Leica TPS700 Series
User Manual

Version 2.4
English

- when it has to be **right**

Leica Geosystems

Electronical Total Station

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

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "Safety Directions" for further information.
Read carefully through the User Manual before you switch on the product.

Product Identification

The model and the serial number of your product are indicated on the type plate.
Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorized service workshop.

Type: _____

Serial no.: _____

Trademarks

- Windows is a registered trademark of Microsoft Corporation

All other trademarks are the property of their respective owners.

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.

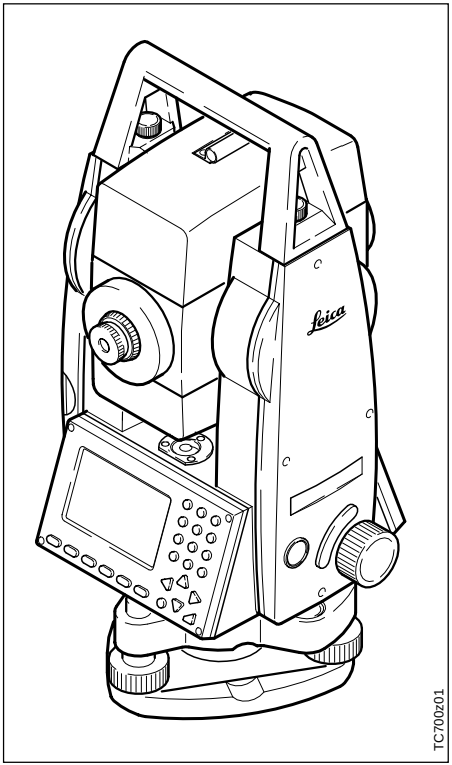
Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Contents

The Leica Geosystems TPS700 performance series is a proven generation of electronic total station designed for the construction site. A solid design and highly sophisticated functions enable the user to use the instruments efficiently and accurately. Innovative features such as the laser plummet or the endless drives contribute significantly in making daily surveying jobs easier.

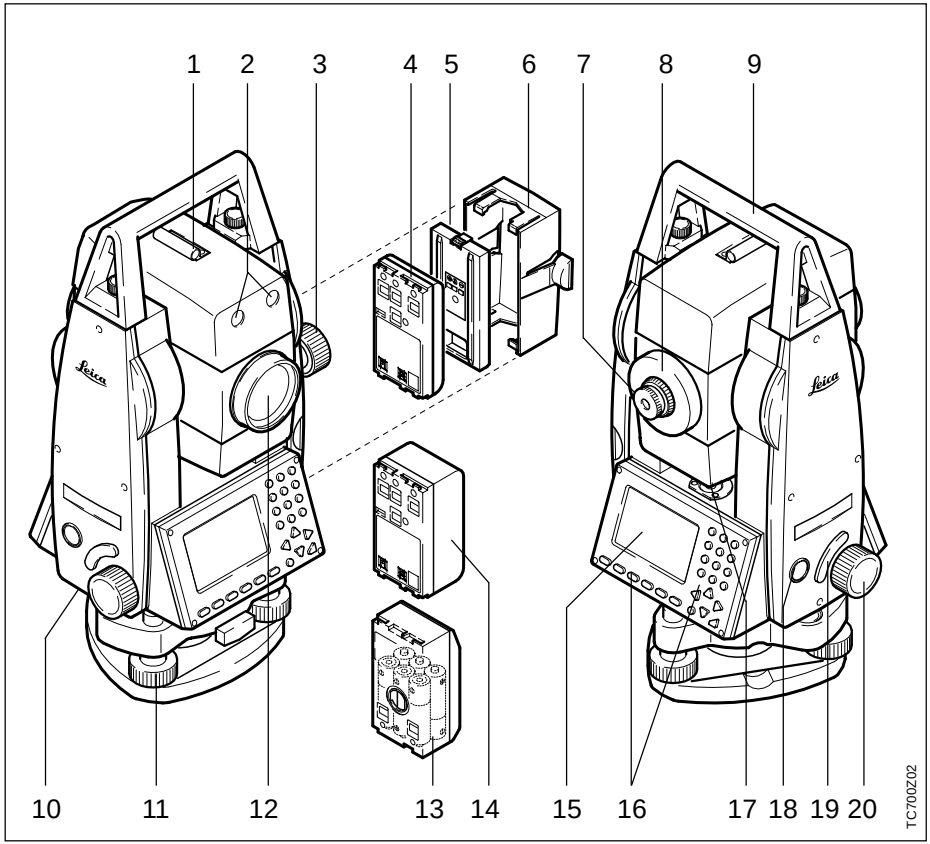
The instruments are best suited for cadastral and construction surveys, for surveying buildings and for civil engineering with emphasis on stakeouts and tacheometric surveys.

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



Special Features

- Reflectorless measuring EDM R100 or R300
- Automatic target recognition ATR
- Large display, alphanumeric keypad
- Endlessdrive
- Laser plummet
- Two axis compensator
- Camcorder batteries
- Light, slender construction
- On-board software and data memory



1 Optical sight
2 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
8 Telescope focusing ring
9 Detachable carrying handle
10 Serial interface RS232
11 Foot screws tribrach
12 Telescope with integrated EDM, ATR (optional) and EGL (optional)
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

A laser distancer (EDM) is incorporated into the instruments of the TPS700 series.

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

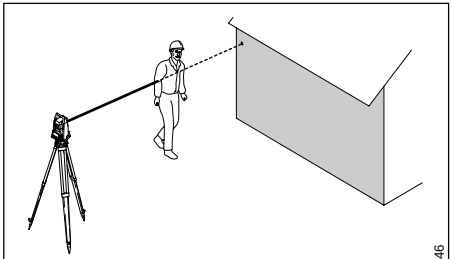
Measurements to strongly reflecting targets such as to traffic lights in infrared mode without prism should be avoided. The measured distances may be wrong or inaccurate.

For applications without reflector, the TCRApower and TCRAultra version also use **a visible red laser beam** which emerges in the same manner. A special arrangement of the EDM, and appropriate arrangement of the beam paths, enable ranges of over five kilometres to be attained with standard prisms.

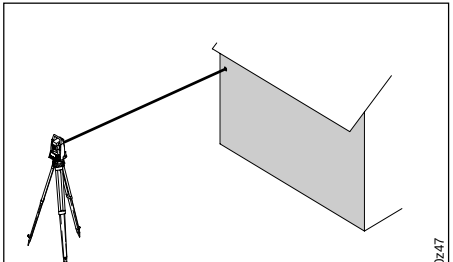
Reflector tapes can also be used, and measurement is also possible without a reflector.

When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment.

If e.g. people, cars, animals, swaying branches, etc. cross the laser beam while a measurement is being taken, a fraction of the laser beam is reflected and may lead to incorrect distance values.
Avoid interrupting the measuring beam while taking reflectorless measurements or measurements using reflective foils. Measurements to prism reflectors are only critical if an object crosses the measuring beam at a distance of 0 to 30m and the distance to be measured is more than 300m.
In practice, because the measuring time is very short, the user can always find a way of avoiding these critical situations.



Incorrect result



Correct result

Reflectorless


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


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


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

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


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

Red laser to prisms


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

Red laser to reflector tape

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


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

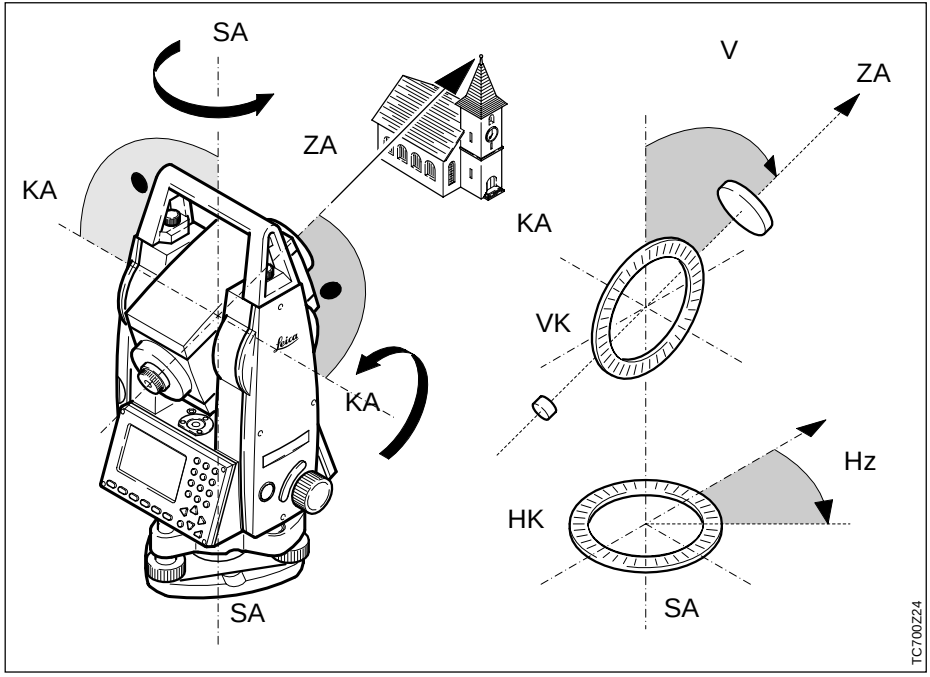
TCRApower and TCRAultra instruments are motorized and equipped with Automatic Target Recognition (ATR) coaxially in the telescope. The Electronic Guide Light (EGL), mounted on the telescope, is optional.

ATR mode

These instruments permit automatic measurements to normal prisms and reduce the tedious task of precise visual sighting to prisms.
The prism is sighted with the optical sight only. Initiating a distance measurement will turn the instrument with the help of the motors to sight the prism-centre automatically.
The angles V and Hz are measured to the centre of the prism after completion of the distance measurement.

As with all other instrument errors, the collimation error of the automatic target recognition (ATR) must be redetermined periodically (Refer to chapter *"Determing Instrument Errors"* in the Field Manual).

To speed up measuring time, in ATR mode the crosshairs are not positioned exactly over the center of the prism. The remaining distance between the crosshairs and the center of the prism is measured electronically and the horizontal and vertical angles are corrected accordingly. As a result, in ATR mode the displayed angles are of the usual precision and correspond to the specifications of your instrument.



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.

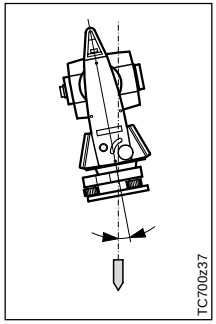
KA = Tilting axis
Horizontal rotation axis of the telescope (Trunion axis).

V = Vertical angle / zenith angle

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

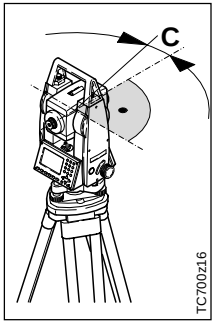
Hz = Horizontal angle

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



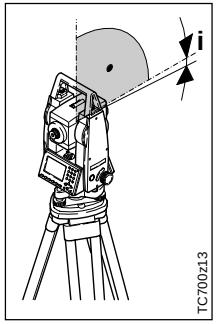
Standing axis inclination

Angle between plumb line and standing axis.



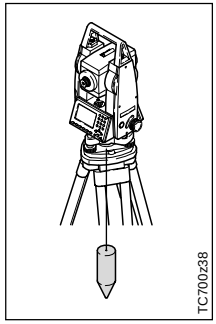
Line-of-sight error (Hz-collimation)

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



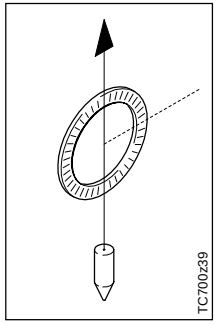
V-index (Vertical index error)

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



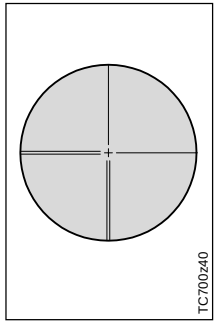
Plumb line / Compensator

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



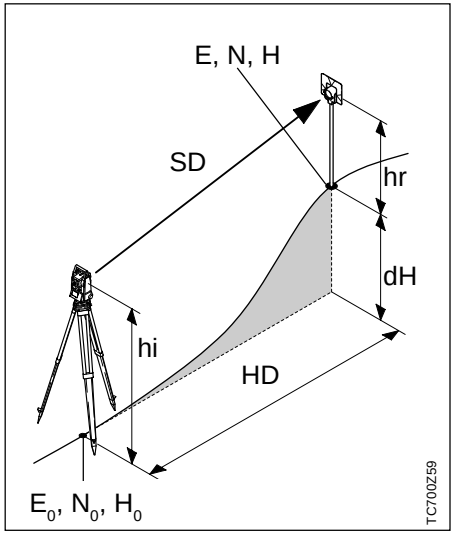
Zenith

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
E_0	Easting of station
N_0	Northing of station
H_0	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 measurement.

TCRApower and TCRAultra instruments are equipped with automatic target recognition (ATR).

Chapters only meant for TCR and automated instruments are marked accordingly.

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

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

Installation on the PC

The installation program can be found on the CDROM supplied. Please note that LGO-Tools can only be installed on computers with MS Windows 98, 2000 or XP operating systems.

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

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

Program content

After successful installation the following programs appear:

Tools

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

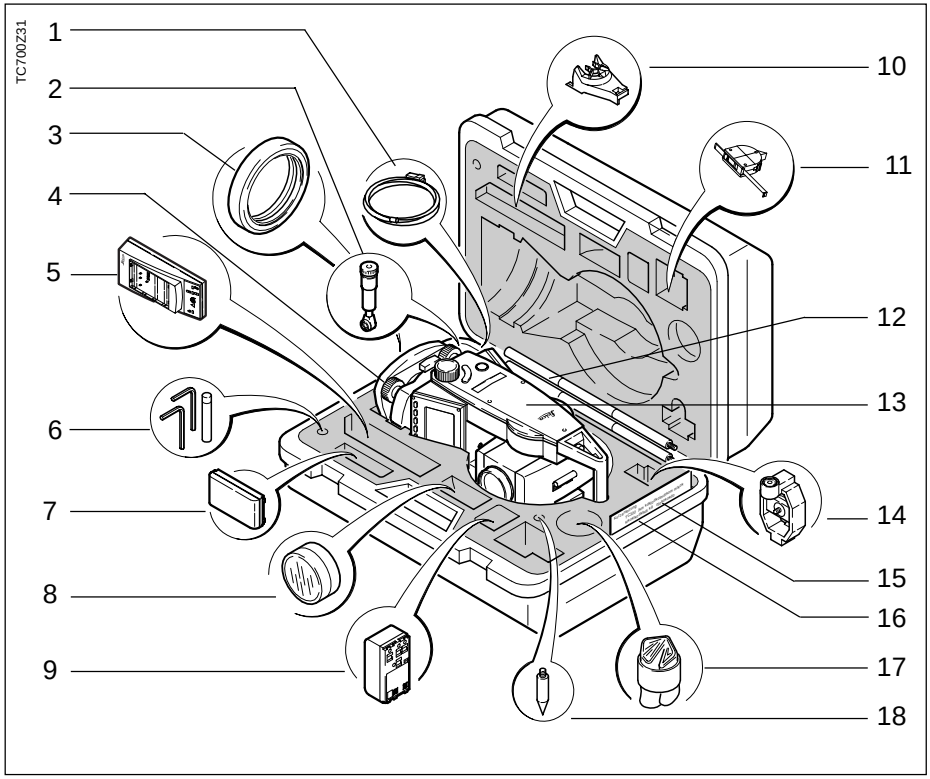
Before the Software Upload, always insert a charged battery into the instrument.

- **Format Manager**
  For creating of own, special formatted data output files.
- **Configuration Manager**
  Import/Export as well as creating of instrument configuration.

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

Setting up

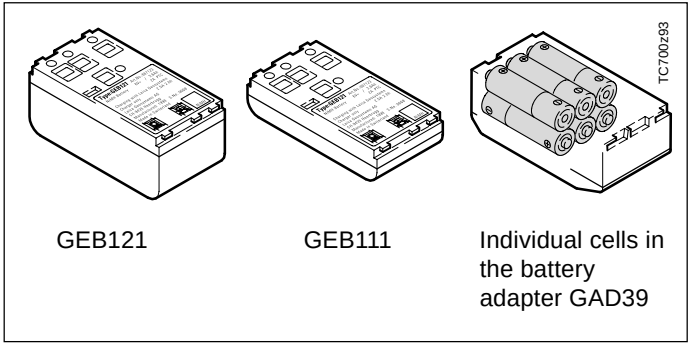
Remove the TPS700 instrument from transport case and check for completeness:



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 Two Allen keys each, Adjusting pins
7 Battery GEB111 (optional)
8 Auxiliary lens and filter (optional)
9 Battery GEB121 (optional)
10 Spacing bracket GHT 196 for instrument height meter (optional)
11 Instrument height meter GHM 007 (optional)
12 Mini prism rod (optional)
13 Total station
14 Mini prism + holder (optional)
15 Mini target plate (only for TCR instruments)
16 User Manuals
17 Protective cover / Lens hood
18 Tip for mini prism (optional)

Use the Leica Geosystems batteries, chargers and accessories or accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.
Power for the instrument can be supplied either internally or externally. An external battery is connected to the instrument using a LEMO cable.

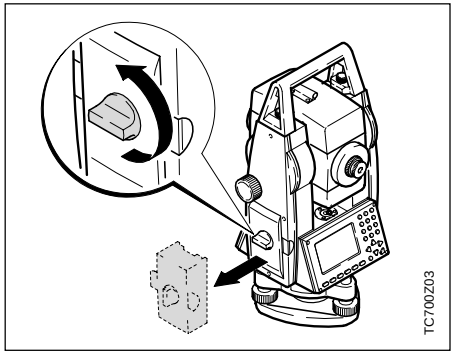
- **Internal battery**:
  One GEB111 or GEB121 battery or the adapter GAD39 fit in the battery compartment.
- **External battery**:
  One GEB171 battery connected via cable.



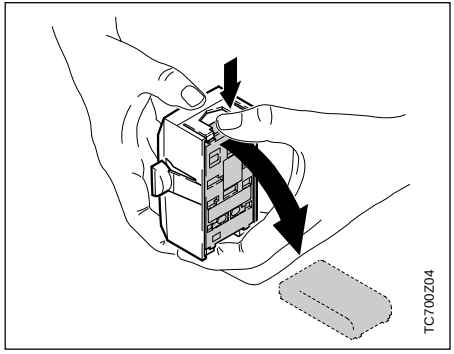
GEB121 | GEB111 | Individual cells in the battery adapter GAD39

Your Leica Geosystems instrument is powered by rechargeable plug-in batteries. For this product, we recommend the basic battery (GEB111) or the Pro battery (GEB121). Optionally six single cells can be used with the GAD39 battery adapter.
Six single cell batteries (1.5 V each) supply 9 Volts. The voltmeter on the instrument is designed for a voltage of 6 Volts (GEB111/ GEB121).

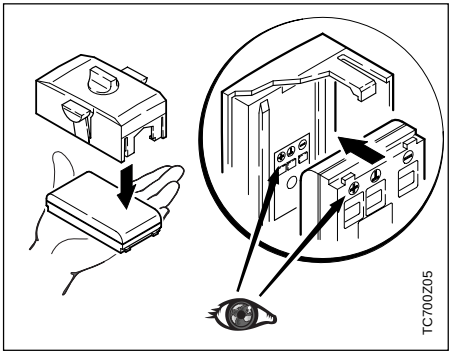
The battery charge is not displayed correctly when using single cells. Use the single cells with the battery adapter as emergency power supply. The advantage of the single cells is in a lower rate of discharge even over long periods.



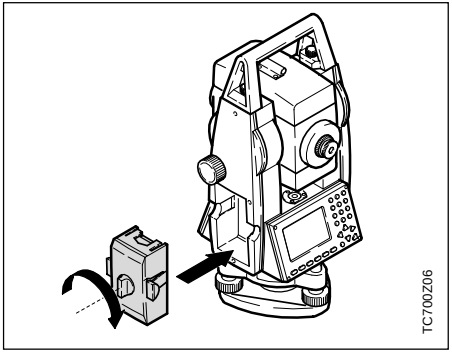
1. Remove battery holder.



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 holder). 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.

Primary use/charging

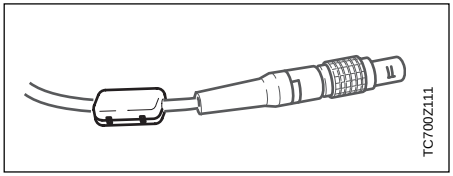
- The batteries must be charged prior to using for the first time because it is delivered with an energy content as low as possible.
- For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make 2 - 5 charge/discharge cycles.
- The permissible temperature range for charging is between 0°C to +35°C / +32°F to +95°F. For optimal charging we recommend a low ambient temperature of +10°C to +20°C / +50°F to +68°F.

Operation/Discharging

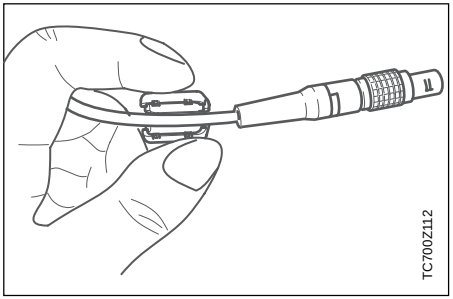
The batteries can be operated from -20°C to +55°C/-4°F to +131°F. Low operating temperatures reduce the capacity that can be drawn; very high operating temperatures reduce the service life of the battery.

To comply with electromagnetic compatibility (EMC) requirements when supplying the TPS700 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.

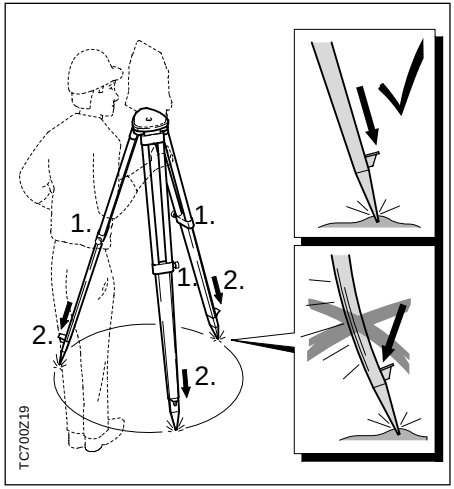
The Lemo connector with the ferrite core must always be at the instrument end of the lead.



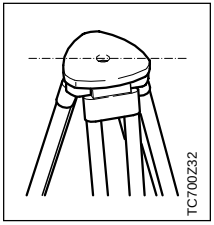
The cables supplied by Leica Geosystems are fitted with a ferrite core as standard. If you intend to use older cables that are not fitted with a ferrite core, the cables must be fitted with a ferrite core prior to use.
You can order ferrite cores from your Leica Geosystems representative (spare part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

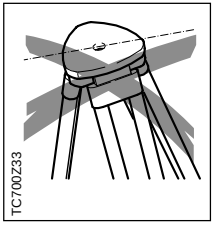


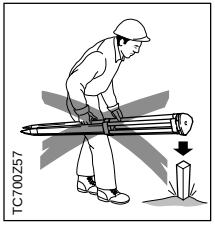
To fit the core, open it and clip it onto the cable close to the Lemo connector before the cable is used with a TPS700 instrument (approx. 2 cm from the Lemo connector).

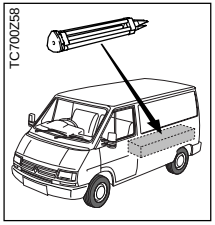


1. Loosen the clamping screws on the tripod legs, pull out to the required length and tighten the screws.
2. In order to guarantee a firm foothold sufficiently press the tripod legs into the ground. When pressing the legs into the ground note that the force must be applied along the legs.







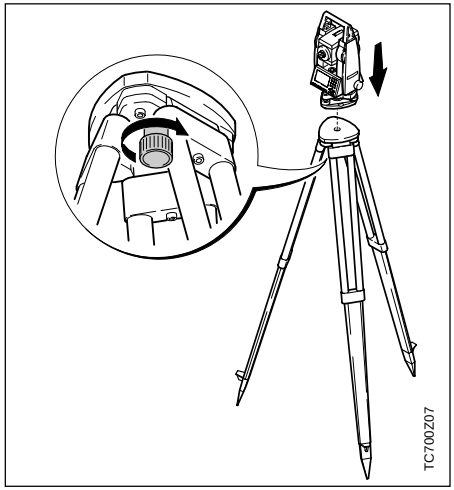


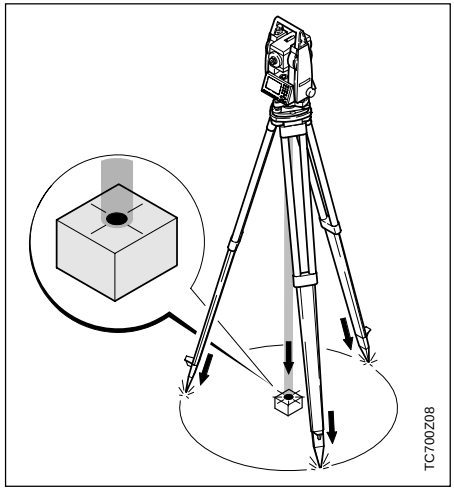
When setting up the tripod pay attention to a horizontal position of the tripod plate.

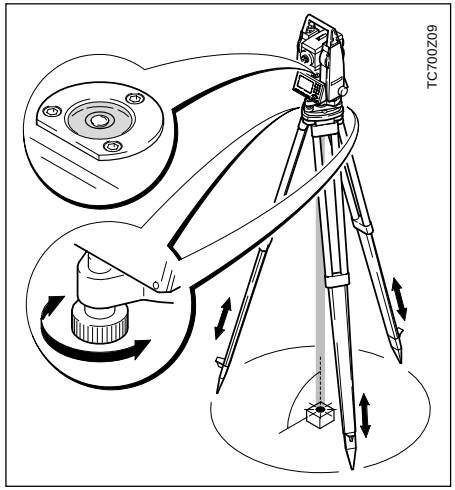
Slight corrections of inclination can be made with the foot screws of the tribrach. Larger corrections must be done with the tripod legs .

Careful handling of tripod

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







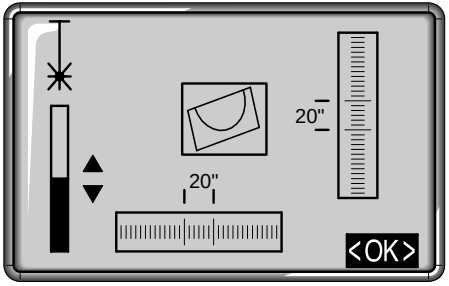
1. Place the instrument onto the tripod head. Tighten central fixing screw of tribrach slightly.
2. Turn footscrews of tribrach into its centre position.

Make sure the tribrach is in proper working order.

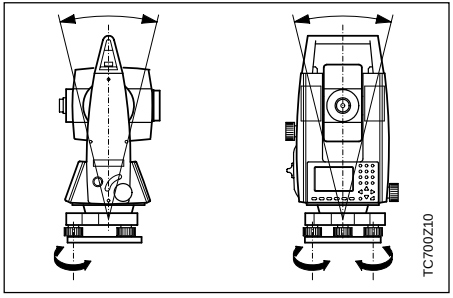
3. Switch on laser plummet with . The electronic level appears in the display.
4. Position tripod legs so that the laser beam is aimed to the ground point.
5. Firmly press in tripod legs.
6. Turn the footscrews of the tribrach to centre the laser beam exactly over the ground point.
7. Move the tripod legs to centre the circular level. The instrument is now roughly levelled-up.

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

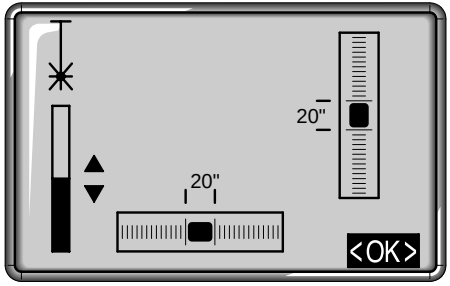
1. Switch instrument on with and activate electronic plummet with . If leveling is insufficient, the symbol of an inclined plummet is displayed.



2. Center electronic plummet by turning the foot screws.



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

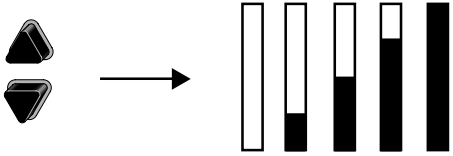


3. Check centring with the laser plummet and re-centre if necessary.

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

Changing the laser intensity

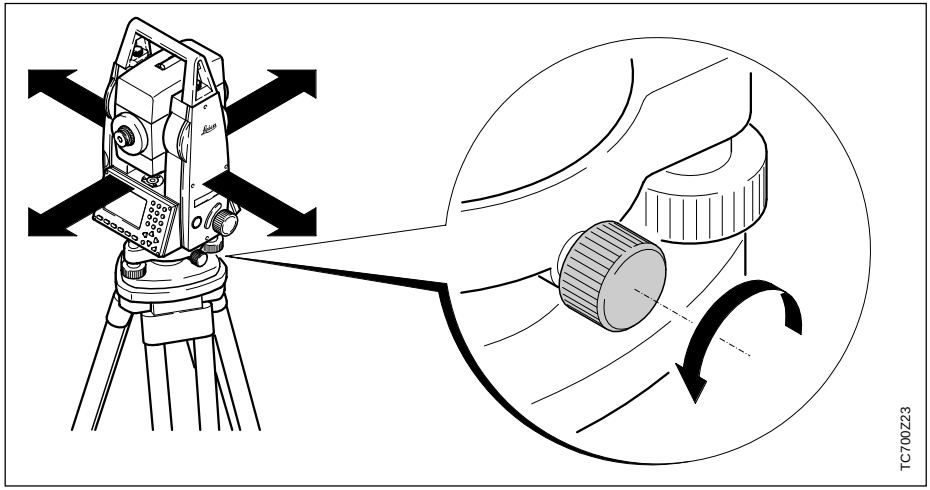
External influences and the surface conditions may require the adjustment of the intensity of the laser. The intensity of the laser plummet can be adjusted in 25% steps as required.



Min. 50% Max

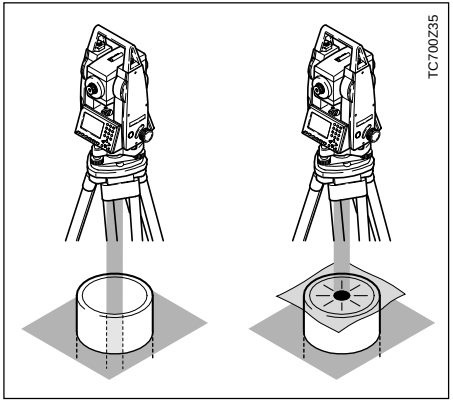
5. The indicated laser intensity is set, and the function terminated, with the <OK> button .

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.

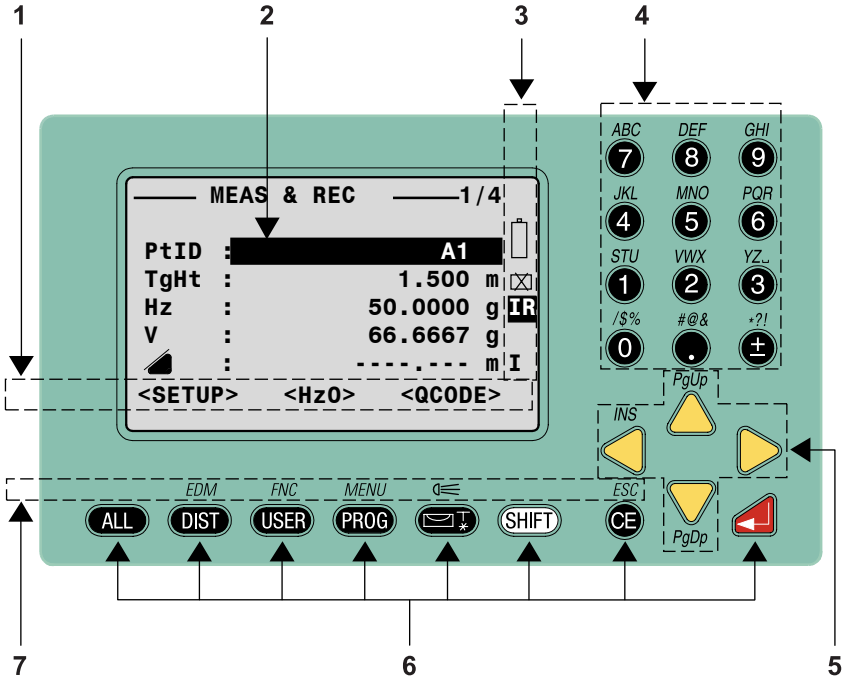
1. Loosen screw.
2. Shift instrument.
3. Fix instrument by turning screw.



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 semi-transparent material over the end of the pipe.

Keypad



1 **Buttons**

2 **Focus bar**
Currently processed field or button

3 **Symbols**

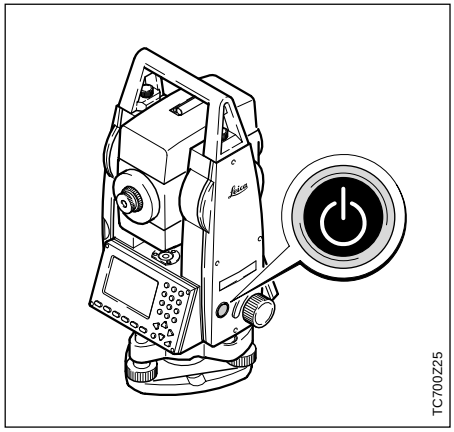
4 **Data entry keys**
Entry of numbers, letters, and special characters

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

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

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

The **On/Off key** is located on the side cover of the TPS700 instrument to avoid inadvertently switching the instrument off.



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

Fixed keys

ALL — Measure distance and angles; record measured values.

DIST — Measure distance and angles; display measured values without recording.

USER — Key, programmable with function from the FNC menu.

PROG — Starts application programs.

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

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

CE — Deletes character/field; stops EDM.

Confirms an entry; continue to the next field.

Fixed keys 2nd level

EDM-> SHIFT **+** DIST
Access to distance measuring functions and distance corrections (ppm).

FNC-> SHIFT + USER

Quick-access to measurement-supporting functions.

MENU-> SHIFT **+** PROG
Access to Data Manager, instrument settings and adjustments.

-> SHIFT +

On/Off switch for display and crosshairs illumination.

Fixed keys 2nd level

ESC -> SHIFT + CE

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

PgUp-> SHIFT + ▲

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

PgDn-> SHIFT + ▼

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

More details can be found in the Field Manual.

Data entry keys

0 : 9 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.

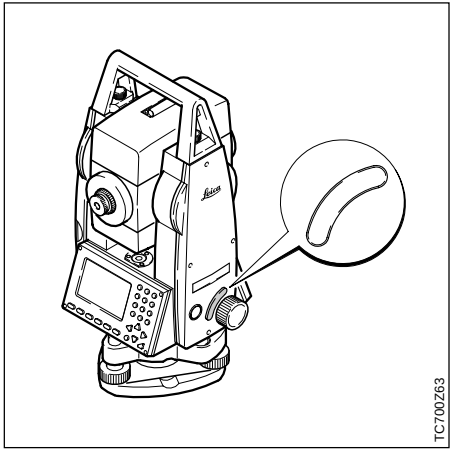
The exact function of these keys will be covered in more detail at the appropriate points in the User Manual.

Navigation keys

(▲ / ▼ / ◀ / ▶)

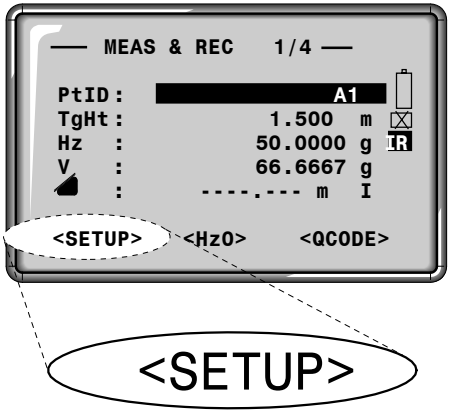
The navigation keys can take on a range of functions depending on the context in which they are used:

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



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 (More details can be found in the Field Manual).



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 quit with ◀ as well as with ▲ or ▼.

1/3 Indicates that several pages are available which can be selected with SHIFT ▼ and SHIFT ▲.

I, II Indicates telescope face I or II


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


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


Compensator switched off.


Indicates that ATR is activated.

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"

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

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), 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 a 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
.	.	#	@	&	. (Alpha5) ,
±	+/-	?	!	+	-
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

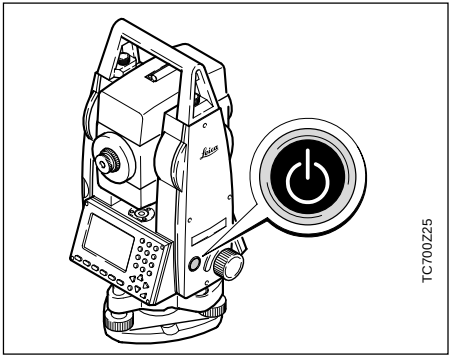
+/- In the alphanumeric character set, "+" and "-" are treated as normal alphanumeric characters. i.e. they have no mathematical function.

Special characters

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

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

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

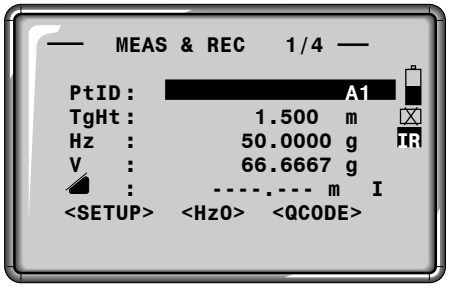


In the measuring display calling all functions/applications under FNC, EDM, PROG, MENU, LIGHT, LEVEL and LASER PLUMMET is possible.

Keep in mind that for all precision measurements, the instrument has to adapt to the ambient temperature and that it has to be protected from one-sided heat exposure.

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

Example of a possible measuring display:



Displays

1/4 Indicates further displays with additional data (e.g. , , **,SD, dH, E, N, H, etc).**

SHIFT : Changes the display.

<Hz0> Set the Hz-orientation to 0° resp. 0 gon.

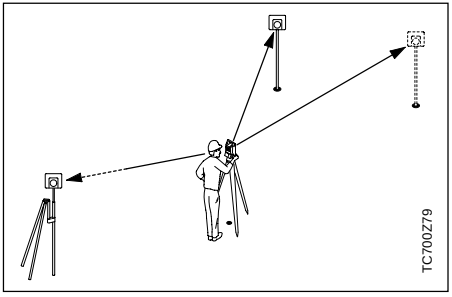
ALL When the key is pressed, a distance measurement is triggered, then the angle values are displayed and both values are either stored to internal memory or transmitted via the serial interface.

DIST Triggers a distance measurement and displays it. The displayed distance remains valid until it is stored or replaced by a new measurement.

Station Block

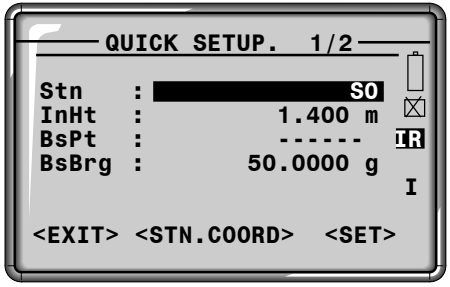
This dialog generates a station block without coordinates which can be evaluated by software.

In the data output the data is made available depending on the evaluation possiblities. 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.

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

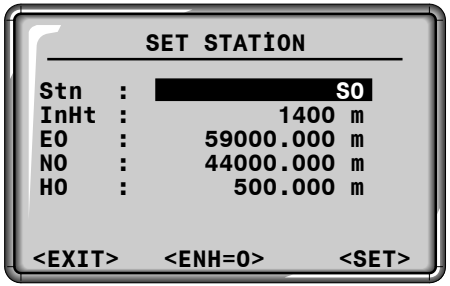
Buttons:

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

<STN.COORD> Starts manual input of the station coordinates.

Manual input of station coordinates:

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



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

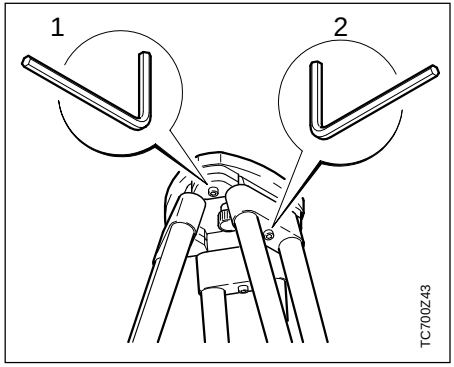
2. SET>: The entries are registered and the measuring display is activated again.

<ENH=0>: The station coordinates are set to (0/0/0).

<EXIT>: Back to measuring display without saving.

<PREV> Back to setup display.

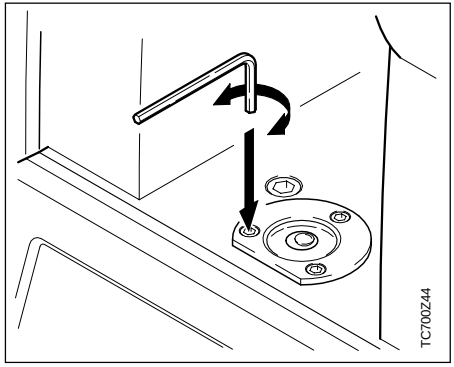
Tripod



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.

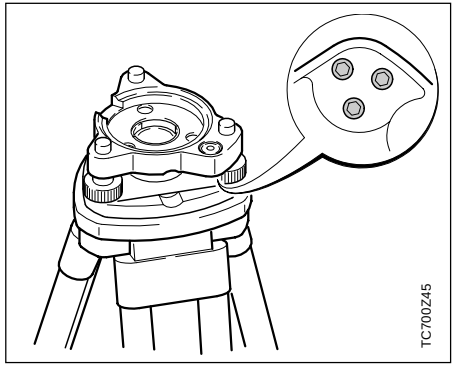
Circular Level



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.

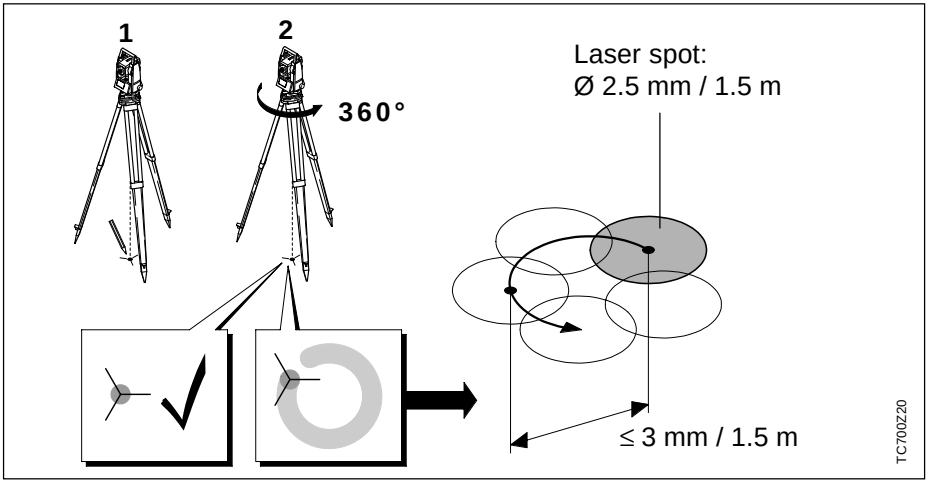
After adjustment no screw must be loose.

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 3 mm from the first marked point an adjustment is possibly necessary. Call your nearest Leica service department.

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

The maximum rotation diameter of the center of the laser spot should not exceed 3 mm (2 sigma) 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 inaccurate distance measurements.

WARNING

For safety aspects direct intrabeam viewing should be considered always as hazardous.

Precautions:

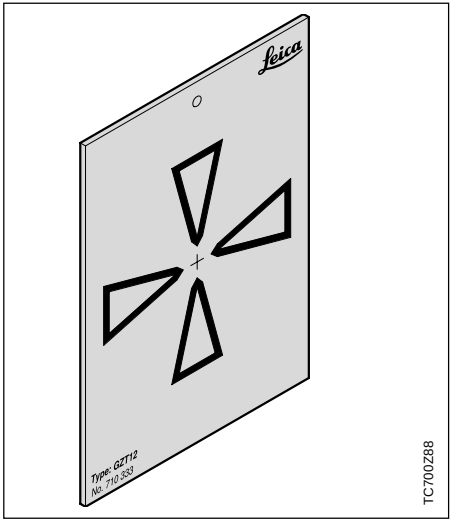
Do not stare into the beam or direct it towards other people unnecessarily. These measures are also valid for the reflected beam.

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 pointer function. Use the telescope crosshairs 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.

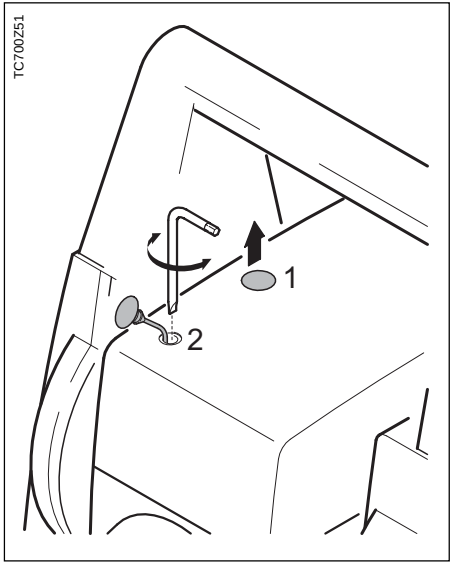
If the spot illuminates the cross, the achievable adjustment precision has been reached; if it lies outside the limits of the cross, the direction of the beam needs to be adjusted.

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.



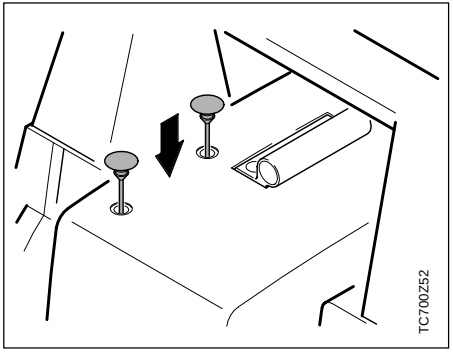
Adjusting the Direction of the Beam

Turn the telescope in such a way that the two plugs are on the top side. Pull the two plugs out from the adjustment ports.
To correct the height of the beam, insert the screwdriver into the adjustment port (1) 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 adjustment port (2) 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, close adjustment ports again to keep out damp and dirt.



Transport

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

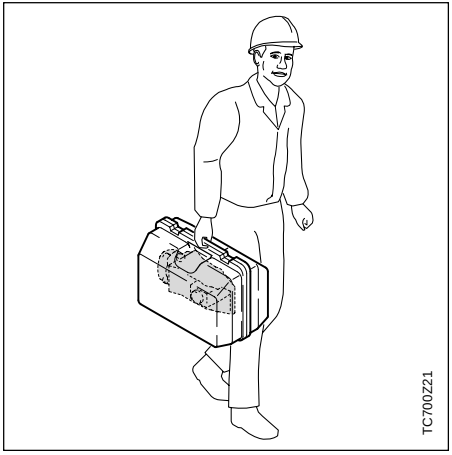
After a longer period of storage or transport of your instrument always check the field ajustment parameters indicated in this manual before using the instrument.

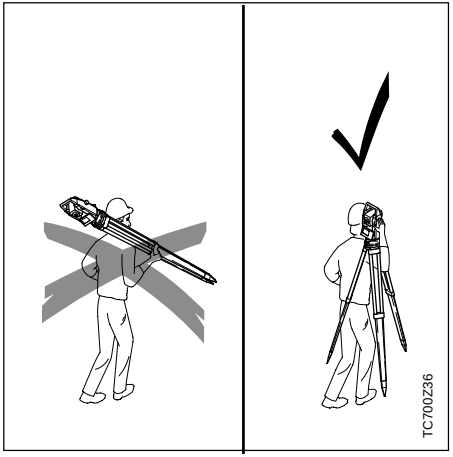
Maintainance for motorized drives

An inspection of the drives in TCRApower or TCRAultra instruments must be done in a Leica Geosystems service shop:

- After about 4000 hours operation
- Twice a year in case of permanent use of the instrument (e.g. in monitoring applications)

In the Field

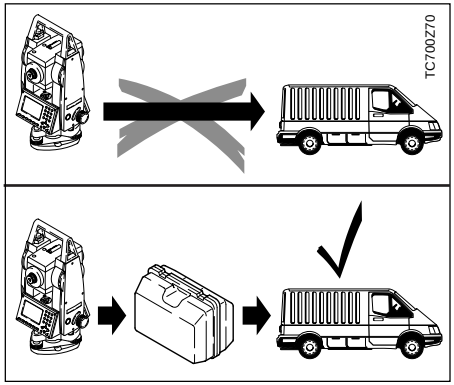




When transporting the equipment **in the field,** always make sure to

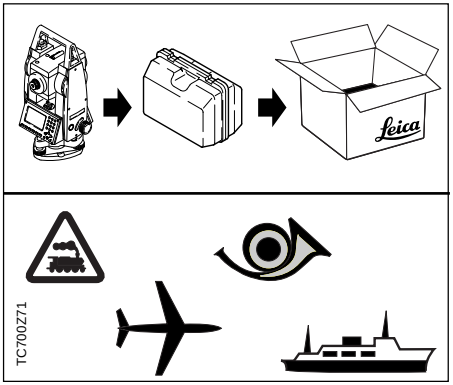
- either carry the instrument in its original transport case or,
- carry the tripod with its legs splayed across your shoulder, keeping the attached instrument upright.

Inside Vehicle

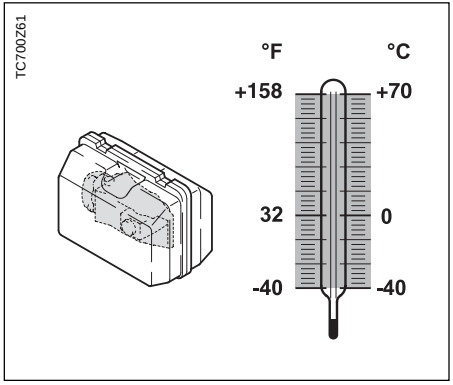


Never transport the instrument loose **inside the vehicle.**
The instrument can be damaged by blows and vibrations. It must always be transported in its case and be properly secured.

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.

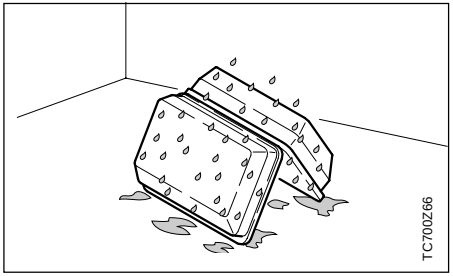


When storing the equipment, particularly in summer and inside a vehicle, take the **temperature limits** into account.

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

NiMH and Alkaline batteries

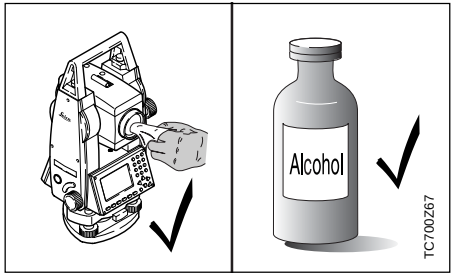
- The permissible temperature range for storing is -40°C to +55°C / -40°F to +131°F. A storage temperature range of 0°C to +20°C / +32°F to +68°F in dry environment is recommended to minimize self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 10% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries (NiMH) before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.



If the instrument becomes wet, please unpack.

Wipe down, clean, and dry the instrument (at not more than 40 °C/ 104°F), transport case, foam inserts, and accessories. Pack up the equipment only when it is perfectly dry.

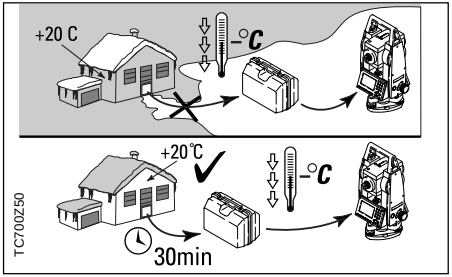
When using the instrument in the field always close the transport case.



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:
Make sure plugs do not get dirty and are protected against moisture. Blow clean all dirty plugs. If connecting cables are disconnected while measuring, data may be lost. Only remove connecting cables after the instrument has been turned off.

Intended Use

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

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

Permitted use

- Measuring horizontal and vertical angles
- Measuring distances
- Recording measurements
- Computing by means of application software
- Automatic target recognition (with ATR)
- Visualizing the aiming direction (with EGL)
- Visualizing the vertical axis (with the laser plummet).

Prohibited use

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

- Controlling machines, or controlling moving objects or similar, with the automatic target recognition ATR or with the visible EDM.
- Deliberate dazzling of third parties

WARNING

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

Environment

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

DANGER

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

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

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

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

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.

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

International Warranty
The International Warranty can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/internationalwarranty or received from your Leica Geosystems dealer.

Software Licence Agreement
This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online pursuant to prior authorization from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

Such agreement is provided together with all products and can also be found at the Leica Geosystems home page at http://www.leica-geosystems.com/swlicense or your Leica Geosystems dealer.

You must not install or use the software unless you have read and accepted the terms and conditions of the Leica Geosystems Software Licence Agreement. Installation or use of the software or any part thereof, is deemed to be an acceptance of all the terms and conditions of such licence agreement. If you do not agree to all or some of the terms of such licence agreement, you may not download, install or use the software and you must return the unused software together with its accompanying documentation and the purchase receipt to the dealer from whom you purchased the product within ten (10) days of purchase to obtain a full refund of the purchase price.

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 product.

WARNING

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

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

CAUTION

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

Precautions:
Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.

DANGER

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

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

WARNING

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

Precautions:
Do not carry out field surveys during thunderstorms.

CAUTION

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

Precautions:
Do not point the product directly at the sun.

WARNING

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

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

WARNING

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

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

WARNING

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

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

CAUTION

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

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

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

WARNING

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

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

CAUTION

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

Precautions:
When setting-up the product, make sure that the accessories, for example tripod, tribrach, connecting cables, are correctly adapted, fitted, secured, and locked in position. Avoid subjecting the product to mechanical stress.

WARNING

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

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

Precautions:

The product must not be disposed with household waste.

Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorized personnel.

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

CAUTION

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

Integrated Distancer, Invisible Laser

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

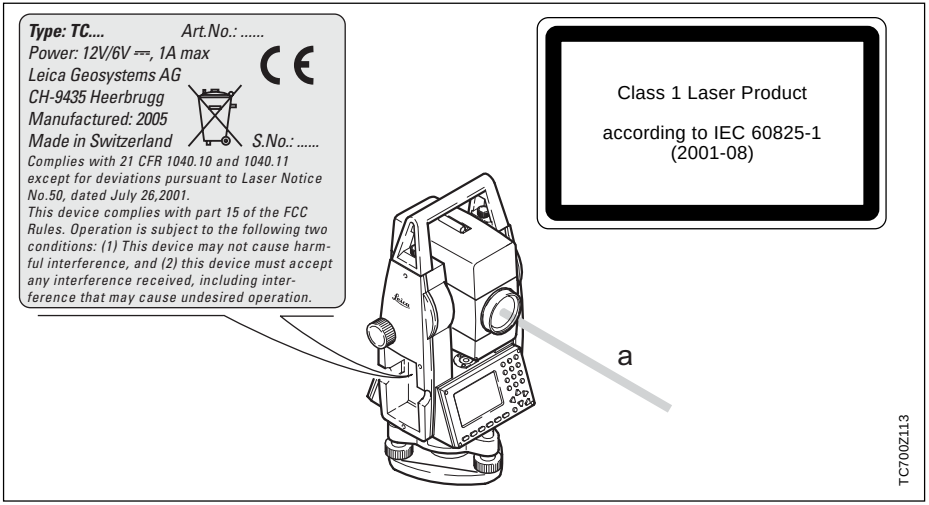
The product is a Class 1 Laser Product in accordance with:

- IEC 60825-1 (2001-08): "Safety of Laser Products".
- EN 60825-1:1994 + A11:1996 + A2:2001: "Safety of Laser Products".

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

Description	Value
Beam divergence	1.8 mrad
Pulse duration	800 ps
Pulse repetition frequency	100 MHz
Maximum average radiant power	0.33 mW ±5 %
Maximum peak radiant power	4.12 mW ±5 %

Labelling



a) Laser beam

As an alternative to the invisible laser, the EDM incorporated into the product produces a visible red laser beam which emerges from the telescope objective.

WARNING

The two types R100 and R300 of distancers with visible laser are available, identifiable by the type plate.

The products are Class 3R Laser Products in accordance with:

- IEC 60825-1 (2001-08): "Safety of Laser Products".
- EN 60825-1:1994 + A11:1996 + A2:2001: "Safety of Laser Products".

Class 3R Laser Products:

For safety aspects direct intrabeam viewing should be considered always as hazardous. Avoid direct eye exposure. The accessible emission limit is within five times the accessible emission limits of Class 2 in the wavelength range from 400 nm to 700 nm.

Description	R100	R300
Maximum average radiant power	4.75 mW ± 5%	4.75 mW ± 5%
Maximum peak radiant power	59 mW ± 5%	59 mW ± 5%
Pulse duration	800 ps	800 ps
Pulse repetition frequency	100 MHz	100 MHz - 150 MHz
Beam divergence	0.15 x 0.35 mrad	0.15 x 0.5 mrad

WARNING

For safety aspects direct intrabeam viewing should be considered always as hazardous.

Precautions:

Do not stare into the beam or direct it towards other people unnecessarily. These measures are also valid for the reflected beam.

WARNING

Looking directly into the reflected laser beam could be dangerous to the eyes when the laser beam is aimed at areas that reflect like a mirror or emit reflections unexpectedly, for example prisms, mirrors, metallic surfaces or windows.

Precautions:

Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections. Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on, in Laserpointer or distance measurement mode. Aiming at prisms is only permitted when looking through the telescope.

WARNING

The use of Laser Class 3R equipment can be dangerous.

Precautions:

To counteract hazards, it is essential for every user to respect the safety precautions and control measures specified in the standard IEC 60825-1 (2001-08) resp. EN 60825-1:1994 + A11:1996 + A2:2001, within the hazard distance *); pay particular attention to Section Three "User's Guide".

Following an interpretation of the main points in the relevant section of the standard quoted.

Class 3R Laser Products used on construction sites and outdoors, for example surveying, alignment, levelling:

a) Only qualified and trained persons should be assigned to install, adjust and operate the laser equipment.

b) Areas in which these lasers are used should be posted with an appropriate laser warning sign.

c) Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.

d) The laser beam should be terminated at the end of its useful beam path and should in all cases be terminated if the hazardous beam path extends beyond the limit (hazard distance *)) of the area in which the presence and activities of personnel are monitored for reasons of protection from laser radiation.

e) The laser beam path should be located well above or below eye level wherever practicable.

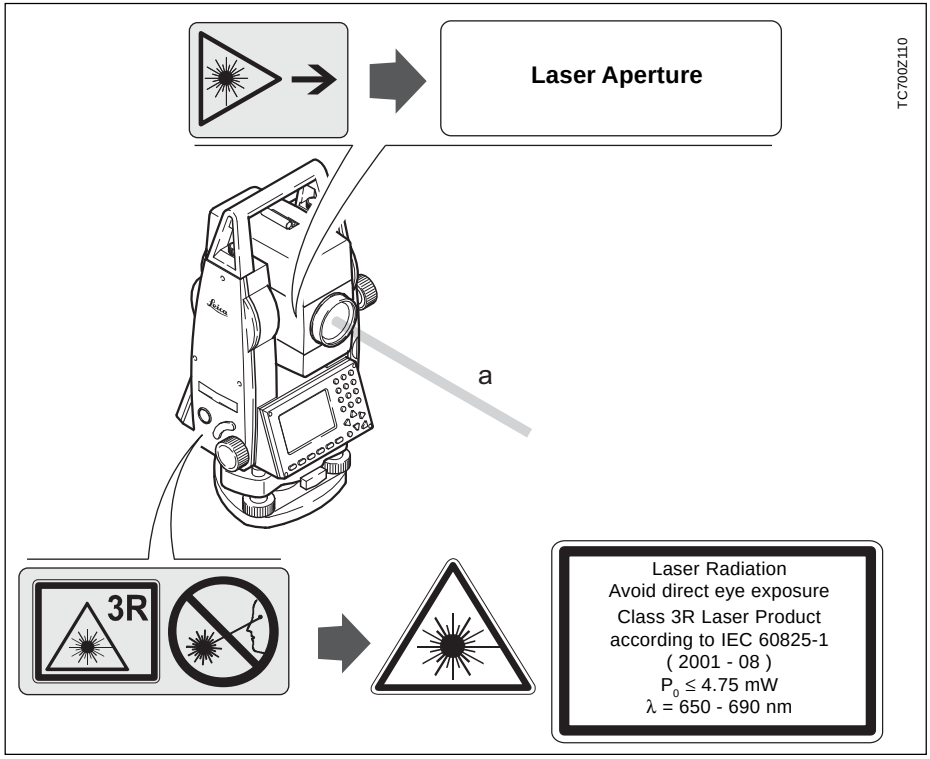
f) When not in use the Laser Product should be stored in a location where unauthorized personnel cannot gain access.

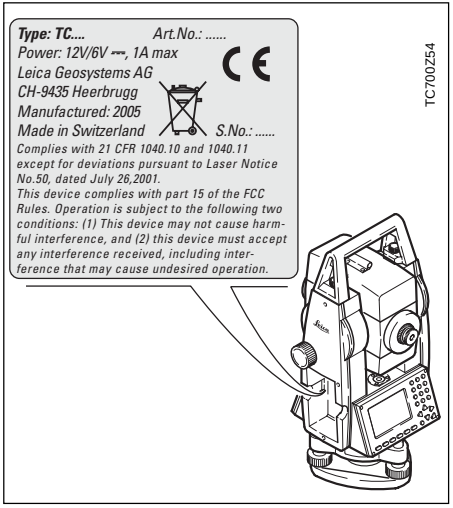
g) Precautions should be taken to ensure that the laser beam is not unintentionally directed at mirror-like, specular surfaces, for example mirrors, metal surfaces or windows. But, more importantly, at flat or concave mirror-like surfaces.

*) The hazard distance is the distance from the laser at which beam irradiance or radiant exposure equals the maximum permissible value to which personnel may be exposed without being exposed to a health risk.

Products with an integrated distancer of laser class 3R this hazard distance is 68 m / 224 ft. At this distance, the laser beam rates as Class 1M, that means direct intrabeam viewing is not hazardous.

Labelling





a) Laser beam

The integrated automatic target recognition produces an invisible laser beam which emerges from the telescope objective.

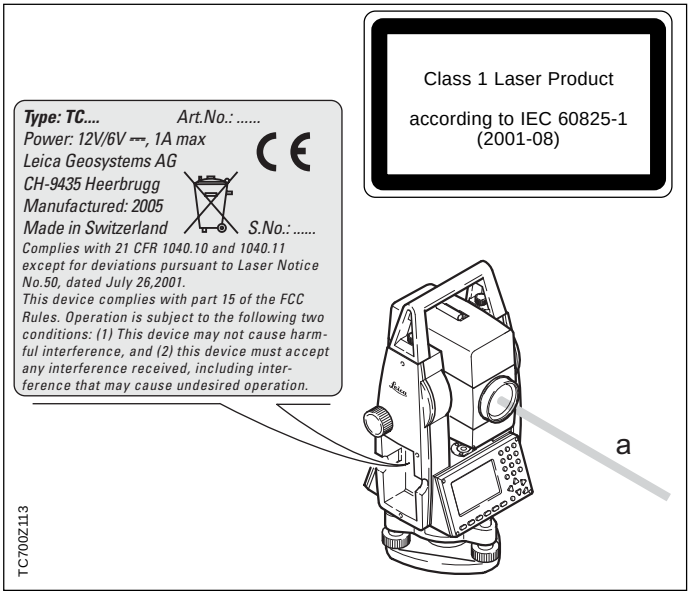
The product is a Class 1 Laser Product in accordance with:

- IEC 60825-1 (2001-08): "Safety of Laser Products".
- EN 60825-1: 1994 + A11:1996 + A2:2001:"Safety of Laser Products".

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

Description	Value
Maximum average radiant power	1 mW ± 5%
Maximum peak radiant power	2 mW ± 5%
Pulse duration	9.8 ms
Pulse repetition frequency	50 Hz
Beam divergence	26.2 mrad

Labelling



a) Laser beam

The integrated electronic guide light produces a visible LED beam from the front side of the telescope. Depending on the type of telescope the EGL may be designed differently.

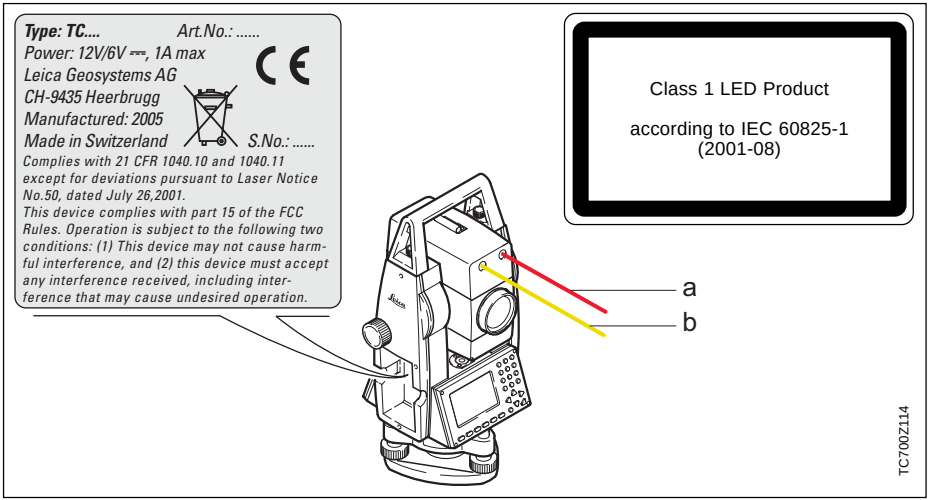
The product is a Class 1 LED product in accordance with:

- IEC 60825-1 (2001-08): "Safety of Laser Products".
- EN 60825-1:1994 + A11:1996 + A2:2001: "Safety of Laser Products".

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.

Flashing LED	Yellow	Red
Maximum average radiant power	0.28 mW ± 5 %	0.47 mW ± 5 %
Maximum peak radiant power	0.75 mW ± 5 %	2.5 mW ± 5 %
Pulse duration	2 x 105 ms	1 x 105 ms
Pulse repetition frequency	1.786 Hz	1.786 Hz
Beam divergence	2.4 °	2.4 °

Labelling



a) LED beam red
b) LED beam yellow

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

The product is a Class 2 Laser Product in accordance with:

- IEC 60825-1 (2001-08): "Safety of Laser Products".
- EN 60825-1:1994 + A11:1996 + A2:2001: "Safety of Laser Products".

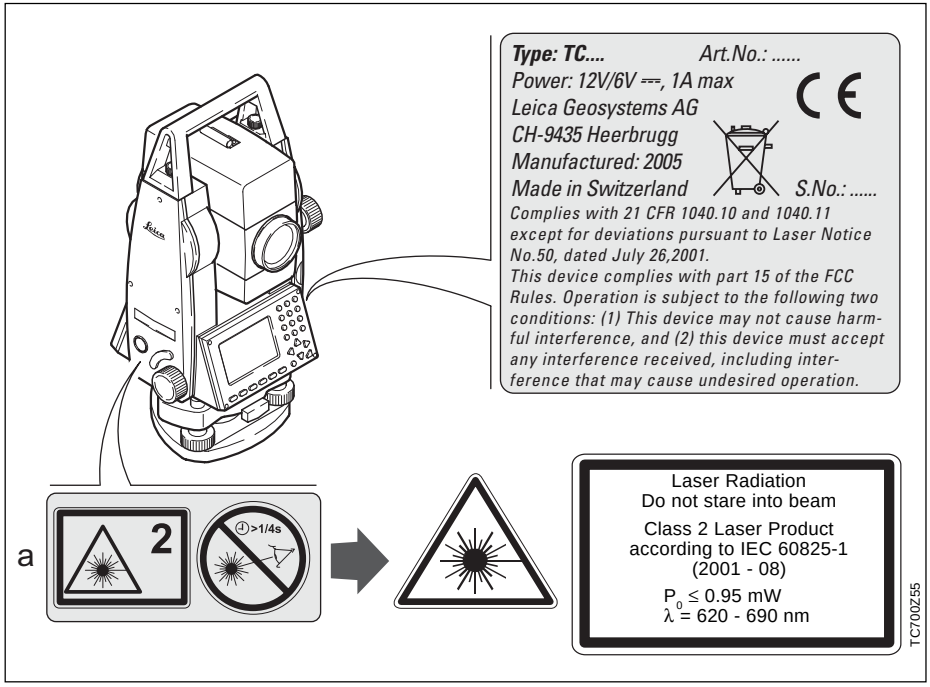
Class 2 Laser Products:
Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

Description	Value
Maximum average radiant power	0.95 mW ± 5%
Pulse duration	c.w.
Beam divergence	0.16 x 0.6 mrad

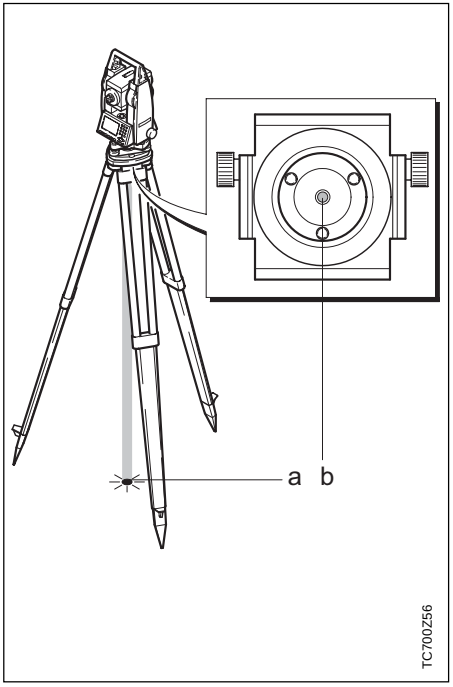
WARNING
It can be dangerous to look into the beam with optical equipment, for example binoculars or telescopes.

Precautions:
Do not look directly into the beam with optical equipment.

Labelling



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



a) Laser beam
b) Exit for laser beam

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

CAUTION

There is a risk that disturbances may be caused in other equipment if the product is used in conjunction with accessories from other manufacturers, for example field computers, personal computers, two-way radios, non-standard cables or external batteries.

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

CAUTION

Disturbances caused by electromagnetic radiation can result in erroneous measurements.

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

Precautions:
Check the plausibility of results obtained under these conditions.

WARNING

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

Precautions:

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

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.

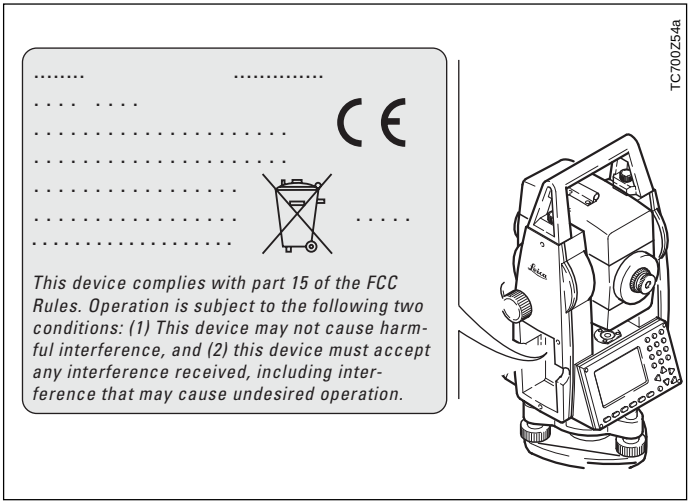
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 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:



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 100 m 2.6 m

Angle measurement
- absolute, continuous,
- Units selectable
  360° sexagesimal, 400gon,
  360° decimal, 6400 mil, V%, ±V
- Accuracy standard deviation Hz, V (acc. to ISO17123-3)

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

- Smallest display resolution

gon:	Type 702	0.0001
	Type 703/705	0.0005
360d:	Type 702	0.0001
	Type 703/705	0.0005
360s:	all types	1"
mil:	all types	0.01

Level sensitivity
- Circular level: 6'/2 mm

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

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

Laser plummet
- In alidade, turns with instrument
- Accuracy: max. deviation from plummet line: 1.5 mm (2 sigma) at instrument height of 1.5 m
- Laser dot diameter: 2.5mm / 1.5m

Optical plummet

Location: • in tripod (optional)

Magnification: • 2 x / focussing

Keyboard

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

Position	In both faces 2nd face optional
Character set	Extended ASCII as standard character set. Additional language can be loaded (optional)

Display

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

Type of tribrach

- Tribrach removable GDF111/ GDF121
  Thread dia: 5/8"
  (DIN 18720 / BS 84)

Dimensions, Weight

- 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: 207 mm

- Case: 468x254x355 mm (LxBxH)

Type	Weight (rounded)
TC/ TCR	4.6 kg (10.1 lbs)
TCRA power/ ultra	4.8 kg (10.6 lbs)
Tribrach GDF 111 Tribrach GDF 121	0.6 kg (1.3 lbs) 0.8 kg (1.8 lbs)
Battery GEB 111 GEB 121	0.2 kg (0.45 lbs) 0.4 kg (0.9 lbs)

Tilting axis height

- above the tribrach plate 196 mm
- with tribrach GDF111
  240 mm ± 5 mm
- with tribrach GDF121
  238 mm ± 5 mm

Voltage

- Battery GEB111: NiMh
  Voltage, capacity: 6V, 2.1 Ah
- Battery GEB121: NiMh
  Voltage, capacity: 6V, 4.2 Ah
- 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 (angle + distance)	
Battery Type	*GEB121*	*GEB111*
TC / TCR	2000	1000
TCRAultra/power	600	300

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 (vertical axis tilt) Yes

Recording

- RS232 interface Yes
- Internal memory (Flashmemory) Yes
  Total capacity 576 KB
  ≈ 10'000 data blocks

Drives

- Number Hz/V 1 Hz, 1V
- Movement endless
- TCRApower motorized
- TCRAultra motorized

EGL

- Working range: 5m - 150m (15 ft - 500 ft)
- Positioning range at 100 m: 50mm
- Left/right indication: Yes

- Type: infrared
- Carrier wave: 780 nm
- Measuring system: special frequency system basis 100 MHz ≙ 1.5 m
- EDM type: coaxial
- Display (least count): 1 mm

EDM measuring programm	Accuracy ** (standard deviation, acc. to ISO17123-4)	Time per measurement
IR-Fine	2 mm + 2 ppm	< 1.0 sec.
IR-Rapid	5 mm + 2 ppm	< 0.5 sec.
IR-Track	5 mm + 2 ppm	< 0.15 sec.
IR-Tape	5 mm + 2ppm	1.0 sec.

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

Prism constants

- Standard prism: GPR1, GPR121, GPR111, GPR112, GPH1P and Mini prism GMP111-0: 0.0 mm
- 360° reflector: GRZ4, GRZ121: +23.1 mm
- 360° Mini prism GRZ101: +30.0 mm
- Reflector tape: +34.4 mm
- Mini prism: GMP101, GMP102, GMP104, GMP105, GMP111: +17.5 mm

Shortest measuring distance

- Standard prism: 0.2 m
- 360° reflector: 1.5 m
- 360° Mini prism: 1.5 m
- Reflector tape: 1.5 m
- Mini prism: 0.2 m

	Range (normal and rapid measurement)					
	Standard-Prism	**3 Prism (GPH3)**	**360° reflector**	**360° Mini prism*** **	**Reflector tape 60 x 60**	**Mini prism**
1)	1800 m (6000 ft)	2300 m (7500 ft)	800 m (2600 ft)	450 m (1500 ft)	150 m (500 ft)	800 m (2600 ft)
2)	3000 m (10000 ft)	4500 m (14700 ft)	1500 m (5000 ft)	800 m (2600 ft)	250 m (800 ft)	1200 m (4000 ft)
3)	3500 m (12000 ft)	5400 m (17700 ft)	2000 m (7000 ft)	1000 m (3300 ft)	250 m (800 ft)	2000 m (7000 ft)

Atmospheric conditions:

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

*** The 360° mini prism is only recognizable up to approx. 500m. Using it for distances > 500m will likely incur targeting errors. Recommended measuring range of the mini prism is therefore from 1.5m to 500m.

(Instruments with extended range)

- Type: Coaxial, visible red laser class 3R
- Power (R100): Special frequency system basis 100 MHz ≙ 1.5 m
- Ultra (R300): System analyser basis 100 MHz - 150 MHz
- Carrier wave: 670 nm
- Display (least count) 1 mm

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 20	7 x 14
at 100	12 x 40
at 200	25 x 80
at 300	36 x 120
at 400	48 x 160
at 500	60 x 200

Accuracy

EDM measuring program	Standard measuring	Accuracy ** (standard deviation)	Measure time, typical [s]	Measure time, maximum [s]
IR SHORT	Reflectorless 0 - 500 m	3 mm + 2 ppm	3 - 6	12
IR SHORT	Reflectorless >500 m	5 mm + 2 ppm	3 - 6	12
IR TRACK	Reflectorless 0 - 760 m	5 mm + 2 ppm	3 - 6	12

** Object in shade, sky overcast.
Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.
The display resolution (least count) is 1 mm.

Distance measurement Power (R100) (without reflector)

- Range of measurement: 1.5 m to 300 m (to target plate, part.no. 710333)
- Display unambiguous: Up to 760 m
- Prism constant: + 34.4 mm

Distance measurement Ultra (R300) (without reflector)

- Range of measurement: 1.5 m to 760 m (to target plate, part.no. 710333)
- Display unambiguous: Up to 760 m
- Prism constant: + 34.4 mm

	Power: Range (without reflector)	
Atmospheric conditions	No reflector (white target)*	No reflector (grey target)*
4	140 m (460 ft)	70 m (230 ft)
5	170 m (560 ft)	100 m (330 ft)
6	>170 m (>560 ft)	> 100 m (>330 ft)

	Ultra: Range (without reflector)	
Atmospheric conditions	No reflector (white target)*	No reflector (grey target)*
4	300 m (990 ft)	200 m (660 ft)
5	500 m (1640 ft)	300 m (990 ft)
6	>500 m (>1640 ft)	>300 m (>990 ft)

* Kodak Grey Card used with exposure meter for reflected light.
White target 90% reflection, grey target 18% reflection.

4) Object in strong sunlight, severe heat shimmer
5) Object in shade, or sky overcast
6) Underground, night and twilight

Distance measurement (long range)

- Recommended range of measurement: From 1000 m
- Display unambiguity: Up to 12 km

- Principle: Phase measurement
- Type: Coaxial, visible red laser class 3R
- Carrier wave: 670 nm

EDM measuring programm	Accuracy ** (standard deviation,)	Measure time
RL-PRISM	5 mm + 2 ppm	typ. 3 - 6 sec. max. 12 sec.

** Object in shade, sky overcast.
Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.
The display resolution (least count) is 1 mm.

Range

The range of the long range measurements is the same for R100 and R300.

	Range (long range)	
Atmospheric conditions	Standard-Prism	Reflector tape (60 x 60 mm)
1	2200 m (7200 ft)	600 m (2000 ft)
2	7500 m (24600 ft)	1000 m (3300 ft)
3	> 10000 m (33000 ft)	1300 m (4200 ft)

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

Positioning accuracy
(TCRA / Standard prism, static, ATR single measurement)

Distance	Accuracy (standard deviation)	Measuring time
to 300 m	3 mm	3.0 Sec.
> 300 m	2"/3"/5" *	3 - 4

* corresponds to angle meas. accuracy of instrument

Prism use

- Standard prisms Yes
- 360° reflector Yes
- 360° Mini prism Yes
- Mini prism Yes
- Reflector tape No

Special active prisms are not required.

Recognition method

- Video techniques: Yes
- EDM techniques: No

Range in ATR mode
(under average conditions, unimpaired visibility)

	ATR mode
Standard prism	1000 m (3300 ft)
360° reflector	600 m (2000 ft)
360° Mini prism	350 m (1150 ft)
Mini prism	500 m (1600 ft)
Reflector tape 60 x 60	65 m (200 ft)

Shortest measuring distance

- ATR 1.5 m

Rotation speed

Positioning to 50 gon/Sec.

Searching

Typical search time in telescopic field of view	Normal measurement = 2.5 Sec + 1 Sec. positioning
Full scope of search	>1°30' (1.66 gon)
Interrupted viewing	Yes, briefly

Application Programs

For a detailed description, refer to the TPS700 Field Manual

Integrated programs:

- Target eccentricity
- Manual coordinate input
- Single-point orientation
- Data converter (flexible data formats GSI, ASCII).
- Free stationing including resection
  Up to 5 tie points with or without distance measurement
- Orientation and height transfer
  Up to 5 tie points
- Stakeout
- Tie distance
- Remote height and coordinates determination
- Area calculation
- Reference line
- File editor

Optional programs

- Sets of Angles

Atmospheric Correction ΔD_1

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.

To calculate the atmospheric correction, the fixed value of 60% relative humidity is used for the TPS700 series.

The index n for the infrared EDM (carrier wave 780nm) = 1.0002830. For the visible red laser (carrier wave 670nm), n = 1.0002859.

The index n is calculated from the formula of Barrel and Sears, and is valid for air pressure p = 1013.25 mbar, for air temperature t = 12°C and for relative air humidity h = 60%.

Formula for infrared EDM:

$$\Delta D_1 = 283.04 - \left[\frac{0.29195 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^{x} \right]$$

Formula for visible red laser:

$$\Delta D_1 = 285.92 - \left[\frac{0.29492 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^{x} \right]$$

Atmospheric Correction ΔD_1

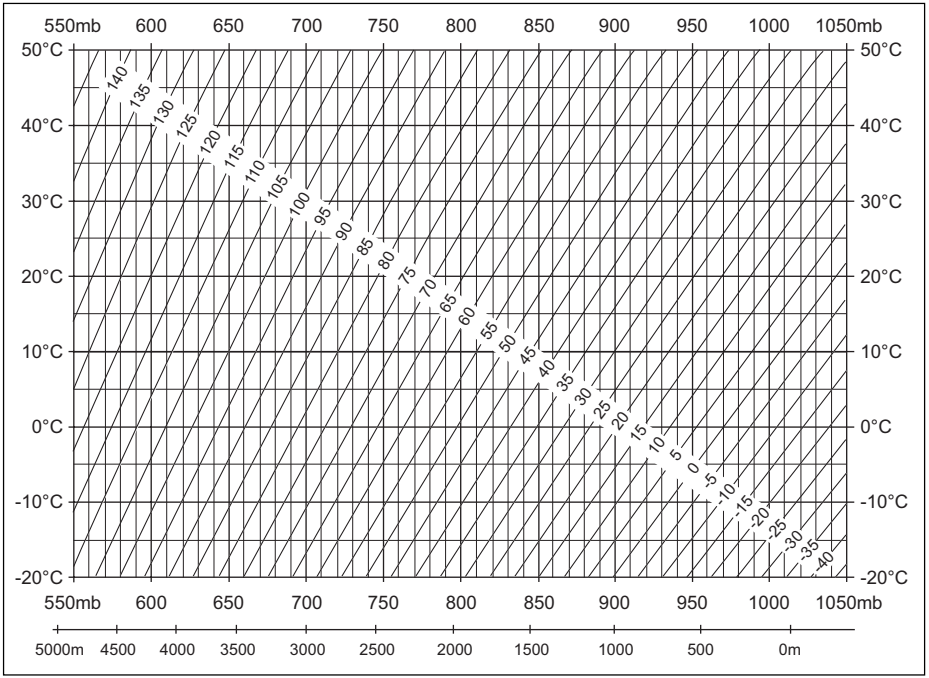
ΔD_1 = atmospheric correction [ppm]

p = air pressure [mbar]
t = air temperature [°C]
h = relative humidity [%]
α = 1 / 273.16

$$x = \frac{7.5\ t}{237.3 + t} + 0.7857$$

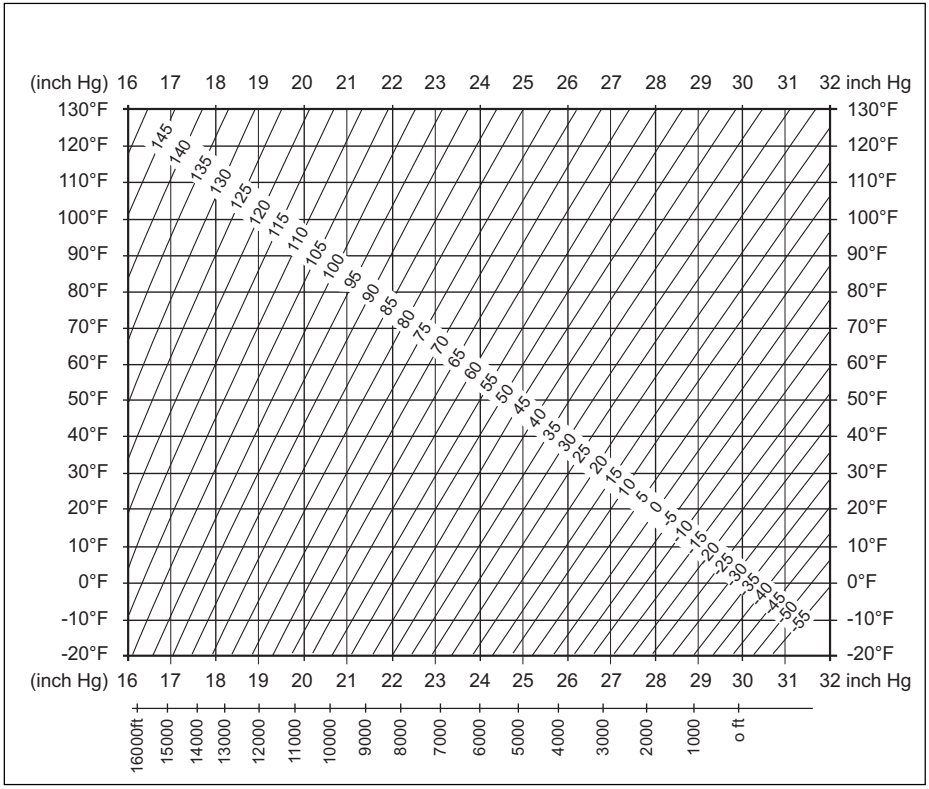
If the basic value of 60% relative humidity as used by the EDM is retained, the maximum possible error in the calculated atmospheric correction will be 2 ppm (2 mm / km).

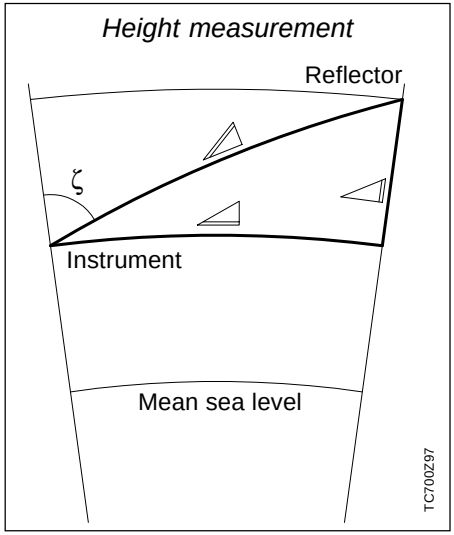
Atmospheric correction in ppm with °C, mb, H (metres); at 60% relative humidity.



Atmospheric Correction ΔD_1

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





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, the user may change it) are taken into account automatically. The calculated horizontal distance relates to the station height, not to the reflector height.

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

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

$$\text{slope} = Y - A \cdot X \cdot Y$$

$$\text{slope} = X + B \cdot Y^2$$

slope = horizontal distance [m]
slope = height difference [m]
$Y = \text{slope} \cdot |\sin \zeta|$
$X = \text{slope} \cdot \cos \zeta$
ζ = vertical-circle reading

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

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

k = 0.13
$R = 6.37 \cdot 10^6$ m

Independent of the atmospheric correction, a scale correction may be entered. This is however **only** taken into consideration for the calculation of the coordinates, and **not** for the slope and horizontal distances. Distances calculated from target and station coordinates deviate by this correction from "measured" resp. displayed horizontal distances.

Total Quality Management: Our commitment to total customer satisfaction.

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).

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

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Leica Geosystems AG
Heinrich-Wild-Strasse
CH-9435 Heerbrugg
Switzerland
Phone +41 71 727 31 31

www.leica-geosystems.com

- when it has to be **right**

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