no valid co-ordinates in the memory, the program prompts for manual entry of the co-ordinates.



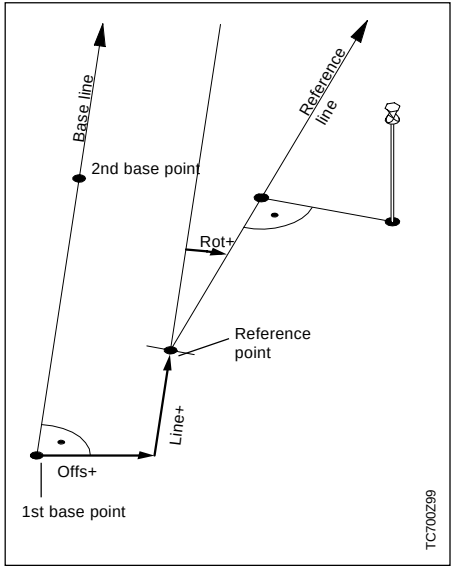
DIST — Triggers a distance measurement.

ALL — Triggers a distance measurement and register the measured data.

Analogous procedure for the second base point.

<EXIT>	Return to the start-up programs.
<COORD>	Input co-ordinates or search for fixed points and measurements.
<FINDPT>	Activates selective point search (see "Point Search" section)
<OK>	Confirms the entry and continues the program.
<NewL>	Renewed input of the first base point.

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



Input of the parameters:

Using the navigation keys / , the focus can be moved to the offset and rotation parameters for the reference line.

```
Define Ref.Line Shifts
Pt.1 :                101
Pt.2 :                102
Offs:           1.000 m
Line:           5.450 m
Rot :          20°00'00"
Hoff:           0.000 m
<EXIT><NewL><L&O> <RefL>
```

The following entries are possible:

Offs+: Parallel offset of the reference line to the right, referred to the direction of the base line (1-2).

Line+: Longitudinal offset of the start point (=reference point) of the reference line in the direction of base point 2.

Rot+: Rotation of the reference line clockwise around the reference point.

Hoff+: Height offset; the reference line is higher than the first base point.

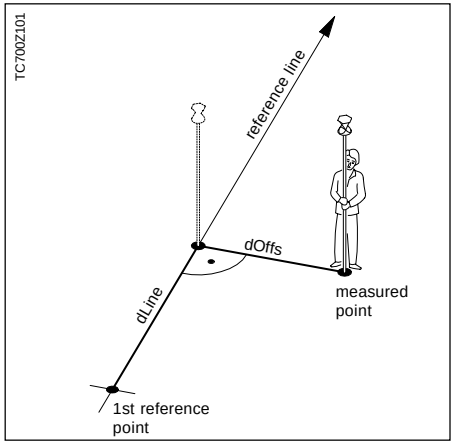
The calculation of the reference line is performed in stages as per the diagram shown on the left.

<EXIT> Return to the start-up programs

<NewL> Return to the definition of a new base line

<L&O> Opens the "Orthogonal Setout" application

<RefL> Opens the "Reference Line" application



The <RefL> function calculates longitudinal, transverse and height differences relative to the reference line. After the first distance measurement, the measurement dialog displays the calculated values (dLine, dOffs, dHt) continually if tracking mode is activated.

```
Reference Line Result
PtID:                 103
hr  :             1.550 m

dOffs:           -0.054 m
dLine:            0.020 m
dHt  :            0.120 m
<EXIT>             <RefL>
```

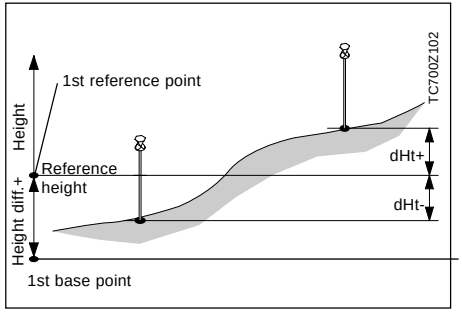
DIST Triggers a distance measurement.

ALL Measures and registers measured data.

<EXIT> Return to the start-up programs

<RefL> Redefine reference line.

The height of the first reference point is always used as the reference height for the calculation of height differences (dHt).



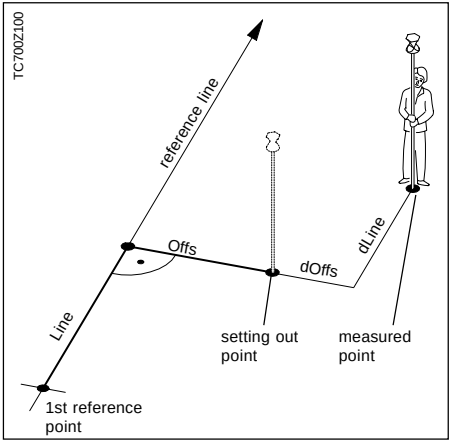
If tracking mode is activated (see "EDM Settings section"), correction values for the position of the reflector are displayed continuously.

Relative to the reference line you can enter longitudinal, transverse and height offsets for the target points to be set-out. The program then calculates the differences between the measured point and the calculated point. The program displays either the orthogonal (dL, dT, dH) or the polar differences (dHz, dHD, DH). By "making" these differences as small as possible, you can position the prism on the point to be set-out.

Using SHIFT / , you can switch between polar and orthogonal setting out differences.

If tracking mode is activated (see "EDM Settings" section), correction values for the position of the reflector are displayed continuously.

Example "orthogonal methods"



Offset input:

```
Input Line & Offset
PtId:                 103
hr  :             1.550 m

Offs:             3.750 m
Line:            10.500 m
Ht  :             1.500 m
<EXIT> <SHIFTS>   <CALC>
```

Display in measure mode:

```
Measure Line & Offset ▼
PtId:                 103
hr  :             1.550 m

dHz :           -0°15'20"
dHD :             1.220 m
dH  :             0.350 m
<EXIT> <SHIFTS>    <L&O>
```

```
dOffs:            3.750 m
dLine:           10.500 m
dHt  :            0.350 m
```

<EXIT> Return to the start-up programs.
<SHIFTS> Redefine reference line.
<CALC> Set-out points.
<L&O> Input new setting out elements.
DIST Triggers a distance measurement.
ALL Triggers a distance measurement and register the measured data.

The signs for the distance and angle differences are exactly the same as for the "Setout" application. These are correction values (required minus actual).

+dHz	Turn telescope clockwise to the setting out point.
+dHD	The setting out point is further away than the point measured.
+dHt	The setting out point is higher than the measured point.

Warnings/messages

Important messages	Meaning
Save via RS232	Data output (system setting menu) via RS232 interface is activated. To be able to successfully start reference line, the "IntMem" setting must be enabled.
Base line too short	Base line is shorter than 1 cm. Choose base points such that the horizontal separation of both points is at least 1 cm.
Distance not measured	No distance measured or invalid. Repeat distance measurement until a valid distance is displayed.
Co-ordinates invalid	No co-ordinates or invalid co-ordinates for a point. Ensure that a point used has at least one Easting and one Northing co-ordinate.

When Setting-out via PC is used, data is sent from a computer (field computer, external data recording unit) to the instrument. In general, this data is either coordinates or calculated data, e.g. angles or distances.

Following transmission of the necessary data, the corresponding screen is displayed, i.e. either setting-out with co-ordinates or setting-out with azimuth, distance and height. The subsequent procedure for setting-out points is the same as in the "Setting-Out" application on the instrument.

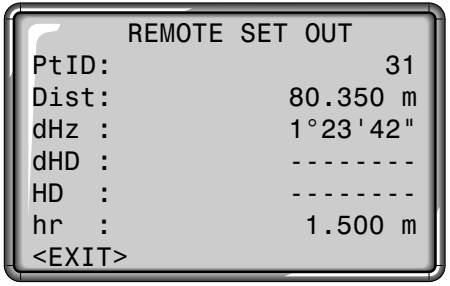
Procedure

	RS232 Command
1. Open the start dialog.	**setout** CRLF **c** CRLF

2. Input the setting-out values or the co-ordinates to be set-out.

Data Type	**RS232 Command**
Point ID (PtID):	PUT/11….+12345678_CRLF
Bearing (Brg):	PUT/24…2+12345678_CRLF
Horizontal distance (Dist):	PUT/34…0+12345678_CRLF
Easting co-ordinate (E):	PUT/81…0+12345678_CRLF
Northing co-ordinate (N):	PUT/82…0+12345678_CRLF
Height (H):	PUT/83…0+12345678_CRLF (_ = space)

Once the required data has been transferred to the instrument, the display changes automatically and shows the difference in the direction to the point to be set-out.



DIST Following the distance measurement, the horizontal distance difference and the height difference to the point to be set-out are displayed.

ALL or REC Transmission of the measured data to the external data recording unit. Measurements including data recording can also be triggered from the external data recording unit.

The measured data is always transmitted over the RS232 interface and is never written to the internal memory in the instrument.

Further commands

	RS232 Commands
Inputs new data	c CRLF
Quits setting-out via PC	x CRLF

Further displays

SHIFT Change to further displays with additional data in accordance with the selected setting-out method:

- Setting-out with azimuth, distance, and height; change to orthogonal setting-out (dL, dQ, dH) and display of the setting-out values (PtID, Brg, Dist) and the station data (E0, N0, H0, hi).
- Setting-out with co-ordinates: change to orthogonal (dL, dQ, dH) or cartesian setting -out (dE, dN, dH) and display of the setting-out values (PtID, E, N, H, Brg, Dist).

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

A clear differentiation is made between GSI-coding (TPS100 instruments) and OSW-coding (TPS300/TPS700-instruments). For further information regarding "Coding", please refer to section *"Data Manager".*

OSW-coding

Unlike the GSI-coding OSW-coding enables the division into attribute names and values.

Code:	Code name
Desc.:	Additional remark
Attrib.:	User-defined attribute name; defined when creating the codelist.
Value:	Attribute value; can be entered or edited when calling the code.

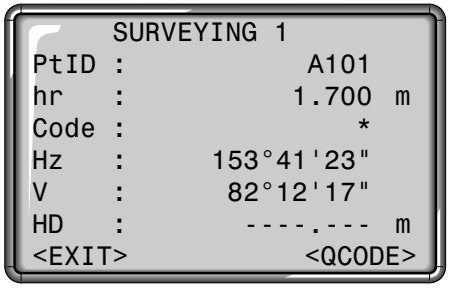
GSI-coding

GSI codelists created with TCTools or in T100 instruments can be used.

Code:	Code name
Desc.:	Additional remark
Info1:	more, freely editable
...	information
Info8:	lines

Searching code blocks

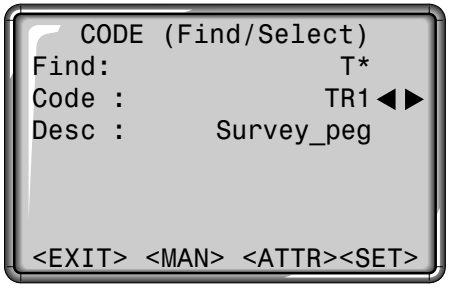
How I can find an already entered code again ?
Starting from "SURVEYING" the code function can be easily called.



1. Move cursor to field "Code".

2. Enter a wildcard place holder (e.g. T*) or exact code designation and confirm with . Code function is activated.

All codes corresponding to the entered search criteria are found.



<ATTR> Displays the remaining attributes.

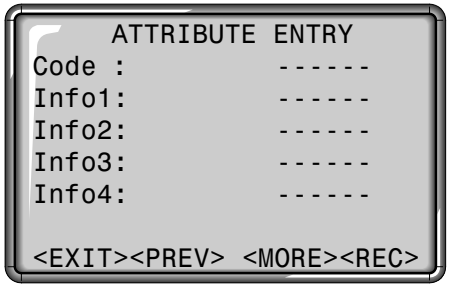
<MAN> Starts manual code input .

◀ ▶ Using the arrow keys, you can page through the codes found with entered search criteria.

Manual code input

Individual code blocks can be entered directly via keypad.

<MAN> Starts manual code input and opens an empty code block.

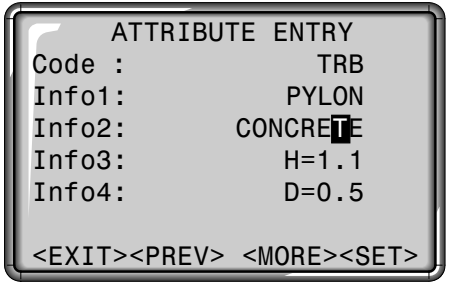


Navigation and numeric/ alphanumeric input possible via cursor keys.

Attributes 5 to 8 can be displayed with <MORE> or .

Extending/editing code

1. Call available code from code list.
2. Attributes can be overwritten freely.



Call edit mode and edit attribute.

Exceptions:

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

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

Recording code block

After quitting the code function with <SET> the code block in the system is temporarily set. Recording only with measurement (ALL- or REC-fix keys) and always with reference to the actual point number.

Leica SurveyOffice
With the help of the TPS-Setup ("External Tools") the instrument can be configured, so that the codes are recorded either before or after the measurement.

Warnings / Messages

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
<OK>
> Code missing. Extend input. One or more attributes must be entered or confirmed.

Individually (<MAN>) entered code blocks will not be copied to the codelist.

Leica SurveyOffice
Codelists can be easily created and uploaded to the instrument using the supplied "Leica SurveyOffice" Software.

Possible buttons

<EXIT> Quits code function. Returns to previous application or function.

<MAN> Activates the manual code entry.

<MORE> Displays more code attributes.

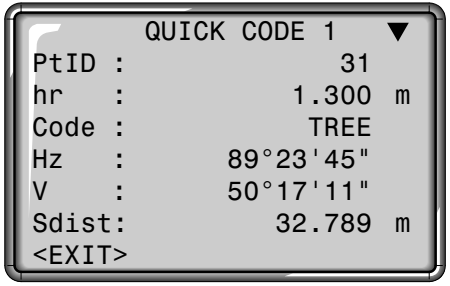
<SET> Accepts the code entry or selection and sets the code block in the system temporarily.

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 Leica SurveyOffice "Codelist Manager". The quick code function is started by typing this number on the numeric keypad.
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 … 00 -> hundredth (and last) code in the code list).

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 activate the function the quick code display must be opened.



Procedure

1. Press <QCODE> button in the "Measuring" or "Surveying" application.
2. 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.

It is not possible to make any entries in the quick code dialog.

The quick code function can only be activated in the "Measuring" and "Surveying" applications (if there is a code list in the memory).

Quick Settings

SHIFT PROG Opens the menu functions.

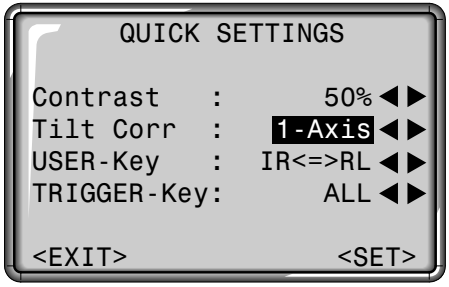
<EXIT> Leaves the menu. Back to "Measure".

Each menu command can either be started directly using the appropriate data entry key (1 ... 5) or selected using ▲ / ▼ and the selection confirmed using ◀. Only the shortcut method is referred to in this User Manual.

"Quick Settings" are settings frequently used integrated into a common display. All of these settings can also be changed in the configuration.
The parameter or selection fields are controlled via the navigation keys. The current active parameter is indicated by the black bar.

SHIFT PROG Calling up menu functions.

1 Shortcut to the function "QUICK SETTINGS".



Contrast:
Set the display contrast in 10% steps.

Tilt Correction:
Switch the compensator on or off.

USER key:
Allocate function from FNC menu.

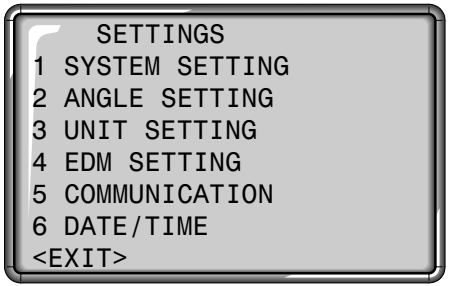
Trigger key:
Configuration of trigger key located at the side of the instrument. This can be assigned with ALL, DIST or deactivated.

The display contents, particularly lines, contained in this description can vary in local versions of the software. The function of the display is however identical.

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

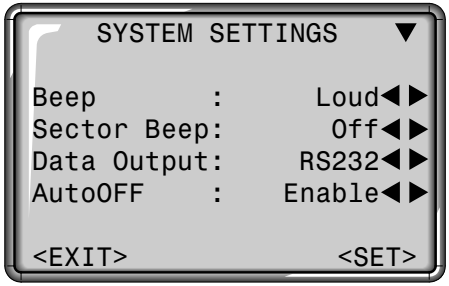
SHIFT PROG Opens the menu functions.

2 Shortcut to the function "ALL SETTINGS".



<EXIT> Leaves "Settings". Back to "Measure".

All parameter selection fields are available to the user.



SHIFT Displays additional parameters.

Select a setting.

<EXIT> Back to "Settings" without setting the changed settings.

<SET> Sets the changed settings and returns to "Settings".

Beep
The beep is an acoustic signal after each key stroke.

Off	Beep switched off
Normal	Beep switched on
Loud	Increased volume

Sector Beep

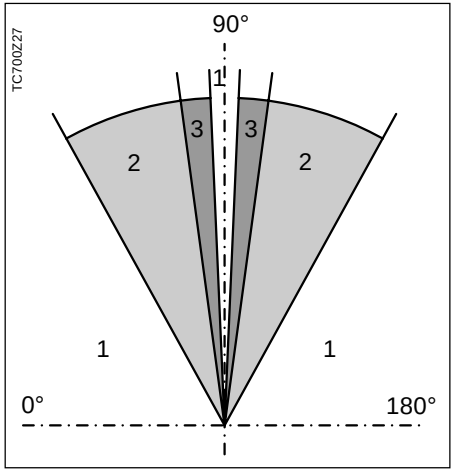
Off:	Sector beep switched off.
On:	Sector beep sounds at right angles (0°, 90°, 180°, 270° or 0, 100, 200, 300 gon).

Code Set
Defines whether the code block is saved before or after the measurement (see also "Coding" section).

Before	Save code block before the measurement
After	Save code block after the measurement

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 100.995 gon) a "Permanent beep" sounds.



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

Data Output

RS232 Data is recorded via the serial interface. For this purpose, a data storage device must be connected.

IntMem All data is recorded in the internal memory.

AutoOFF

Enable The instrument is switched off after 20 minutes without any action (= no key pressed; V and Hz angle deviation ≤ ±3' / ±600cc).

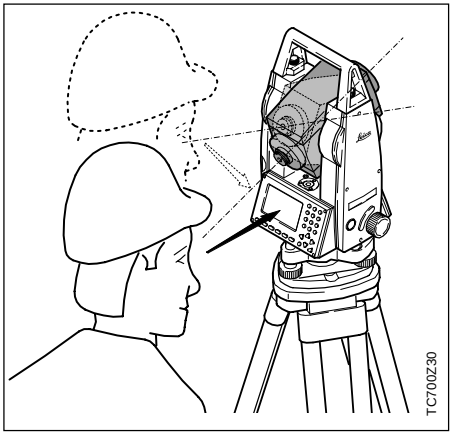
Disable Function is deactivated and the instrument is permanently operating. The battery will not last for as long.

Sleep Economy mode. Instrument is recovered by any key stroke.

Contrast

10% Setting the display contrast in 10% steps; adapting the readability depending on the light conditions.

The readability of LCDs is influenced by external conditions (temperature, lighting) and by the reading angle *(see figure)*. The display contrast can be adapted step by step until the optimum readability is achieved.



USER-Key

Allocation of a function from FNC menu (SHIFT USER) to the User key (USER).

IR<=>RL	Changes the EDM type between IR and RL.
REC	Records a measurement block.
LASERPNT	Switches the visible laser point on or off .
TRACKING	Switches the tracking measurement mode on or off.
OFFSET	Definition of length, cross and/or height offset for target points.
CHECKTIE	Displays the tie elements.
REM	Indirect height determination.
DLR	Deletes the last data block recorded in the internal memory.

TRIGGER-Key

Configuration of the trigger key on the 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.

Face I Definition

Defines the telescope face I in relation to the position of the V-drive.

V-Left	Telescope face I if V-drive is left hand located.
V-Right	Telescope face I if V-drive is right hand located.

GSI-Format

Select GSI output format.
GSI8: 81..00+12345678
GSI16: 81..00+1234567890123456

GSI-Mask

Select GSI output mask.
Mask 1: PtID, Hz, V, SD, ppm+mm, hr, hi
Mask 2: PtID, Hz, V, SD, E, N, H, hr

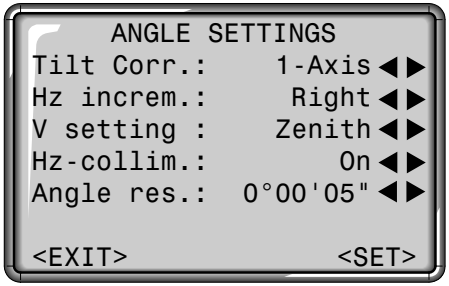
DSP-Heater

On	Is automatically activated when the display illumination is on and the instrument temperature is < –5°C .

Reticle

The reticle illumination is only switched on if the display illumination is on.

Low	reticle illumination dimmed
Medium	average brightness
High	strong illumination



Tilt corr

Off	Tilt compensation switched off.
1-Axis	V-angles relate to the plumb line.
2-Axis	V-angles relate to plumb line and the Hz-angles are corrected for the tilt of the standing axis.

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 its measuring range and interupting the measuring process by indicating an error.

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

Hz-Incrementation

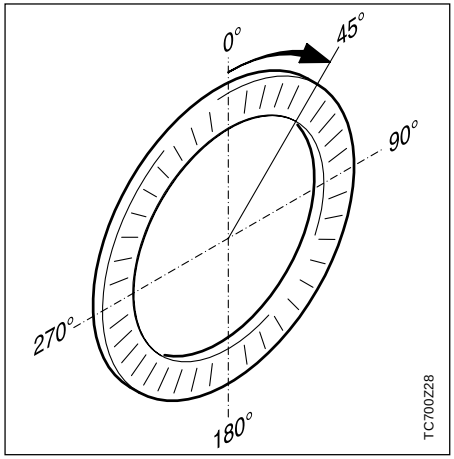
Hz angle incrementation

Right	Set Hz to "Right angle measurement" (= clockwise).
Left	Set Hz to "Left angle measurement" (= counterclockwise). "Left angle measurements" are only shown in the display. They are recorded as "Right angle measurements" to the internal memory.

V setting

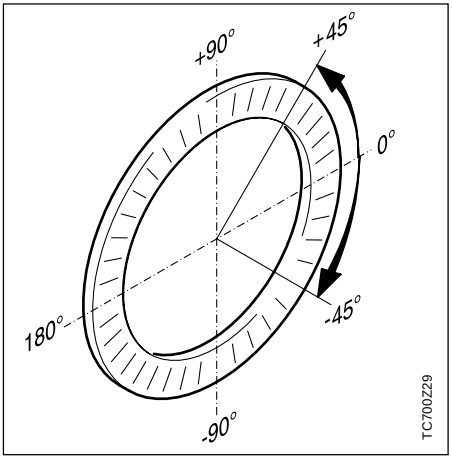
The "0"- orientation of the vertical circle can be selected to the zenith, the horizontal plane or in %.

Zenith



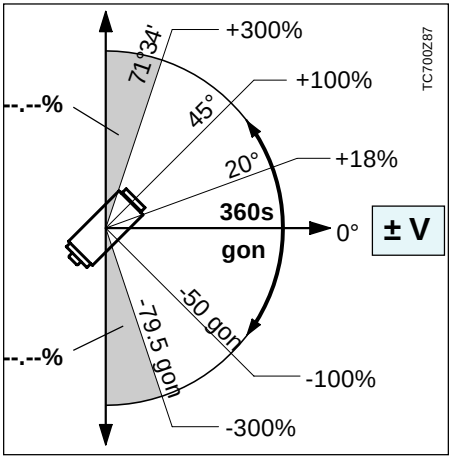
The V-angle increases from 0° - 360° (0 - 400 gon).

Horizontal plane



V-angles above the horizontal plane are indicated as positive values and below the horizontal plane as negative values.

Slope %



100% correspond to an angle of 45° (50 gon, 800 mil).

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

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 relative to the V-angle.

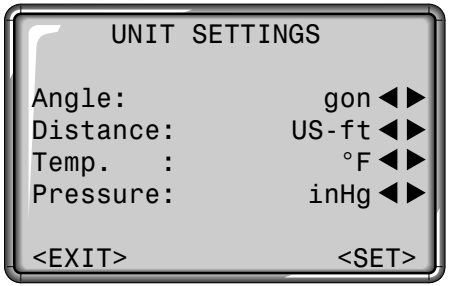
For normal operation the Hz-collimation remains switched on.

Find more information about the Hz-collimation in section *"Determining instrument errors".*

Resolution

The displayed angle format can be selected in three steps.

- **For 360°'"**:
  0° 00' 01" / 0° 00' 05" / 0° 00' 10"
- **For 360°**:
  TC(R)702: 0.0001° / 0.0005° / 0.0010°
  TC(R)703/705: 0.0005° / 0.0010° / 0.0050°
- **For gon**:
  TC(R)702: 0.0001 gon / 0.0005 gon / 0.0010 gon
  TC(R)703/705: 0.0005 gon / 0.0010 gon / 0.0050 gon
- **For mil**:
  0.01 mil / 0.05 mil / 0.10 mil



Angle

° ' "	(degree sexagesimal) possible angle values: 0° to 359°59'59"
dec. deg	(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.

Distance

meter	Meter
ft-in1/8	US feet -inch - 1/8 inch
US-ft	US feet
INT-ft	International feet

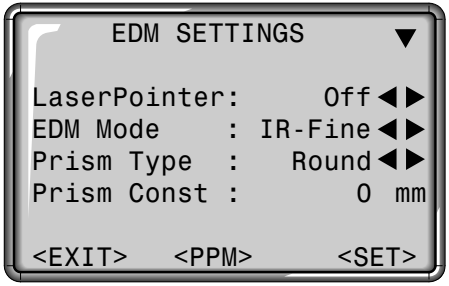
Temperature

°C	Degree Celsius
°F	Degree Fahrenheit

Pressure

mbar	Millibar
hPa	Hecto Pascal
mmHg	Millimeter mercury column
inHg	Inch mercury column

The EDM settings contain a detailed menu with selection fields for required settings.



Open second display with SHIFT.

Laser Pointer

Off: Visible laser beam is switched off.

On: Visible laser beam for defining the target point is switched on.

Dist Mode

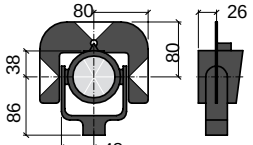
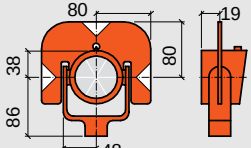
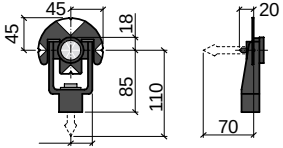
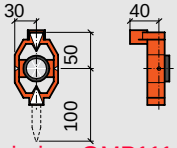
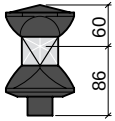
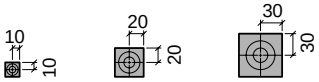
With TCR instruments different settings for measurements with visible (RL) and invisible (IR) EDM type are available.
Depending on selected measuring mode the selection prism types are different.

RL-Short	Short range. For distance measurements without prisms with a target distance up to 80 m (3mm + 2 ppm)
RL-Track	Continuous distance measurement without prisms (< 1 km) (5mm + 2 ppm)
RL-Prism	Long range. For distance measurements with prisms from 1 km (5mm + 2 ppm)

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

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)

Prism type
Open the function in the EDM settings.

Leica Geosystems Prisms (Professional Series)	**Constants [mm]**	Leica Geosystems Prisms (Basic Series)
 Standard prism GPR121	**0.0**	 Standard prism GPR111
 Miniprism GMP101/102	**+17.5**	 Miniprism GMP111
360° Prism GRZ4	**+23.1**	
Reflective targets	**+34.4**	
USER	**--**	is set at "Prismconst" (Example adjacent)
RL	**+34.4**	Reflectorless

Prism constant
Open the function in the EDM settings.

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

Formula:
Prism constant to be entered
= -mm + 34.4

Example:

Non-Leica Geosystems prism constant = 14 mm

=>Prism constant to be entered
= -14 + 34.4 = **20.4**

Limit value: -999 mm to +999 mm

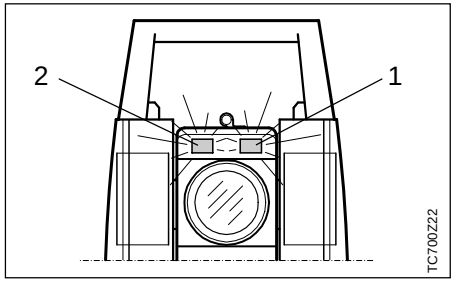
Guide Light EGL

The optionally available Guide Light EGL consists of two coloured flashing lights in the telescope of the total station. All TC(R)702/703/705-instruments can be equipped with this 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 setting out points.

Off: The automatic Guide Light EGL is switched off.

On: The automatic Guide Light EGL is switched on.

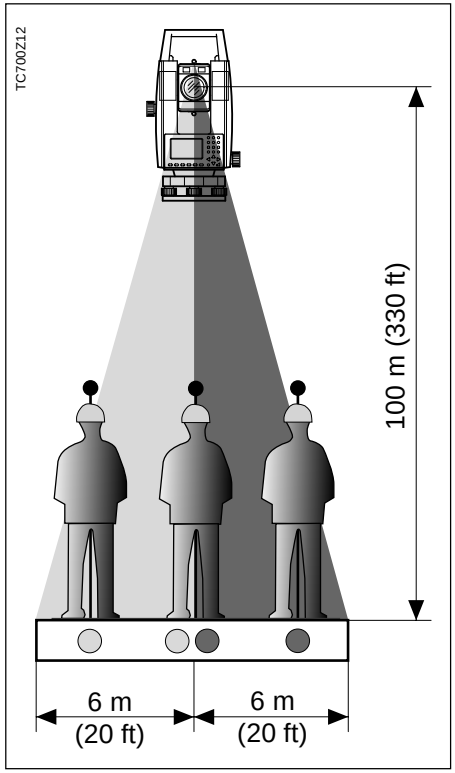
Menu options are only active when an EGL is installed.



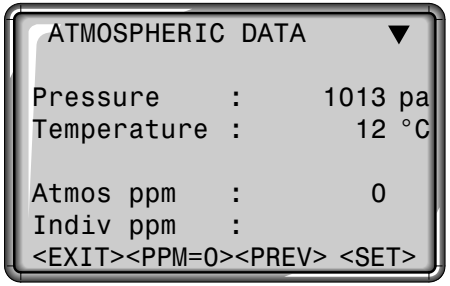
1 Flashing red diode

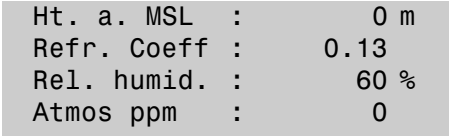
2 Flashing yellow diode

Operating range:
5 - 150 m (15 -500 ft)
Divergence:
12 m (40ft) at 100m (330 ft)



Atmospheric Parameters (ppm)
Distance measurement is influenced directly by the atmospheric conditions of the air through which distance measurements are taken.





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

The atmosperic distance corrections are derived from the air temperature, from the air pressure or the height at mean sea level and the relative air humidity or the humidity temperature.

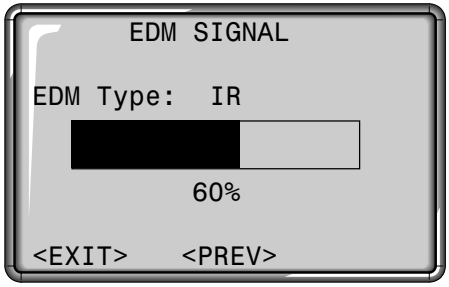
- Pressure
  Air pressure at instrument location.
- Ht. a. MSL
  Height above sea level at instrument location.
- Temperature
  Air temperature at instrument location.
- Rel. Humid.
  Relative humidity of air in % (normally 60%)
- Refr.Coeff
  Input of refraction coefficient for the atmospheric conditions.
- Atmos_ppm
  Calculated and indicated atmospheric ppm.

Refraction correction

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

Standard <PPM=0>
Set all values such that the total PPM is equal to "0" (see also *"PPM Tables"* in section *"Atmospheric Corrections"*).

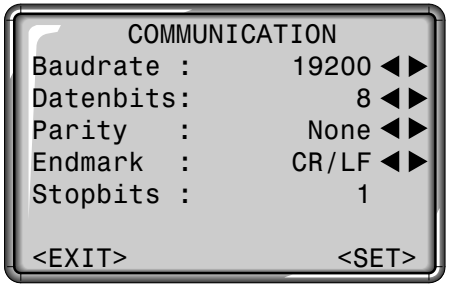
<SIGNAL> button



EDM Type:
Indication of current EDM selection (infrared or reflectorless).

 :
Indication of EDM signal strength (reflection strength) in 1% steps. Enables optimum distance measurement to poorly visible targets.

<PREV> Back to EDM settings.



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

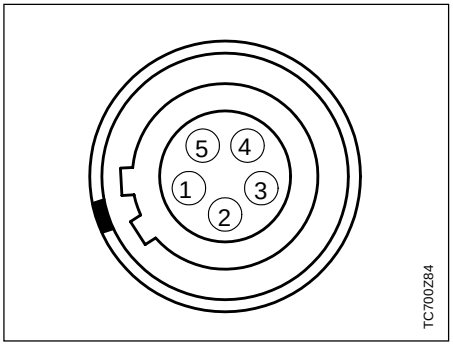
Even	Even parity
Odd	Odd parity
None	No parity (if data bit is set to 8)

Endmark

CR/LF	Carriage return; line feed
CR/LF	Carriage return

Stopbits
Firm setting 1.

Interface plug connections:



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

TH ... Theodolite

For displaying and setting of date and time.

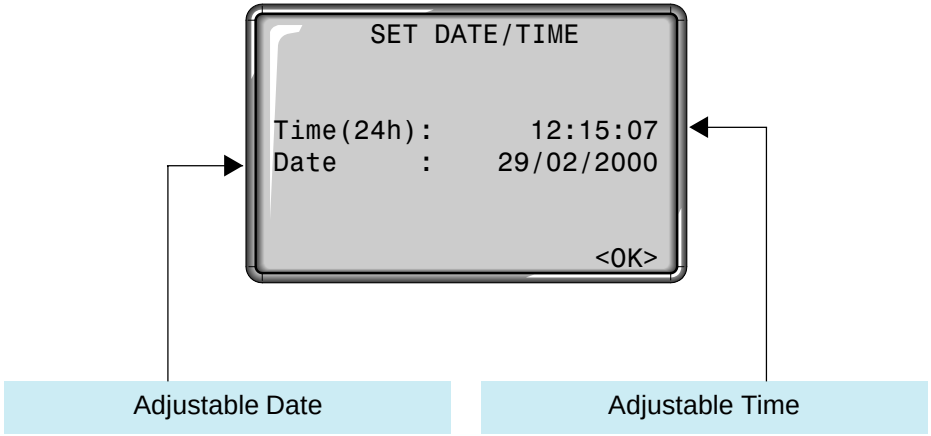
Time:
Form: hh:mm:ss
(hours, minutes, seconds)

Date:
Form: dd/mm/yyyy
(day, month, year)

/ Selects an input field.

/ Activates edit mode.

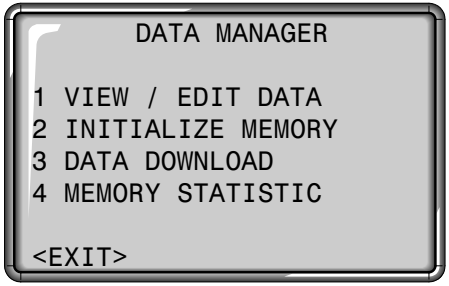
The time/date is immediately set for the complete system after input.



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

SHIFT PROG Open the menu functions.

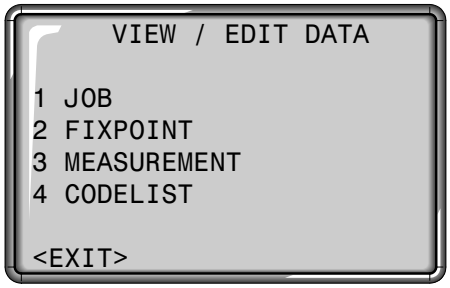
3 Shortcut to the function "DATA MANAGER".



- **VIEW / EDIT DATA**
  Edit, create, view and delete jobs, measurements, fixed points and codelists.
- **INITIALIZE MEMORY**
  Delete complete memory, individual jobs or complete data areas (e.g. fixed points, measurements).
- **DATA DOWNLOAD**
  Selected data sets are transfered to the interface without protocol and test procedures.
- **MEMORY STATISTIC**
  Statistical information about job and memory allocation.

VIEW / EDIT DATA

1 Shortcut to the function "VIEW / EDIT DATA" in the "Data Manager" display.



<EXIT> Back to Data Manager.

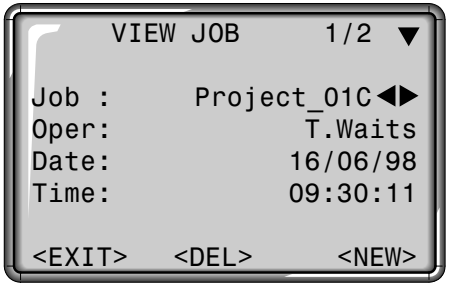
1 .. 4 Direct selection of the data type.

 Select data type using arrow keys.

 Opens Data Manager.

Job

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:

Using the arrow keys the job list can be paged through in both directions.

Deleting job:

Select relevant job.

<DEL> Deletes all data within a job.

Input of a Job:

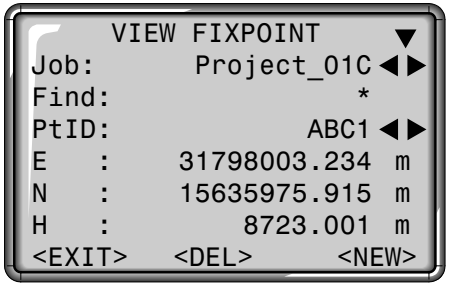
<NEW> Defines a new job and job data entry (e.g. job, user).

<SAVE> Creates and registers the new job.

<PREV> Back to job search without saving.

Fixed points

Fixed points may be entered with point number, coordinates (E, N) and height.



Valid fixed points contain a minimum of one point number and either the co-ordinates (E, N) or the height (H).

<DEL> Deletes the selected fixed point.

Enter fixed points:

<NEW> Starts the point and edit input for fixed points or editing of existing fixed points by calling the relevant point number.

Within the job selection field the directory for the fixed point is selected.

<SAVE> Saves the data entered.

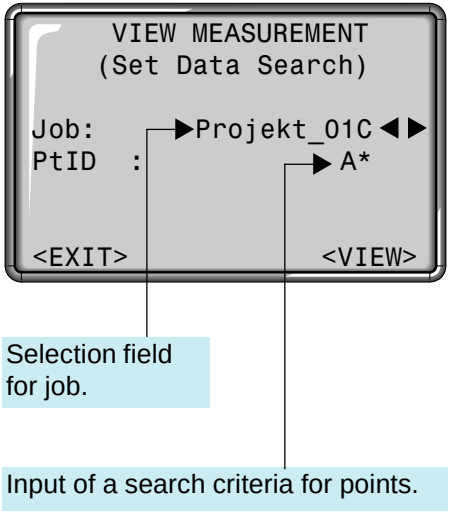
<PREV> Back to fixed point search or display of coordinates.

Fixed point search:

The same conditions are valid here as with point search. You can enter the exact point number or limit the data range by entering a wildcard (e.g. A*).

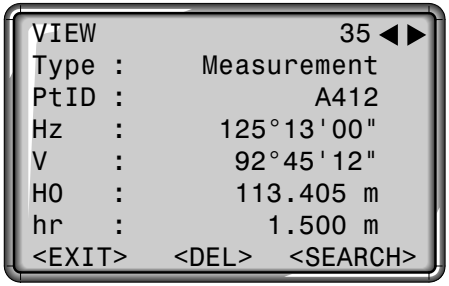
Measurements

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



Points can be searched for by two methods:

- Job selection:
  (e.g. "Project_01C")
- Point selection:
  Finds all points meeting the conditions mentioned above and also the search critera for the point search.



e.g. If "A*" is entered, all data for which the point ID starts with "A" is found.

SHIFT Extended display with co-ordinates and time information.

<DEL> Deletes the selected data set from the internal memory.

<SEARCH> Back to point search.

Additional data blocks can be recorded in the measuring range irrespective of the program in use.

Corrections:
EDM-Type, EDM-Mode, Prism typ, Prism constant, Atmospheric PPM, Pressure, Ht. Above Sea Level, Temperature, Rel. humid., Refraction Coefficient

Stations:
PtID, E, N, H, hi, Date, Time

Results:
No pts, StDev. Hz, Date, Time, Area, Tie Distance, setout differences, etc.

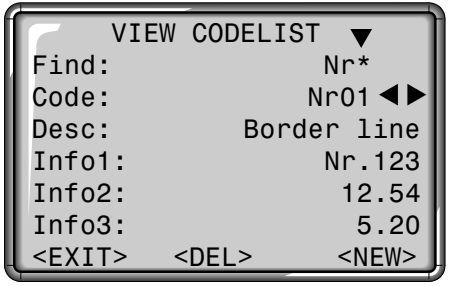
Measurements:
Pt, Hz, V, SD, Hd, dH, hr, E, N, H, Date, Time

Codes:
Code, Rem., Attr.1-8

You will find detailed information on the storage of data in the section "Saving Data".

Codelist

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

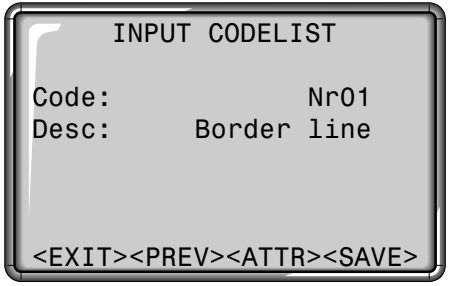


Searching for code:

The codelist can be toggled through in both directions using the arrow keys .

<NEW> : Enter new codelist:

Input of a new code and a descriptive text.



<ATTR> Input of attributes (alphanumeric).

<SAVE> Records inputs; back to code search.

<PREV> Back to code search; without saving.

Deleting code:

Select relevant code.

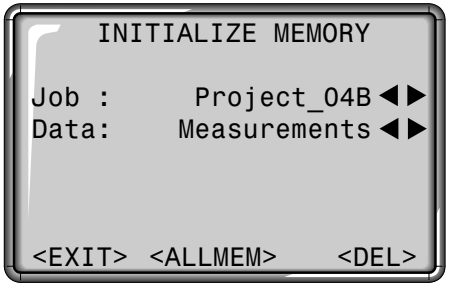
<DEL> Deletes code block.

Extended display for viewing and checking attributes.

Code can be searched directly, either with the code name or wildcard (*).

Individual jobs or complete data areas of a job are deleted. Deleting all data in memory.
Two selection fields enable a specific area to be selected.

Shortcut to the function "INITIALIZE MEMORY" in the "Data Manager" display.



Selection of job and data area to be deleted.

Possible data areas:
- measurements
- fixed points
- jobs

<DEL> Starts deleting process within the selected area.

<ALLMEM> Deletes all data in memory. All data will be lost !

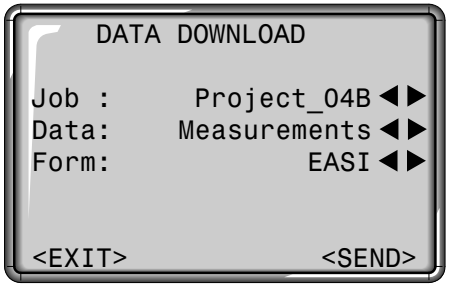
<NO> Back to selection of area to be deleted. Data is kept.

<YES> Deletes the selected data area within the selected job.

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

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

3 Shortcut to the function "DATA DOWNLOAD" in the "Data Manager" display.



Selection of individual parameters.

<SEND> Data is sent via interface.

Job: Selection of job from which data should be transfered.

Data: Fixed points or measurements can be sent separately and independently from each other. Selection of data type.

Format: Select output format. The following formats can be selected for output:
1. GSI
2. APA CAD
3. User-defined data formats

User-defined formats must be first loaded using Leica Survey Office (Data Exchange Manager).

Example: "GSI" format

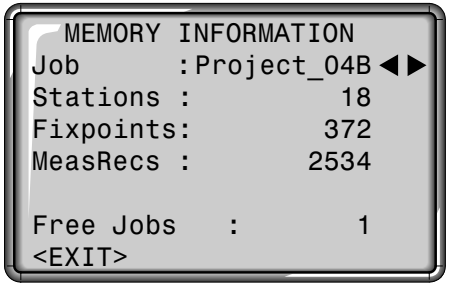
Within the "data" setting "MEASUREMENTS", a data set could have the following appearance:

```
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  522.16-00000000
```

If the receiver is too 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).

It is possible for the user to call-up important information about the status of the internal memory. Additionally, the user can obtain information about the composition of the data in the individual jobs.

4 Shortcut to the function "MEMORY STATISTIC" in the "Data Manager" display.



<EXIT> Back to Data Manager.

Stations:
Number of stations used within the selected jobs.

Fixpoints:
Number of stored fixed points within the selected jobs.

Meas Recs:
Number of recorded data blocks (measured points, codes, etc.) within the selected jobs.

Free Jobs:
Number of free or not defined jobs.

Messages

Data SAVED
- Data has been recorded in the internal memory.

> Display disappears after <1 seconds. Back to last active display.

Data DELETED
- Data has been deleted in the internal memory.

> Display disappears after <1 seconds. Back to last active display.

JOB DELETED
- The content of a complete job has been deleted permanently.

> Display disappears after <1 seconds. Back to last active display.

Warnings

No data found in memory!
- No relevant data blocks could be found in the memory.

> Search for other data or enter relevant data in the Data Manager. Confirm with <OK>. Back to last active display.

Error messages

All memory blocks occupied!!
- Available memory full.

> Delete a job or data area in the internal memory. Confirm message with <OK>.

Job already exists in database!!
- Job or job name already exists in memory.

> Change job name. Make sure that the job name is not already available. Confirm message with <OK>.

Invalid Job-Name!!
- Job name is empty or contains a "-".

> Change job name. Confirm message with <OK>.

The calibration contains the determination of the following instrument errors:

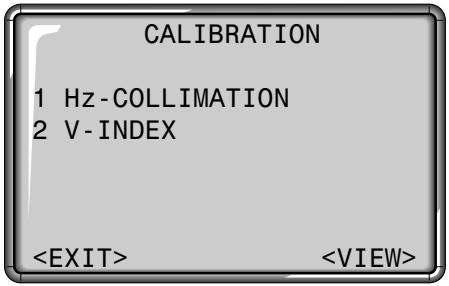
- Hz-collimation
- V-index (simultaneously electronic level)

SHIFT PROG Opens the menu functions.

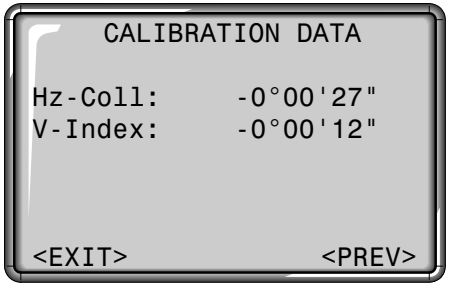
4 Shortcut to the function "CALIBRATION".

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

The user is guided clearly through the procedure. As a result, a wrong determination of instrument error is eliminated.



<VIEW> Overview of the values saved.



Buttons:

<VIEW> Display of actual calibration values.

<MEAS> Measurements are triggered exclusively by pressing this button. Buttons ALL or DIST are not active during calibration.

<EXIT> Back to calibration menu without saving.

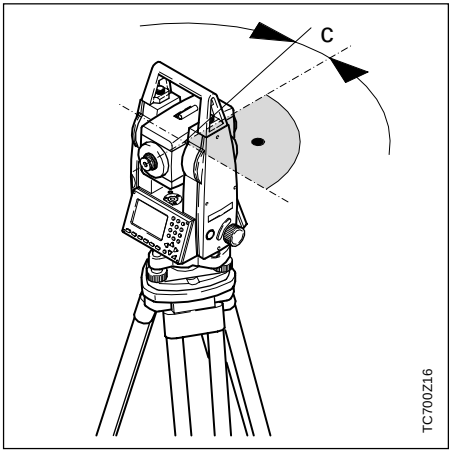
<PREV> Back to last active display.

The instruments are adjusted in the factory prior to shipping.

Instrument errors can change with time and temperature.

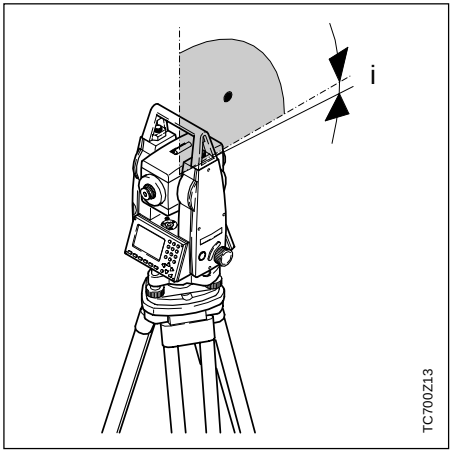
These errors should be determined before the instrument is used for the first time, before precision surveys, after long periods of transport, before and after long periods of work, and if the temperature changes by more than 10°C (18°F).

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 warming on one side only.



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 the Hzangle equals the line-of-sight error.

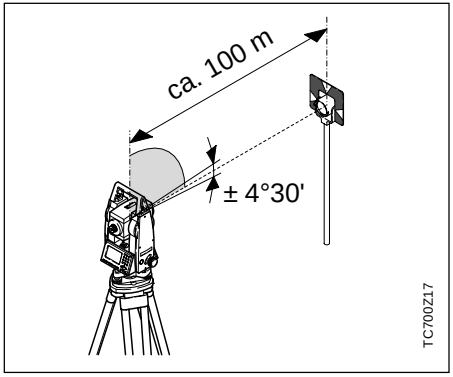


The vertical circle should read exactly 90° (100 gon) when the line of sight is horizontal. Any deviation from this figure is termed vertical index error (i).

By determining the vertical index error the electronic level is adjusted automatically.

1. Level up instrument exactly using the electronic level.

2. Aim at a point approximately 100m from the instrument that is less than ± 4°30' (5 gon) from the horizontal.

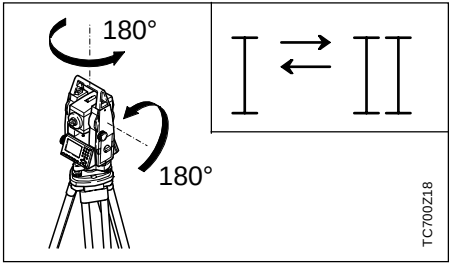


For checking the horiontal aiming Hz and V are displayed.

```
HZ-COLLIMATION 1

Hz :        123°43'07"
V  :        272°11'31"

     Sight target !

<EXIT>              <MEAS>
```

3. <MEAS> Trigger measurement.

4. Change telescope face and aim on point again.



5. <MEAS> Trigger measurement again.

```
HZ-COLLIMATION 2

Hz :        303°43'17"
V  :         87°48'19"
dHz:         -0°00'10"
dV :          0°00'28"

<EXIT>              <MEAS>
```

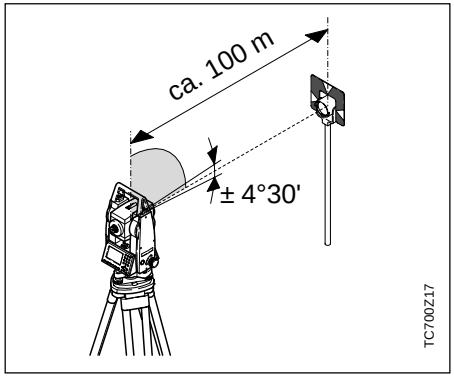
6. Indication of previous and recomputed line-of-sight-error.

```
HZ-COLLIMATION (c)

c(old):      -0°00'27"
c(new):      -0°00'25"
```

The new value can be either accepted with <SET> or rejected with <EXIT>.

1. Level up instrument exactly using the electronic level.

2. Aim at a point approximately 100m from the instrument that is less than ± 4°30' (5 gon) from the horizontal.



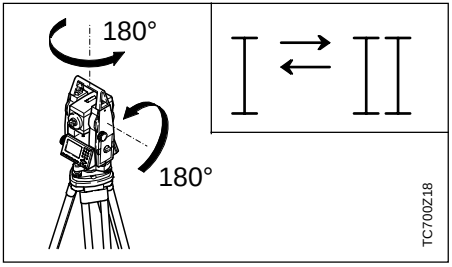
By determining the vertical index error the electronic level is adjusted automatically.

For checking the horiontal aiming Hz and V are displayed.

```
    VERTICAL INDEX 1

Hz :        123°43'07"
V  :        272°11'31"

      Sight target !

<EXIT>              <MEAS>
```

3. <MEAS> Trigger measurement.

4. Change telescope position and aim on point again.



5. <MEAS> Trigger measurement again.

```
    VERTICAL INDEX 2

Hz :        303°43'17"
V  :         87°48'19"
dHz:         -0°00'10"
dV :          0°00'28"

<EXIT>              <MEAS>
```

6. Indication of previous and recomputed V-index.

```
    VERTICAL INDEX (i)

i(old):      -0°00'27"
i(new):      -0°00'14"
```

The new value can be either accepted with <SET> or rejected with <EXIT>.

Important messages	Meaning	Measures
V-Angle not suitable for calibration (Check V-angle or face)	Aiming tolerance not met or telescope 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.
Calibration 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 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 face I and II too long).	Repeat the process. Confirmation of the message required.

Useful information which can be called via menu. These are only indications of actual setting and cannot be changed here. All changes to settings must be carried out in menu "SETTINGS".

Opens the menu functions.

Shortcut to the function "SYSTEM INFO".

Scrolls the display.

<SW> Software versions overview.

Free Jobs
Number of free jobs is displayed. If no jobs are in the memory under "Measure and Record" the system creates a "Default" job automatically. All data is stored into this Default job which can be freely renamed.

Tilt Corr.
Display of current compensator setting:

Off:	Compensator switched off.
1-Axis:	Compensator activated in longitudinal axis along the direction to the target).
2-Axis:	Compensator activated in longitudinal and transverse axis

USER-Key
Current assignment of the 

-key. The following functions from the FNC menu are available:

IR<=>RL	Switches between IR and RL.
REC	Records a measurement block
LASERPNT	Switches on or off the visible laser point.
TRACKING	Switches on or off the tracking measurement mode.
OFFSET	Definition of length, cross and/or height offset for target points.
CHECKTIE	Displays the tie elements.
REM	Indirect height determination.
DLR	Deletes the last data block recorded in the internal memory.

TRIGGER-Key
Off: function deactivated.
ALL: ALL function activated.
DIST: DIST function activated.

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

Instr.Temp.
Measured instrument temperature.

DSP Heater (On/Off)
Activates the display heating. With setting ON the heating is switched on as soon as the instrument temperature falls below "-5°C" and the illumination is switched off. When the temperature increases again, the heating is automatically switched off.

Hz-Coll. (On/Off)
The correction of measured Hz-angles with the Hz collimation can be switched On/Off.

Calibration Values
Indication of last determined and stored calibration values (Hz-collimation, V-index).

Software versions
The software of the instrument is composed of different software packages. Depending on this packages different versions are possible.
Op-System: Operating System
Appl.-SW: Applications, functions and menu
Layout: User displays

The following categories of data are stored in the internal memory:

- Measured data
- Fixed points
- Jobs

The measured data are subdivided into different objects (measurements, target points, stations, results, residuals, correction parameters, codes). Depending on the application, one or more of these objects are saved, the contents (attributes) of the objects are described in the following. The time and date are also saved at the same time with each object, as well as the name of the application in which the objects were saved.

Comment on the "Measurement" object:
E, N, H, HD and dH are **calculated** from the measurements (applies to all applications).

Job

Job = Job name
Oper = Observer name
Rem1 = Comment 1
Rem2 = Comment 2
Date = Date
Time = Time

Station

Stn = Station number
E0 = Station co-ordinate (Easting)
N0 = Station co-ordinate (Northing)
H0 = Station height
hi = Instrument height

Target Point (1):
PtID(1) = Point ID
E(1) = Easting
N(1) = Nothing
H(1) = Height

Measurement (1):
PtID(1) = Point ID
Hz(1) = Horizontal angle
V(1) = Vertical angle
SD(1) = Measured slope distance
hr(1) = Reflector height

Target Point (n):
PtID(n) = Point ID
E(n) = Easting
N(n) = Northing
H(n) = Height

Measurement (n):
PtID(n) = Point ID
Hz(n) = Horizontal angle
V(n) = Vertical angle
SD(n) = Measured slope distance
hr(n) = Reflector height

Results:
PtID(1) = Point ID of the first target point
Brg = Calculated azimuth between the station coordinates and the first target point (based on the telescope face in which orientation was performed)
NoPts = Number of target points used
HzCor = Hz circle correction
St Dev = Standard deviation of the Hz circle correction
Face = Telescope face in which orientation was performed

Residuals:
dHz = Residual for the horizontal angle
dHD = Residual for the horizontal distance
dH = Height residual

Measuring Application

Measurement:

PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
SD = Measured slope distance
hr = Reflector height

Survey Application

Measurement:

PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
SD = Measured slope distance
hr = Reflector height

Setting-Out Application

Target Point:
PtID = Point ID
E = Easting
N = Northing
H = Height

Measurement:
PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
SD = Measured slope distance
hr = Reflector height

Results:
dE = Easting setting-out difference between target and measured point
dN = Northing setting-out difference between target and measured point
dH = Height setting-out difference between target and measured point

Tie Distance Application

Measurement (1):
PtID(1) = Point ID
Hz(1) = Horizontal angle
V(1) = Vertical angle
SD(1) = Measured slope distance
hr(1) = Reflector height

Measurement (n):
PtID(n) = Point ID
Hz(n) = Horizontal angle
V(n) = Vertical angle
SD(n) = Measured slope distance
hr(n) = Reflector height

Results (n-1) - (n):
SD = Slope distance
HD = Horizontal distance
dH = Height difference
Brg = Azimuth

Area Application

Measurement (1):
PtID(1) = Point ID
Hz(1) = Horizontal angle
V(1) = Vertical angle
SD(1) = Measured slope distance
hr(1) = Reflector height

Measurement (n):
PtID(n) = Point ID
Hz(n) = Horizontal angle
V(n) = Vertical angle
SD(n) = Measured slope distance
hr(n) = Reflector height

Results:
NoPts = Number of points
Area = Area
Perim. = Perimeter of area

Free Station Application

Target Point (1):
PtID(1) = Point ID
E(1) = Easting
N(1) = Northing
H(1) = Height

Measurement (1):
PtID(1) = Point ID
Hz(1) = Horizontal angle
V(1) = Vertical angle
SD(1) = Measured slope distance
hr(1) = Reflector height

Target Point (n):
PtID(n) = Point ID
E(n) = Easting
N(n) = Northing
H(n) = Height

Measurement (n):
PtID(n) = Point ID
Hz(n) = Horizontal angle
V(n) = Vertical angle
SD(n) = Measured slope distance
hr(n) = Reflector height

Station results:
Stn = Station number
E = Station co-ordinate (Easting)
N = Station co-ordinate (Northing)
H = Station height
hi = Instrument height

Standard deviations:
StDv(E) = Standard deviation of the station co-ordinates (Easting)
StDv(N) = Standard deviation of the station co-ordinates (Northing)
StDv(H) = Standard deviation of the station height
StDv(P) = Average point position error
= $\sqrt{mF(E)^2 + mF(N)^2}$

Residuals:
dHz = Residual on the horizontal angle
dHD = Residual on the horizontal distance
dH = Height residual

Orientation point (1):
PtID(1) = Point ID
E(1) = Easting
N(1) = Northing
H(1) = Height

Orientation measurement (1):
PtID(1) = Point ID
Hz(1) = Measured horizontal angle + orientation unknowns
V(1) = Vertical angle
SD(1) = Measured slope distance
hr(1) = Reflector height

Orientation results:
PtID(1) = Point ID of the first target point
Brg = Calculated azimuth between the station co-ordinates and the first target point (based on the telescope face in which orientation was performed)
NoPts = Number of target points used
HzCor = Hz circle correction
StDev = Standard deviation of the Hz circle correction
Face = Telescope face in which orientation was performed

- **Reference line**

Measurement (1):

PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
HD = Measured slope distance
hr = Reflector height

Target Point (1):

PtID = Point ID
E = Easting
N = Northing
H = Height

Measurement (2):

PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
HD = Measured slope distance
hr = Reflector height

Target Point (2):

PtID = Point ID
E = Easting
N = Northing
H = Height

Transformation Parameters:

Line = Longitudinal offset
Offs = Parallel offset
Hoff = Height offset
Rot = Rotation

- **Reference Line**

Measurement:

PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
HD = Slope distance
hr = Reflector height

Results:

dLine = Longitudinal offset with respect to reference point
Offs = Transverse offset with respect to reference point
dHt = Height offset with respect to reference point

- **Orthogonal setting out**

Orthogonal setting out elements:

PtID = Point ID
Line = Longitudinal value
Offs = Transverse value
Ht = Height value

Measurement:

PtID = Point ID
Hz = Horizontal angle
V = Vertical angle
HD = Slope distance
hr = Reflector height

Results:

Line = Longitudinal difference required - actual
dOffs = Transverse difference required - actual
dHt = Height difference required - actual

Determination of the Height of Remote Points

Measurement (1):
PtID(1) = Point ID
Hz(1) = Horizontal angle
V(1) = Vertical angle
SD(1) = Measured slope distance
hr(1) = Reflector height

Measurement (n):
PtID(n) = Point ID
Hz(n) = Horizontal angle
V(n) = Vertical angle
SD(n) = Measured slope distance
hr(n) = Reflector height

Results (n-1) - (n):
dH = Height difference

Target Offset

L_Offset = Length offset
T_Offset = Cross offset
H_Offset = Height offset

A correction block is stored every time when:
- a new job is stored or
- one or more parameters are changed in the EDM settings in the instrument (see list below).

EDM

EDM type
EDM mode
Prism type
Prism constants

Atmospheric Corrections

Pressure = Air pressure
Temperature= Temperature
Rel. humid. = Relative atmospheric humidity
Refr. Coeff. = Coefficient of refraction
Ht. a. MSL = Height above see level
Atmos ppm = Atmospheric PPM

Coding

OSW-Coding

Code = Name of code
Desc = Comment
Attr1 = Attribute name 1
Attr2 = Attribute name 2
Attr3 = Attribute name 3
Attr4 = Attribute name 4
Attr5 = Attribute name 5
Attr6 = Attribute name 6
Attr7 = Attribute name 7
Attr8 = Attribute name 8

GSI-Coding

Code = Name of code
Desc = Comment
Info1 = Information 1
Info2 = Information 2
Info3 = Information 3
Info4 = Information 4
Info5 = Information 5
Info6 = Information 6
Info7 = Information 7
Info8 = Information 8

Fixed Points (Coordinates)

PtID = Point ID
E = Easting
N = Northing
H = Height

RS232

Measurements (PtID, Hz, V, SD, hr) are output over the RS232 serial interface if data output over RS232 is set.

No results or other calculated data (e.g. HD) is output over the RS232 serial interface.

The type of data output (internal memory or RS232) is set in the menu (see MENU / SYSTEM INFO).

Intended Use of Instrument

The following directions should enable the person responsible for the TC(R)702/703/705, and the person who actually uses the instrument, to anticipate and avoid operational hazards.

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

Permitted Uses

The electronic total stations are intended to the following applications:

- Measuring horizontal and vertical angles
- Measuring distances
- Recording measurements
- Computing by means of application software
- Visualising the standing axis (with laser plummet)

Adverse Uses

- Use of the total station without previous instruction
- Use outside of the intended limits
- Disabling safety systems and removal of hazard notices
- Opening the instrument using tools (screwdriver, etc.), unless this is specifically permitted for certain functions
- Modification or conversion of the instrument
- Use after misappropriation
- Use with accessories from other manufacturers without the prior express approval of Leica Geosystems
- Aiming directly into the sun
- Inadequate safeguards at the surveying site (e.g. when measuring on roads, etc.)

- Controlling machines, or controlling moving objects or similar, with the integrated EDM (visible laser)
- Deliberate dazzling of third parties

WARNING:

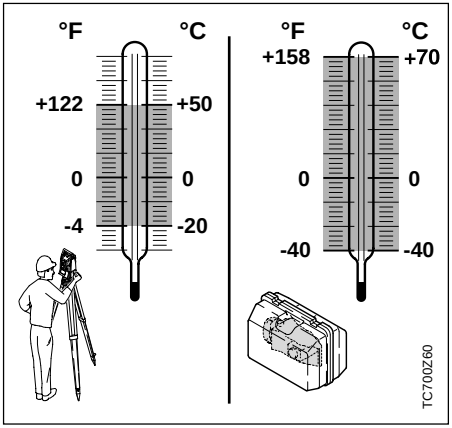
Adverse use can lead to injury, malfunction, and material damage.
It is the task of the person responsible for the instrument to inform the user about hazards and how to counteract them. The electronic total stations are not to be used until the user has been properly instructed how to use them.

Limits of Use

Refer to section "Technical Data".

Environment:
Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments. Use in rain is permissible for limited periods.

Temperature limits



Responsibilities

Area of responsibility for the manufacturer of the original equipment Leica Geosystems AG, CH-9435 Heerbrugg (hereinafter referred to as Leica Geosystems):
Leica Geosystems is responsible for supplying the product, including the User Manual and original accessories, in a completely safe condition.

Responsibilities of the manufacturers of non-Leica Geosystems accessories:

The manufacturers of non-Leica Geosystems accessories for the TC(R)702/703/705 electronic total stations 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.

Responsibilities of the person in charge of the instrument:

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

The person in charge of the instrument 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 accident prevention.
- To inform Leica Geosystems immediately if the equipment becomes unsafe.

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 far-reaching 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 instrument.

WARNING:
The battery charger is not designed for use under wet and severe conditions. If instrument becomes wet it may cause you to receive an electric shock.
Precautions:
Use charger only in dry rooms and protect instrument from humidity. Do not use instruments in a wet environment.

WARNING:

If you open the charger, either of the following actions may cause you to receive an electric shock:

- Touching live components
- Using the charger after incorrect attempts to carry out repairs

Precautions:

Do not open the charger. Only a Leica Geosystems-approved service technician is entitled to repair it.

DANGER:

Because of the risk of electrocution, it is very dangerous to use reflector 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.

WARNING:

By surveying during a thunderstorm you are at risk from lightening.

Precautions:

Do not carry out field surveys during thunderstorms.

CAUTION:

Be careful not to point the instrument directly towards the sun, because the telescope functions as a magnifying lens and can injure your eyes or damage the distance measuring device and the Guide Light EGL.

Precautions:

Do not point the telescope directly at the sun.

WARNING:

During target recognition or stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions (e.g. obstacles, excavations or traffic).

Precautions:

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

WARNING:

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

Precautions:

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

CAUTION:

If a target lamp accessory is used with the instrument the lamp's surface temperature may be extreme after a long working period. It may cause pain if touched. Replacing the halogen bulb before the lamp has been allowed to cool down may cause burning to the skin or fingers.

Precautions:

Use appropriate heat protection such as gloves or woollen cloth before touching the lamp, or allow the lamp to cool down first.

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 instruments.

CAUTION:

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

Precautions:

Before transporting or disposing of equipment, discharge the battery (e.g. by running the instrument in tracking mode until the batteries are exhausted).

WARNING:

If the equipment 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 equipment 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.
- Leakage of silicone oil from the compensator can damage the optical and electronic subassemblies.

Precautions:

Dispose of the equipment appropriately in accordance with the regulations in force in your country. Always prevent access to the equipment by unauthorized personnel.

CAUTION:
If the accessories used with the instrument are not properly secured, and the equipment is subjected to mechanical shock (e.g. blows, falling etc.), the equipment may be damaged, safety devices may be ineffective or people may sustain injury.

Precautions:
When setting-up the instrument, make sure that the accessories (e.g. tripod, tribrach, etc.) are correctly adapted, fitted, secured and locked in position.
Avoid subjecting the equipment to mechanical shock.
Never position the instrument on the tripod baseplate without securely tightening the central fixing screw. If the screw is loosened always remove the instrument immediately from the tripod.

CAUTION:
Watch out for erroneous measurements if the instrument is defective or if it has been dropped or has been misused or modified.

Precautions:
Periodically carry out test measurements and perform the field adjustments indicated in the User Manual particularly after the instrument has been subjected to abnormal use and before and after important measurements.

CAUTION:
Allow only authorized Leica Geosystems service workshops to service the instrument.

The EDM module built into the total stations produces an invisible infra-red laser beam which emerges from the telescope objective.

The product is a Class 1 laser product in accordance with:

- IEC 825-1 : 1993 "Radiation safety of laser products".
- EN 60825-1 : 1994 "Radiation safety of laser products".

The product is a Class I laser product in accordance with:

- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

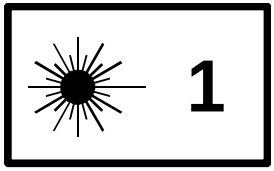
Class 1/I laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with the instructions.

WARNING:

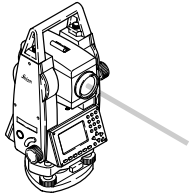
It can be dangerous to look into the beam with optical equipment (e.g. binoculars, telescopes)

Precautions:

Do not look directly into the beam with optical equipment.

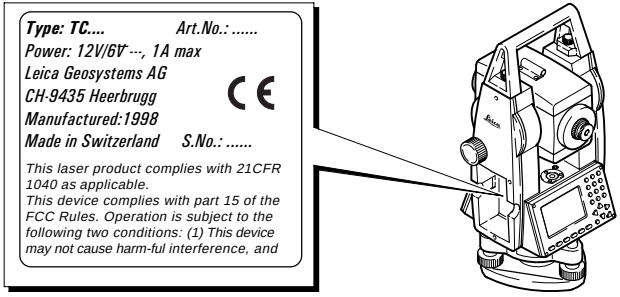


Beam divergence:	1.8 mrad
Pulse duration:	800 ps
Maximum radiant power:	0.33 mW
Maximum radiant power per pulse:	4.12 mW
Measurement uncertainty:	± 5%



Infrared laser beam exit (invisible).

TC700211



TC700254

As an alternative to the infrared beam, the EDM incorporated into the total station produces a visible red laser beam which emerges from the telescope objective.
The product is a Class 2 laser product in accordance with:

- IEC 825-1 : 1993 "Radiation safety of laser products".
- EN 60825-1 : 1994 "Radiation safety of laser products".

The product is a Class II laser product in accordance with:

- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

Class 2/II laser products:
Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

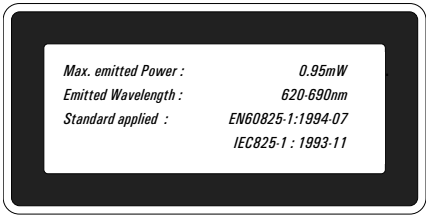
WARNING:

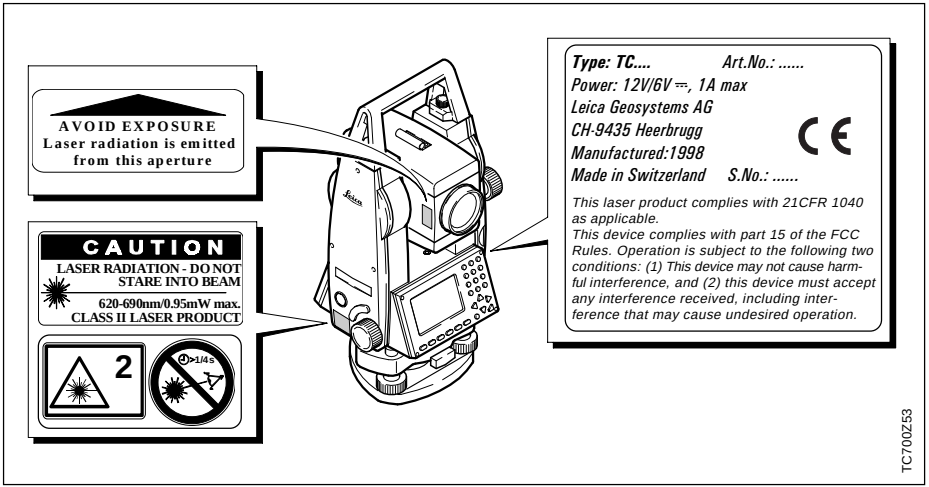
It can be dangerous to look into the beam with optical equipment (e.g. binoculars, telescopes)

Precautions:

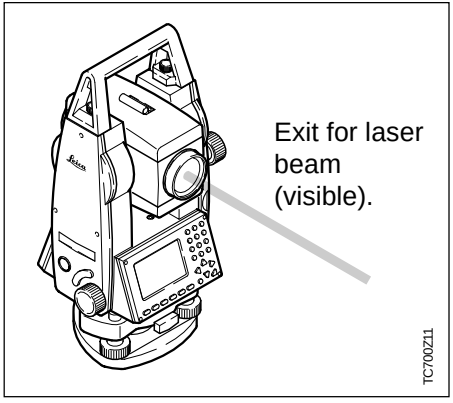
Do not look directly into the beam with optical equipment.

Labelling





Beam divergence:	0.15 x 0.35 mrad
Pulse duration:	800 ps
Maximum radiant power:	0.95 mW
Maximum radiant power per pulse:	12 mW
Measurement uncertainty:	± 5%



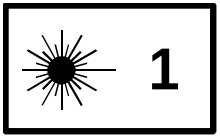
The integrated Guide Light produces a visible LED beam from the upper front side of the telescope.
The product is a Class 1 LED product *) in accordance with:

- IEC 825-1: 1993 "Radiation safety of laser products"
- EN 60825-1: 1994 "Radiation safety of laser products"

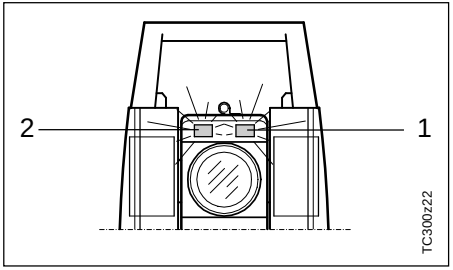
*) Within the specified working range of > 5 m (> 16 ft).

Class 1 LED 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 the instructions.

CAUTION:
Use the Guide Light only within the specified working range of > 5 m (> 16 ft) from the telescope.



Flashing LED	yellow	red
Beam divergence:	2.4 °	2.4 °
Pulse duration:	2 x 105 ms	1 x 105 ms
Maximum radiant power:	0.28 mW	0.47 mW
Maximum radiant power per pulse:	0.75 mW	2.5 mW
Measurement uncertainty:	± 5 %	± 5 %



1 Exit for flashing red LED
2 Exit for flashing yellow LED

The integrated laser plummet produces a visible laser beam which emerges from the base of the instrument.

The product is a Class 2 laser product in accordance with:

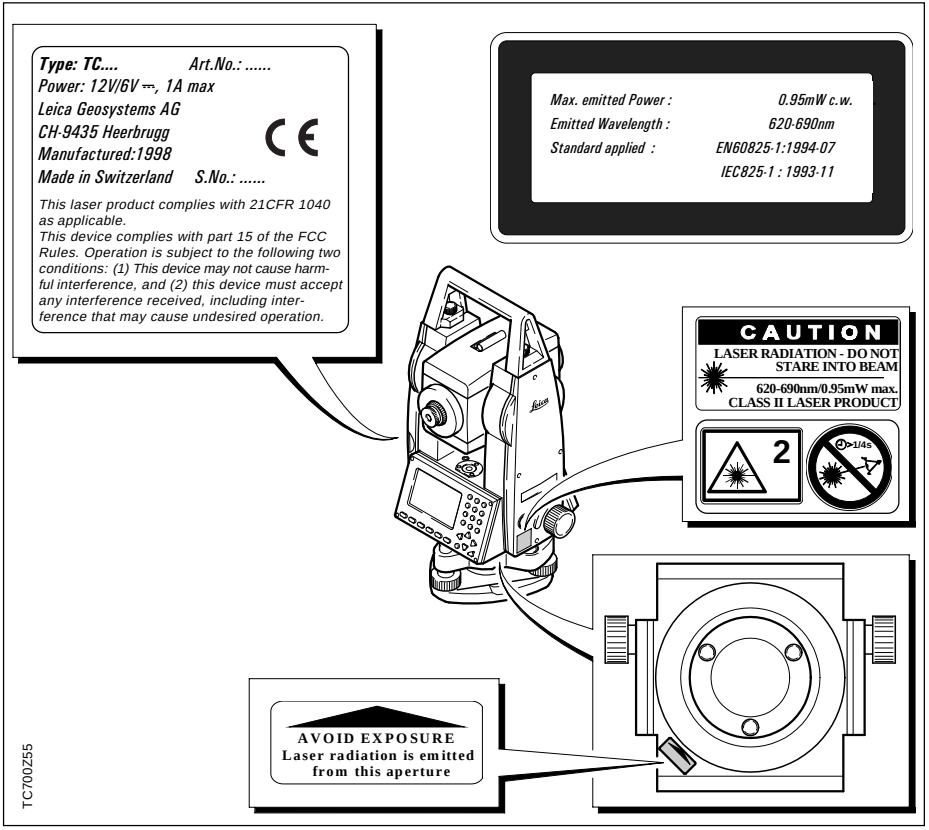
- IEC 825-1 : 1993 "Radiation safety of laser products".
- EN 60825-1 : 1994 "Radiation safety of laser products".

The product is a Class II laser product in accordance with:

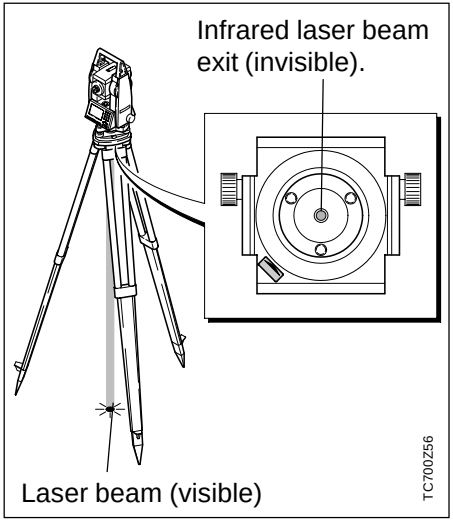
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

Class 2/II laser products:
Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

Labelling



Beam divergence:	0.16 x 0.6 mrad
Pulse duration:	c.w.
Maximum radiant power:	0.95 mW
Maximum radiant power per pulse:	n/a
Measurement uncertainty:	± 5%



Electromagnetic Compatibility (EMC)

The term "electromagnetic compatibility" is taken to mean the capability of the instrument to function correctly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances in other equipment.

WARNING:

Electromagnetic radiation can cause disturbances in other equipment.

Although electronic total stations meet 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 total station is used in conjunction with accessories from other manufacturers, e.g. field computers, personal computers, walkie-talkies, non-standard cables, external batteries.

Precautions:
Use only the equipment and accessories recommended by Leica Geosystems. When combined with total stations, they meet the strict requirements stipulated by the guidelines and standards. When using computers and walkie-talkies, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

CAUTION:
Disturbances caused by electromagnetic radiation can result in the tolerance limits for measurements being exceeded.

Although the total stations meet the strict regulations and standards which are in force in this connection, Leica Geosystems cannot completely exclude the possibility that the total station may be disturbed by very intense electromagnetic radiation, e.g. near radio transmitters, walkie-talkies, diesel generators, power cables.
Check the plausibility of results obtained under these conditions.

WARNING:
If the total station is operated with connecting cables attached at only one of their two ends (e.g. external supply cables, interface cables), the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other instruments may be impaired.

Precautions:
While the total station is in use, connecting cables (e.g. instrument to external battery, instrument to computer) must be connected at both ends.

WARNING:

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 frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.
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:

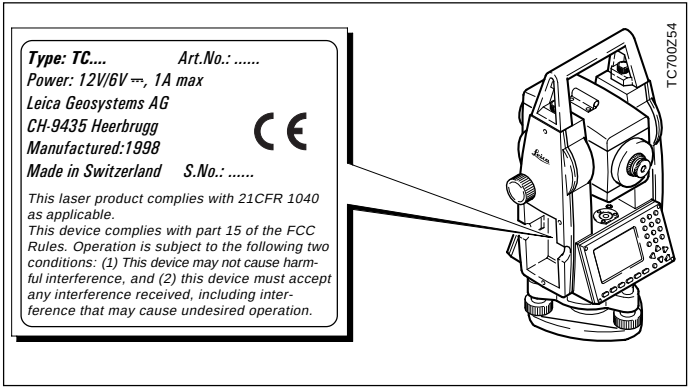
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING:

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

Product labelling:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

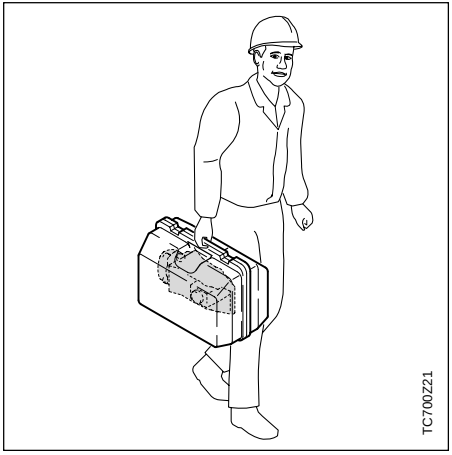


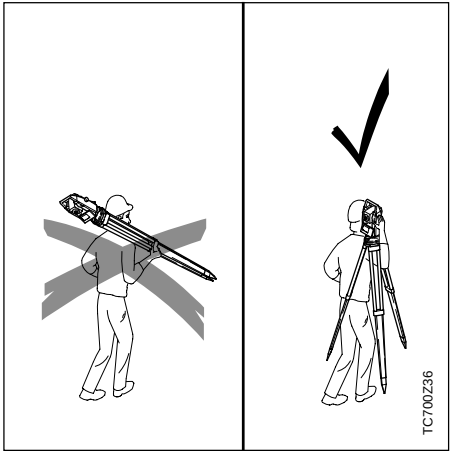
Transport

When transporting or shipping the equipment always use the original Leica Geosystems packaging (transport case and shipping cardboard).

After a longer period of storage or transport of your instrument always check the field ajustment parameters indicated in this manual before using the instrument.

In the Field

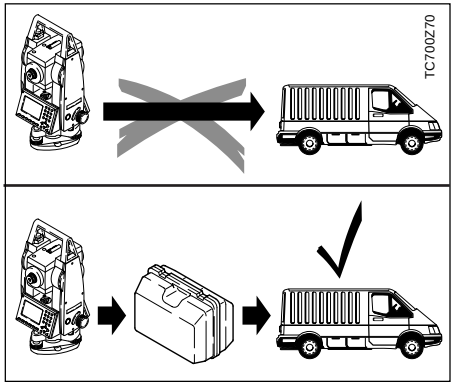




When transporting the equipment **in the field**, always make sure to

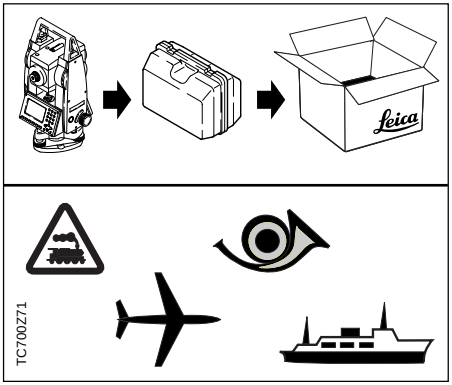
- either carry the instrument in its original transport case or,
- carry the tripod with its legs splayed across your shoulder, keeping the attached instrument upright.

Inside Vehicle



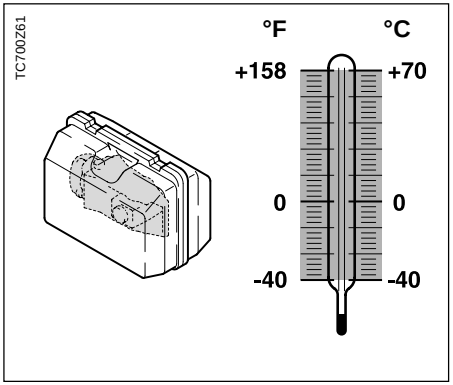
Never transport the instrument loose **inside the vehicle**.
The instrument can be damaged by blows and vibrations. It must always be transported in its case and be properly secured.

Shipping



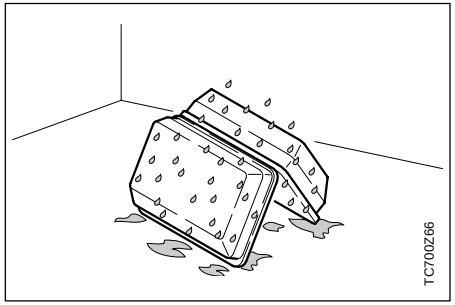
For shipping the instrument by **rail, aircraft** or **ship** use the Leica Geosystems original packaging (transport case or shipping cardboard) or another suitable packaging securing the instrument against blows and vibrations.

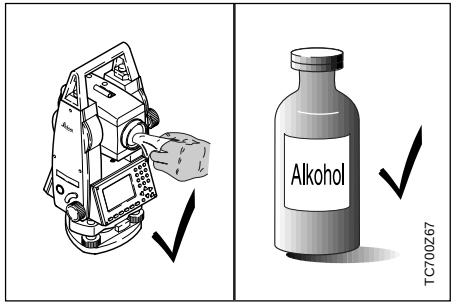
Storage

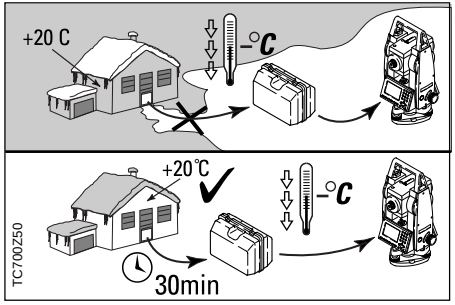


When storing the equipment, particularly in summer and inside a vehicle, take the **temperature limits** into account.

When storing the intrument inside a building also use the transport case (if possible, in a safe place).







If the instrument becomes wet, leave it unpacked.

Wipe down, clean, and dry the instrument (at not more than 40 °C/ 108°F), transport case, foam inserts, and accessories. Pack up the equipment only when it is perfectly dry.

When using the instrument in the field always close the transport case.

Objective, eyepiece and prisms:

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

Use no other liquids; these may attack polymer components.

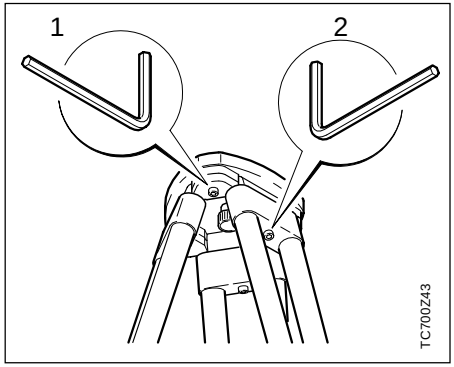
Fogging of prisms:

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.

Cables and plugs

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

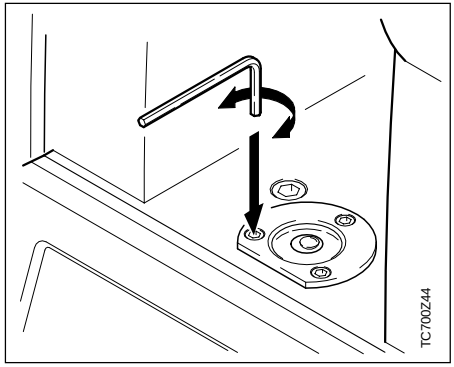
Tripod



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.

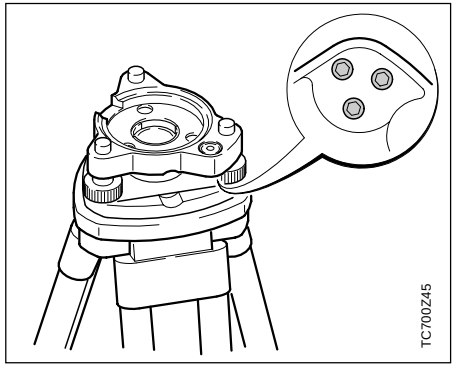
Circular Level



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.

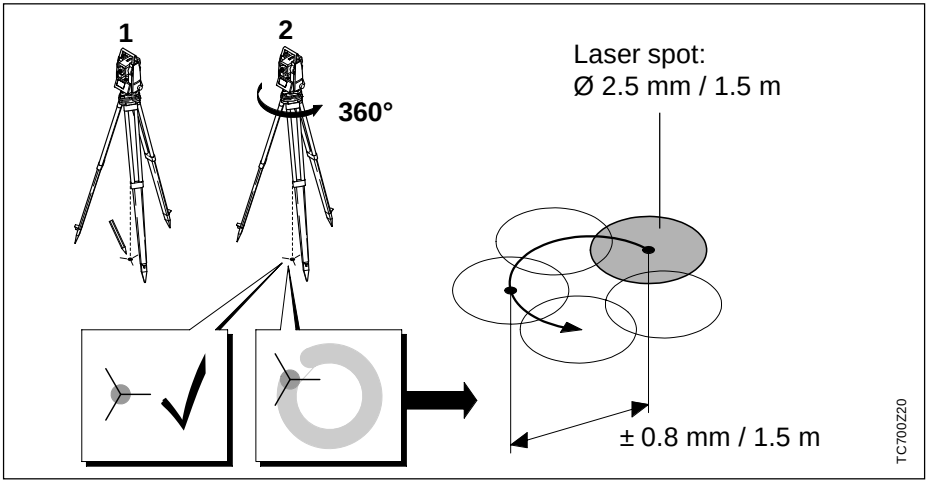
After adjustment no screw must be loose.

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°:

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

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



If the centre of the laser spot makes a clearly circular movement or if the centre of the point is moving away more than 1mm 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 spot 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 of the centre of the laser spot should not exceed +/- 0.8 mm at a distance of 1.5 m.

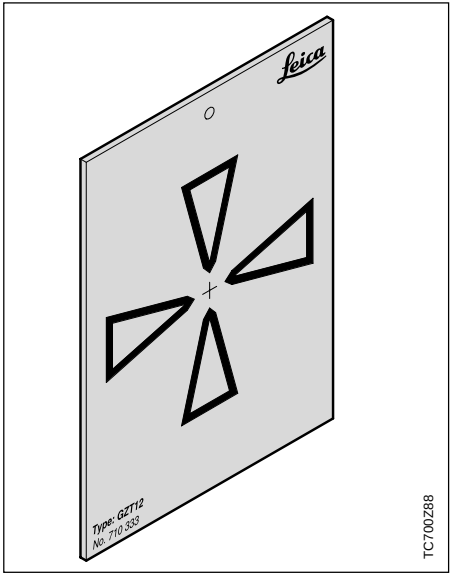
The red laser beam used for measuring without reflector is arranged coaxially with the line of sight of the telescope, and emerges from the objective port. If the instrument is well adjusted, the red measuring beam will coincide with the visual line of sight. External influences such as shock or large temperature fluctuations can displace the red measuring beam relative to the line of sight.

The direction of the beam should be inspected before precise measurement of distances is attempted, because an excessive deviation of the laser beam from the line of sight can result in imprecise distance measurements.

Inspection

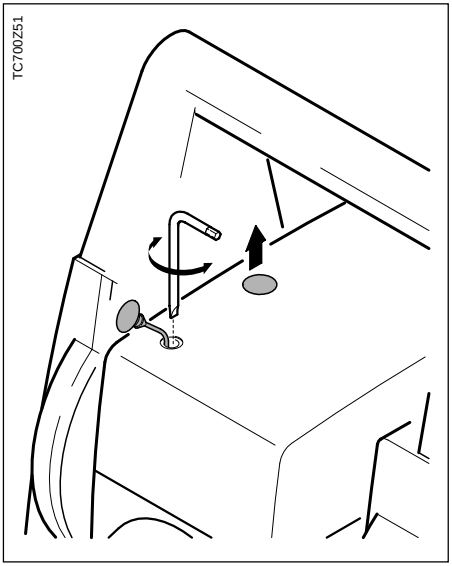
A target plate is provided. Set it up between five and 20 metres away with the grey reflective side facing the instrument. Move the telescope to face II. Switch on the red laser beam by activating the laser-point function. Use the telescope crosshair to align the instrument with the centre of the target plate, and then inspect the position of the red laser spot on the target plate. Generally speaking the red spot cannot be seen through the telescope, so look at the target plate from just above the telescope or from just to the side of it.
If the spot illuminates the cross, the achievable adjustment precision has been reached; if it lies outside the limits of the cross, the direction of the beam needs to be adjusted.

If the spot on the more reflective side of the plate is too bright (dazzling), use the white side instead to carry out the inspection.



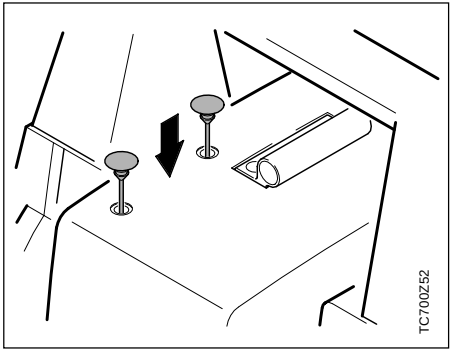
Adjusting the Direction of the Beam

Pull the two plugs out from the adjustment ports on the top side of the telescope housing.
To correct the height of the beam, insert the screwdriver into the rear adjustment port and turn it clockwise (spot on target plate moves obliquely upwards) or anticlockwise (spot moves obliquely downwards).
To correct the beam laterally, insert the screwdriver into the front adjustment port and turn it clockwise (spot moves to the right) or anticlockwise (spot moves to the left).



Throughout the adjustment procedure, keep the telescope pointing to the target plate.

After each field adjustment, replace the plugs in the adjustment ports to keep out damp and dirt.



Telescope
- Transits fully
- Magnification: 30x
- Image: upright
- Free objective aperture: 40 mm
- Shortest focussing distance: 1.7 m (5.6 ft)
- Focusing: fine
- Field of view: 1°30' (1.7gon)
- Telescope 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
- Standard deviation
  (acc. to DIN 18723 / ISO 12857)

TC(R)702	2" (0.6 mgon)
TC(R)703	3" (1 mgon)
TC(R)705	5" (1.5 mgon)

- Smallest display resolution

gon:	TC(R)702	0.0001
	TC(R)703/705	0.0005
360d:	TC(R)702	0.0001
	TC(R)703/705	0.0005
360s:		1"
mil:		0.01

Level sensitivity
- Circular level: 6'/2 mm
- Electronic bubble: 20"/2mm

Laser plummet:
- In alidade, turns with instrument
- Accuracy: max. rot. diameter of laser spot: ± 0.8 mm / 1.5m
- Diameter of laser spot: 2.5 mm / 1.5m

Compensator:
- 2-axis-oil compensator
- Setting range ±4' (0.07 gon)
- Setting accuracy

TC(R)702	0.5" (0.2 mgon)
TC(R)703	1" (0.3 mgon)
TC(R)705	1.5" (0.5 mgon)

Keyboard:
- Tilt angle: 70°
- Base area: 110x75 mm
- No. of buttons: 24 plus ON and trigger key (on side cover)

Display:
- Backlit
- Heatable (Temp. < -5°C)
- LCD: 144x64 Pixel
- 8 lines with 24 characters each

Type of tribrach:
- Tribrach removable GDF111/ GDF121
  Thread diam.: 5/8"
  (DIN 18720 / BS 84)

Dimensions:
- Instrument:
  Height (including tribrach and carrying handle):
  - with tribrach GDF111
    360 mm ± 5 mm
  - with tribrach GDF121
    358 mm ± 5 mm
  Width: 150 mm
  Length: 145 mm
- Case: 468x254x355mm (LxBxH)

Weight:
(including battery GEB111 and tribrach)
- with tribrach GDF111 5.33 kg
- with tribrach GDF121 5.52 kg

Tilting axis height:
- without tribrach 196 mm
- with tribrach GDF111
  240 mm ± 5 mm
- with tribrach GDF121
  238 mm ± 5 mm

Power supply:
- Battery GEB111: NiMh (0% Cadmium)
  Voltage: 6V, 1800 mAh
- Battery GEB121: NiMh (0% Cadmium)
  Voltage: 6V, 3600 mAh
- Battery adapter GAD39:
  6 x LR6/AA/AM3, 1.5V, only alkaline batteries
- External supply (via serial interface)
  If an external cable is used, then the voltage range must lie between 11.5VDC and 14VDC.

Number of measurements:
GEB111:
- Angle: >4 h
- Distance: > 1000

GEB121:
- Angle: >8 h
- Distance: > 2000

Temperature range:
- Storage: -40°C to +70°C
  -40°F to +158°F
- Operating: -20°C to +50°C
  -4°F to +122°F

Automatic corrections:
- Line-of-sight error Yes
- Vertical-index error Yes
- Earth curvature Yes
- Refraction Yes
- Tilt correction Yes

Recording:
- RS232 interface Yes
- Internal memory: Yes
  Total capacity 288 KB
  ≈ 4500 data blocks and
  ≈ 7000 fixed points

Distance measurement (IR: infrared)

- Type: infrared
- Carrier wavelength: 0.780 µm
- Measuring system: special frequency system basis 100 MHz ≙ 1.5 m
- EDM type: coaxial
- Display (least count): 1 mm

EDM measuring program	Accuracy *	Time per measurement
Standard measurement	2 mm + 2 ppm	<1 sec.
Fast measurement	5 mm + 2 ppm	<0.5 sec.
Tracking	5 mm + 2 ppm	<0.3 sec.
IR Tape	5 mm + 2 ppm	<0.5 sec.

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

	Range: (normal and rapid measurement)				
	Standard prism	3 prisms (GPH3)	360° reflector	Tape 60mm x 60mm	Mini-prism
1	1800 m (6000 ft)	2300 m (7500 ft)	800 m (2600 ft)	150 m (500 ft)	800 m (2600 ft)
2	3000 m (10000 ft)	4500 m (14700 ft)	1500 m (5000 ft)	250 m (800 ft)	1200 m (4000 ft)
3	3500 m (12000 ft)	5400 m (17700 ft)	2000 m (7000 ft)	250 m (800 ft)	2000 m (7000 ft)

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

Distance measurement (RL: visible)

- Type: visible red laser
- Carrier wavelength: 0.670 µm
- Measuring system: special frequency system basis 100 MHz ≙ 1.5 m
- EDM type: coaxial
- Display (least count): 1 mm
- Laser spot size: approx. 7x 14 mm / 20 m
  approx. 10 x 20 mm / 50 m

Distance measurement (reflectorless)

- Range of measurement: 1.5 m to 80 m (to target plate 710 333)
- Display unambiguous: to 760 m
- Prism constant (additive constant): + 34.4 mm

	Range (without reflector)	
Atmospheric conditions	No reflector (white target)*	No reflector (grey, albedo 0.25)
4	60 m (200 ft)	30 m (100 ft)
5	80 m (260 ft)	50 m (160 ft)
6	80 m (260 ft)	50 m (160 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
Short	3 mm + 2 ppm	3.0 sec. +1.0 sec./10m > 30m
Prism	5 mm + 2 ppm	2.5 sec.
Tracking	5 mm + 2 ppm	1.0 sec. +0.3 sec./10m > 30m

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

Distance measurement (with reflector)

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

	Range (with reflector)	
Atmospheric conditions	Standard prism (GPR1)	Three prisms (GPH3)
1	1500 m (5000 ft)	2000 m (7000 ft)
2	5000 m (16000 ft)	7000 m (23000 ft)
3	> 5000 m (16000 ft)	> 9000 m (30000 ft)

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

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.

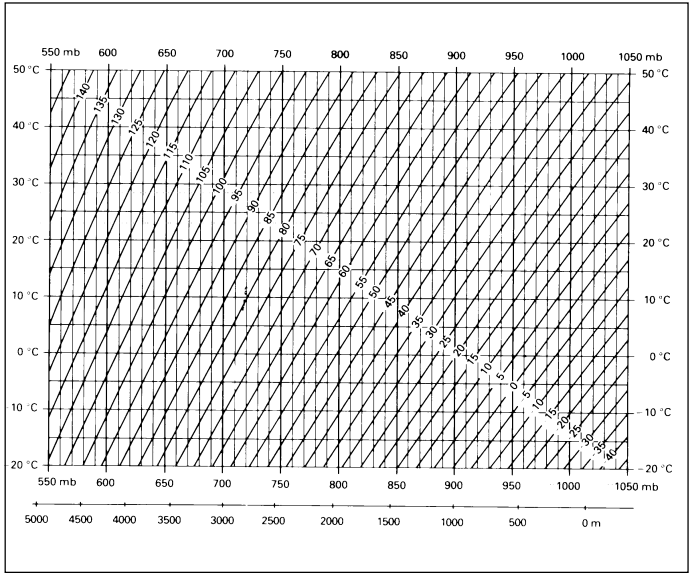
The atmospheric correction includes adjustments for air pressure, air temperature and relative humidity.

If, for highest-precision distance measurements, the atmospheric correction should be determined with an accuracy of 1 ppm, the following parameters must be redetermined: Air temperature to 1°C; air pressure to 3 millibars; relative humidity to 20%.

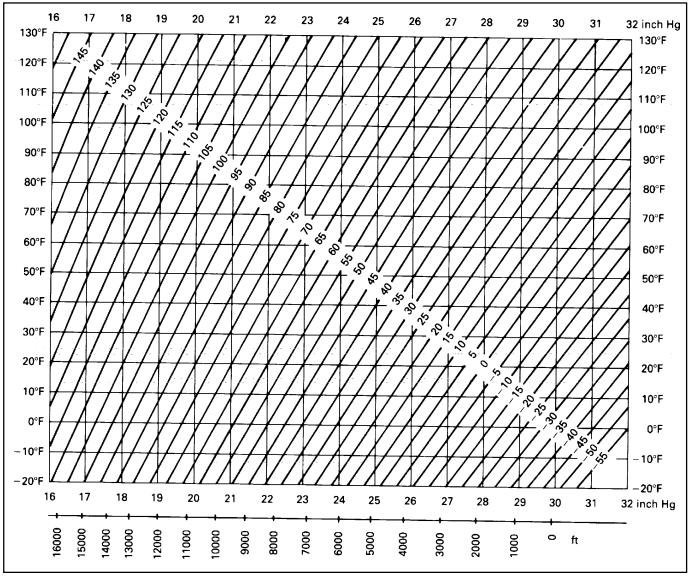
The air humidity influences the distance measurement if the climate is extremely hot and damp.

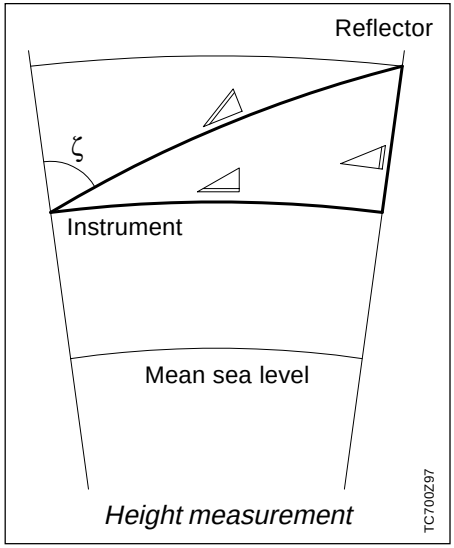
For high-precision measurements, the relative humidity must be measured and entered along with the air pressure and the temperature.

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





Height measurement

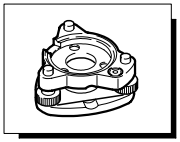
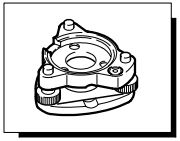
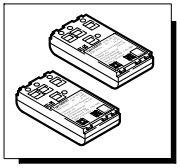
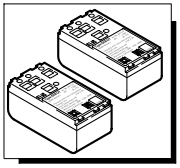
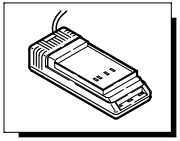
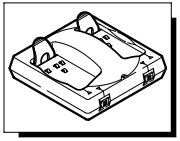
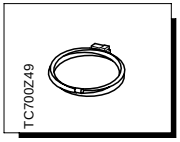
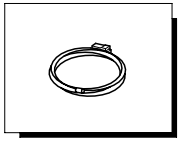
The instrument calculates slope distance, horizontal distance and height difference in accordance with the following formula. Earth curvature and mean refraction coefficient (k = 0.13) are taken into account automatically. The calculated horizontal distance relates to the station height, not to the reflector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

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

◿ = displayed slope distance [m]
D_0 = uncorrected distance [m]
ppm = scale correction [mm/km]
mm = prism constant [mm]

Accessories

Leica Geosystems offers two accessory sets that ease the user's choice from the range of accessories offered by Leica Geosystems. The existing accessories continue to be available.

	Standard Accessory Set		Extended Accessory Set
	Tribrach GDF111 BASIC		Tribrach GDF121 PRO
	Battery GEB111 (2x)		Battery GEB121 (2x)
	Battery charger GKL111 BASIC		Battery charger GKL122 PRO
	Data cable Lemo0/RS232		Data cable Lemo0/RS232

Leica Geosystems AG, Heerbrugg, Switzerland, has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

TQM
ISO 9001 / ISO 14001

Total Quality Management-
Our commitment to total customer satisfaction

Ask your local Leica Geosystems agent for more information about our TQM program

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