Leica Theodolite 100 Series

User Manual T105/T110

Version 1.3
English

Leica Geosystems

Electronic Theodolite

Congratulations on your purchase of a new Leica Geosystems Theodolite.

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 indicated on the label in 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.

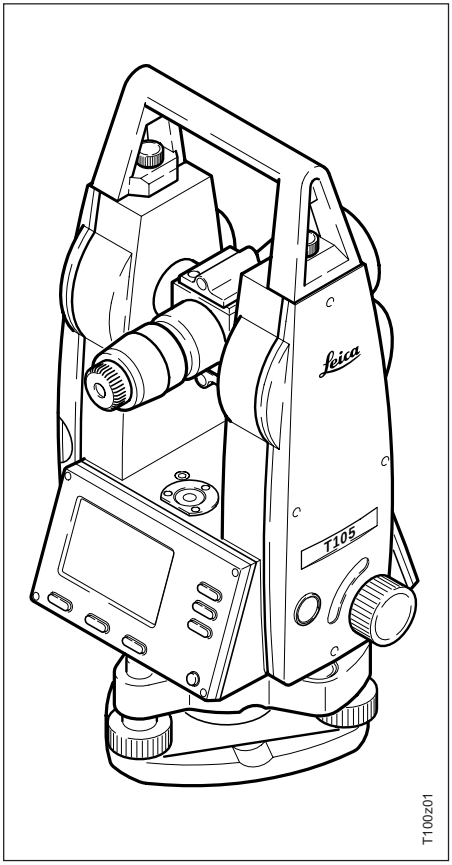
Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Contents

The Leica T105/T110 is a high-quality electronic theodolite designed for the construction site.
Its innovative technology makes the daily surveying jobs easier.

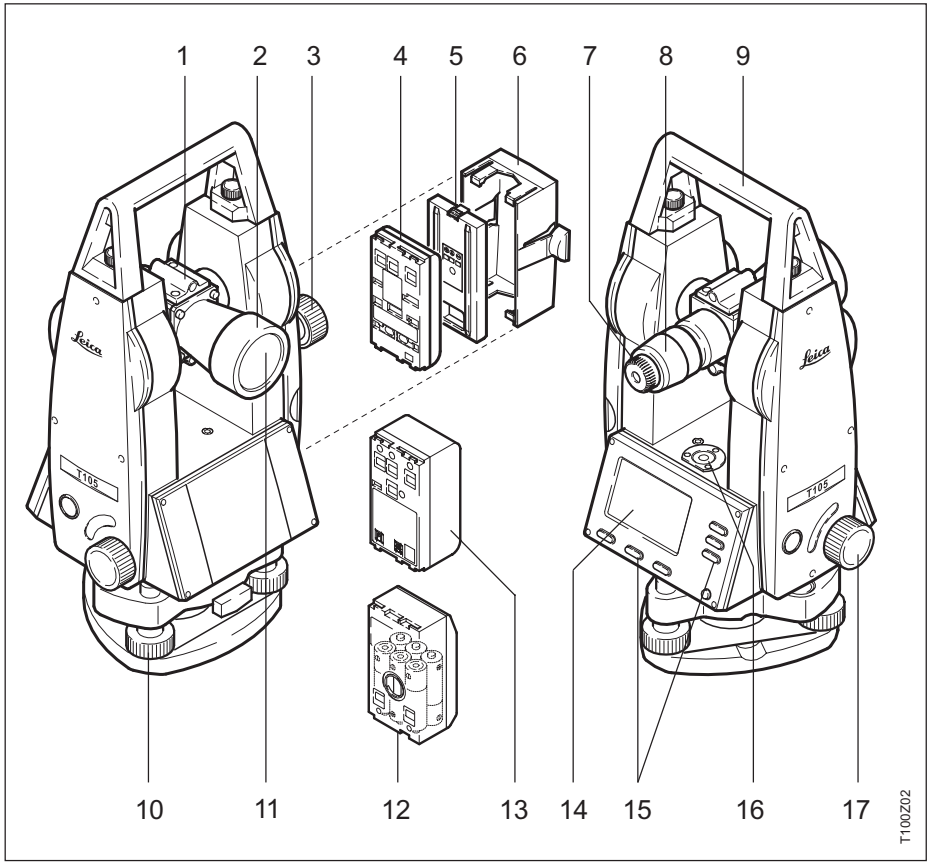
The instrument is ideally suited for simple construction surveys and setting out tasks.

The easy operation of the instrument functions can be quickly learned even by inexperienced surveyors.

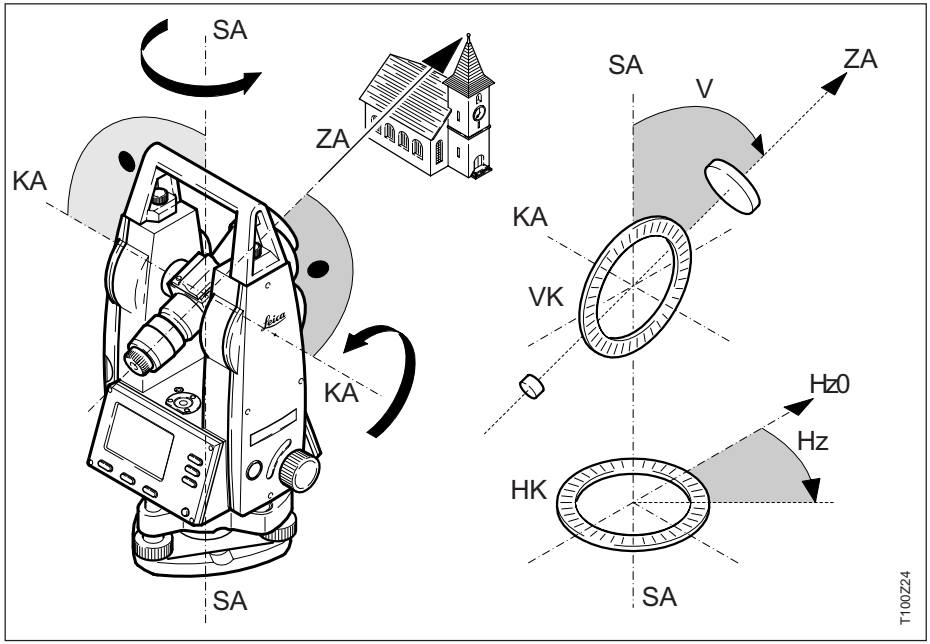


Special features

- Easy and quickly to learn !
- Logically designed keyboard; with large and clear LCD.
- Attractive design; low weight.
- User setting remain active even after switching off.
- Continuous drives for horizontal and vertical angles.
- AutoOFF function to prevent unneccary power consumption.
- Equipped with laser plummet as standard.



1 Optical sight
2 Telescope
3 Vertical drive
4 Battery GEB111 (optional)
5 Battery spacer for GEB111
6 Battery holder for GEB111/ GEB121/GAD39
7 Focussing graticule
8 Focussing telescope image
9 Detachable carrying handle with mounting screws
10 Foot screw
11 Objective
12 Battery adapter GAD39 for 6 single cells (optional)
13 Battery GEB121 (optional)
14 Display
15 Keyboard
16 Circular level
17 Horizontal drive



ZA = Line of sight / collimation axis
Line in space containing all object points imaged into the graticule centre at different distance settings from ∞ to very near.

SA = Standing axis
Vertical rotation axis of the telescope enables measuring of Hz-angles.

KA = Tilting axis
Horizontal rotation axis of the telescope enables measuring of V-angles.

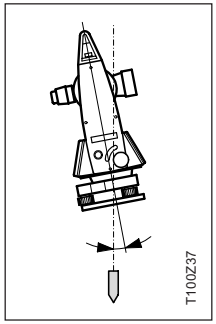
V = Vertical angle / zenith angle

VK = Vertical circle
With coded circular division for reading the V-angle.

Hz = Horizontal angle

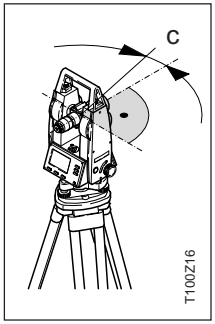
HK = Horizontal circle
With coded circular division for reading the Hz-angle.

Hz0 = Horizontal circle reading 0° (0 gon)



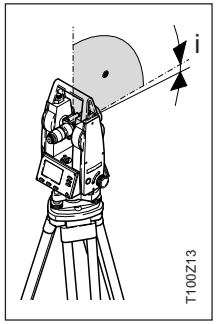
Standing axis inclination

Angle between plumb line and standing axis.



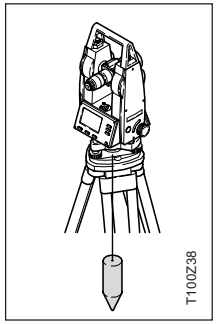
Line-of-sight error (Hz-collimation)

The line-of-sight error is the deviation from the perpendicular between tilting axis and line-of-sight. This is eleminated by measuring in two telescope positions.



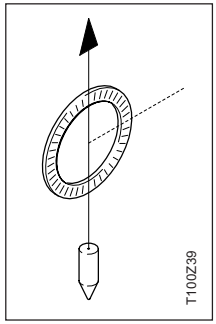
V-index (Vertical index error)

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



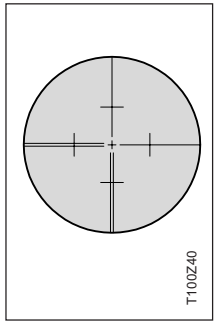
Plumb line / Compensator

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



Zenith

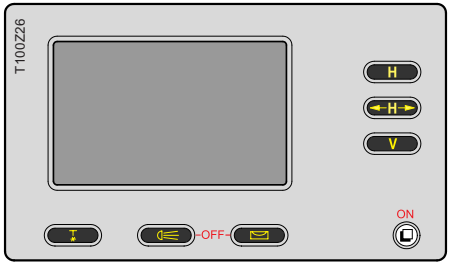
Point on the plumb line above the observer.



Graticule

Glass plate within the telescope with evaporated reticle and distance marks.

Keyboard



ON/OFF keys

ON — Switches instrument ON

OFF — Switches instrument OFF by pressing both keys simultaneously.

Combi key

Calling quick setting for compensator, beep and display contrast.

Function keys

Switching on/off laser plummet; setting laser intensity

Switching on/off display illumination and heating (active under -5°C; is displayed)

Switching on/off electronic level. The laser plummet is activted simultaneously

Angle keys

H — Setting the horizontal angle and Hz0.

H — Setting the Hz-angle right or left.

V — Switching the vertical angle V on/off; selecting the display unit (% or V).

Key combinations

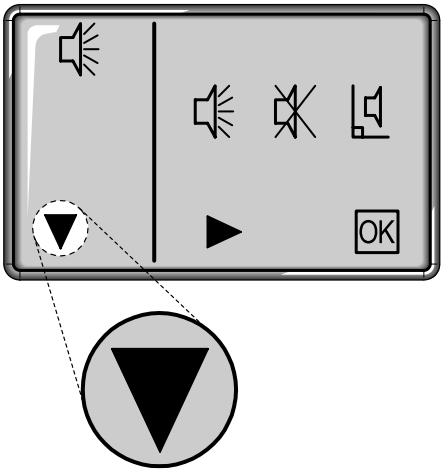
Access to the second key assignment of the angle keys is enabled.

+ H — Determining line-of-sight error.

+ V — Determining vertical index error.

+ H — Activating configuration menu.

Buttons



A button is a symbol in the **display which** is always assigned to a function key directly below it. Buttons can be found mainly in the configuration menu.

Find more and detailled information about buttons in the relevant sections.

Important buttons:

OK — Confirms settings; back into measuring mode.

▼ — Paging through menu (e.g. within the configuration).

▶ — Selection of a setting.
The active selection is always indicated in the left part of the display.

AutoOff

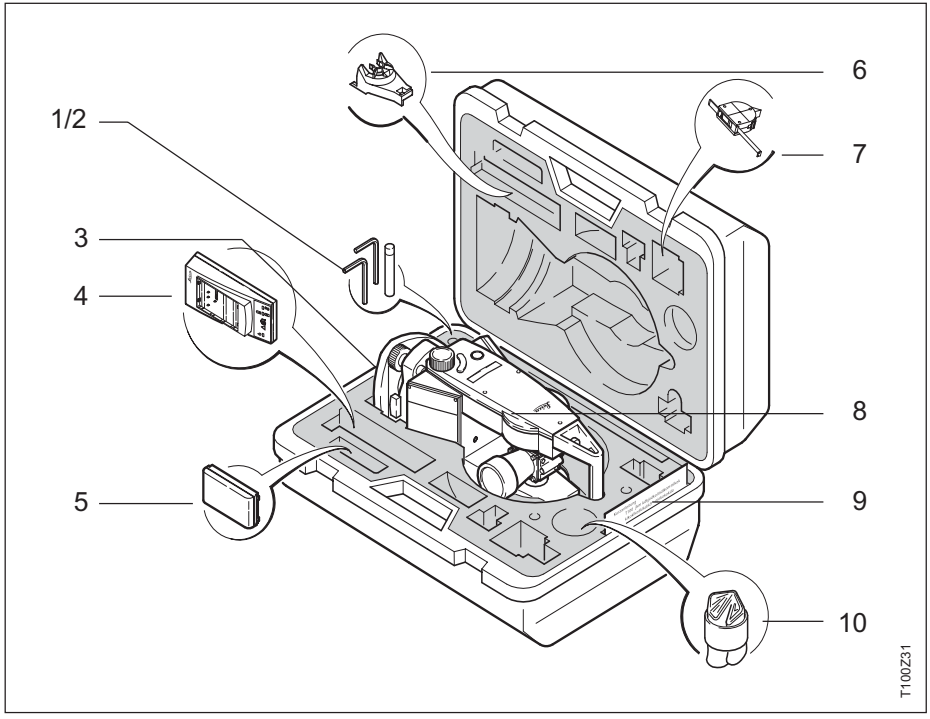
The instrument is equipped with an automatic switching off function.

Is activated when:
- battery low,
- no action is carried out with the instrument for 1/3 hour (= no key pressed; V and Hz angle deviation ≤ ±3' / ±600cc).

The function AutoOff cannot be deactivated.

Unpacking

Remove T105/T110 from transport case and check for completeness:



1 Allen key (2x)

2 Adjusting pins (2x)

3 Removable tribrach GDF101 / Shiftable tribrach GUS75 (optional)

4 Battery charger and accessories (optional)

5 Battery GEB111 (optional)

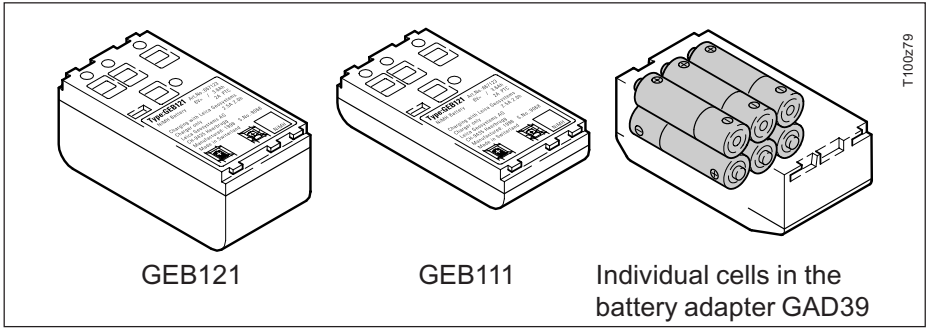
6 GHT196 Spacing Bracket (optional)

7 GHM007 Instrument Height Meter (optional)

8 Theodolite

9 User Manual

10 Protective cover / Lens hood

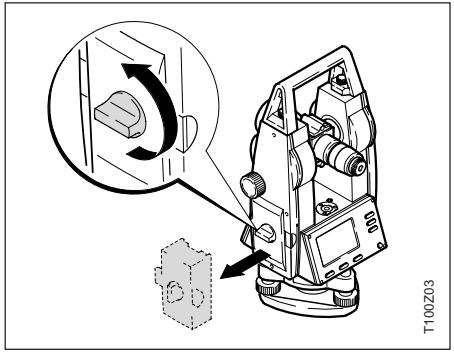


GEB121 GEB111 Individual cells in the battery adapter GAD39

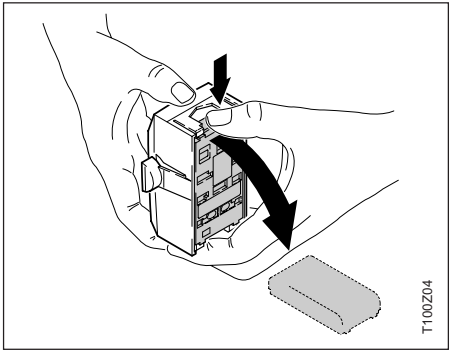
Use the Leica Geosystems batteries, chargers and accessories or accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

Your Leica Geosystems instrument is operated with rechargable plug-in batteries. The Basic battery (GEB111) or the Pro battery (GEB121) is recommended for T105/ T110 instruments. As an option, six individual cells can be used with the appropriate battery adapter GAD39.

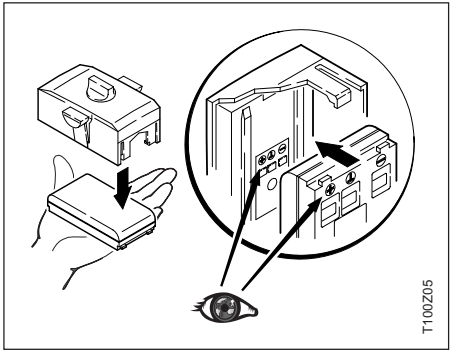
Six individual cells (1.5 V each) produce a voltage of 9 Volts. The battery indicator in the display is designed for a voltage of 6 Volts (GEB111/GEB121). For this reason the charge state of individual cells is not indicated correctly. The battery adapter with individual cells should therefore be used as a backup. The advantage of individual cells is the low self-discharge rate - even over longer periods of time.



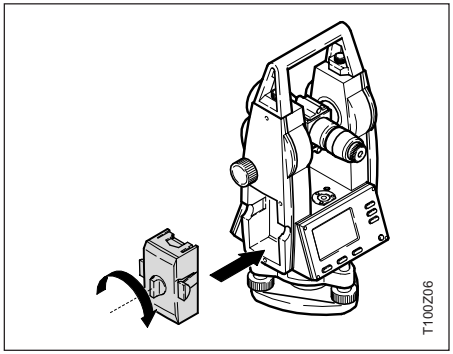
1. Remove battery holder.



2. Remove battery and replace.



3. Insert battery into battery holder.

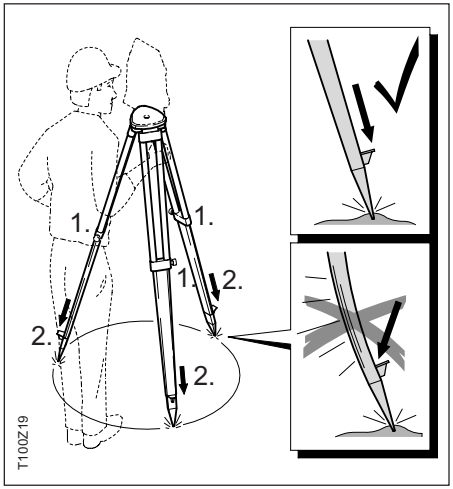


4. Insert battery holder into instrument.

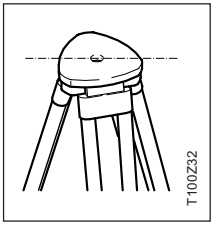
Insert battery correctly (note pole markings on the inside of the battery cover). Check and insert battery holder true to side into the housing.

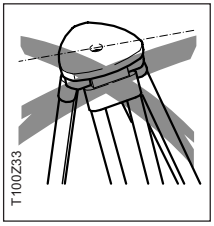
- For type of battery see section *"Technical Data"*.

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.



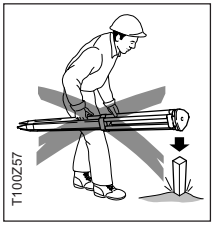
1. Loosen screws of tripod legs, pull out to required length and tighten screws.
2. In order to guarantee a firm foothold sufficiently press the tripod legs into the ground.
   When pressing the legs into the ground note that the force must be applied along the legs.

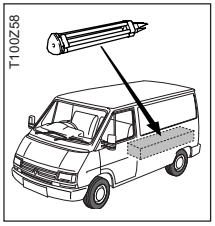




When setting up the tripod pay attention to a horizontal position of the tripod plate.

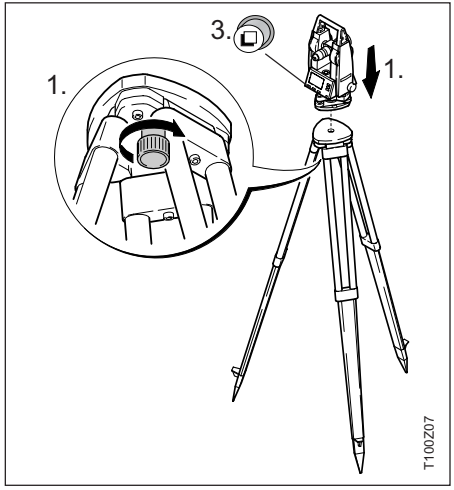
Heavy inclinations of the tripod must be corrected with the footscrews of the tribrach.

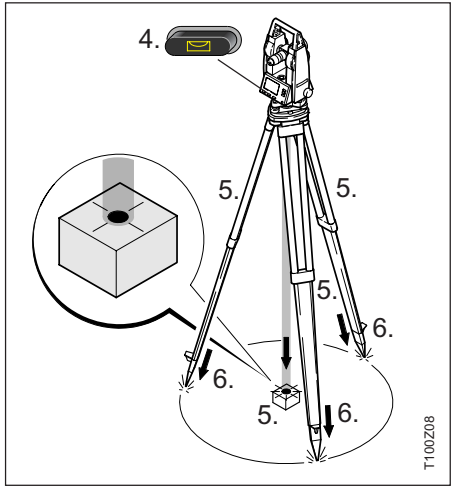


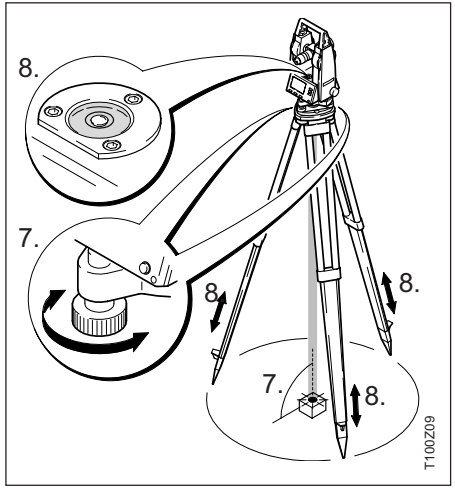


Careful handling of tripod

- 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 jobs.





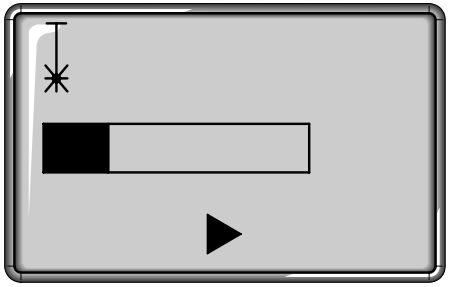


1. Place the instrument onto the tripod head.
   Tighten central fixing screw of tripod slightly.
2. Turn footscrews of tribrach into its centre position.
3. Switch on the instrument with .
4. Switch on laser plummet with . The electronic level appears in the display.
5. Position tripod legs so that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

Laser intensity

External influences may require the adjustment of the intensity of the laser plummet.

Adjusting the laser intensity.



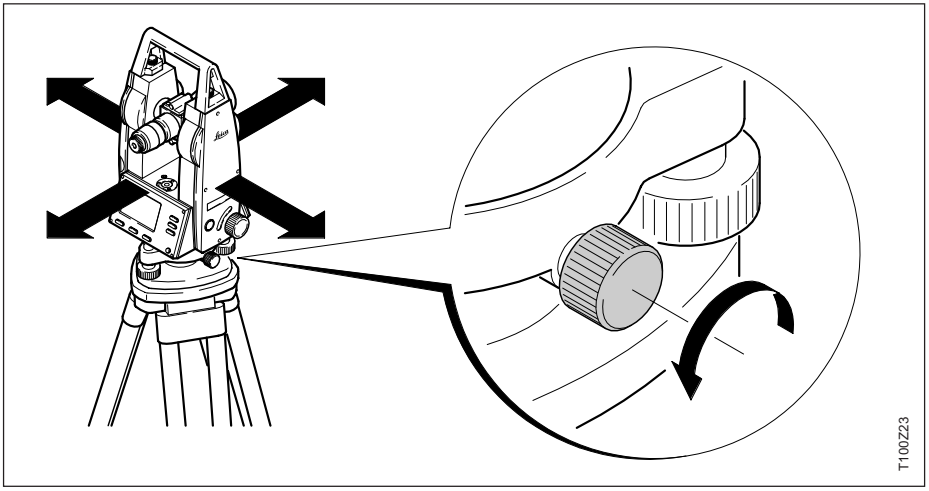
Changing the laser intensity.

Possible adjustments:

Intensity min.
Intensity 25%
Intensity 50%
Intensity 75%
Intensity max.

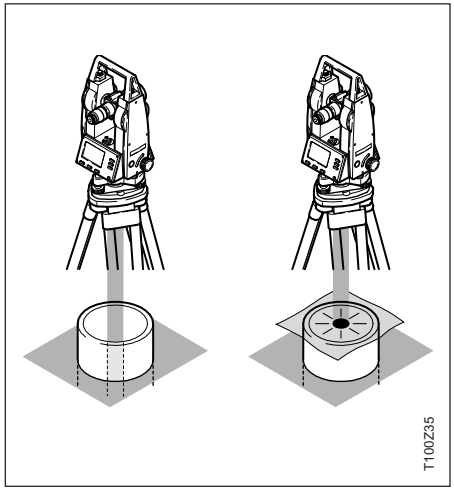
Switch off laser plummet with .

Centring with shiftable tribrach



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

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

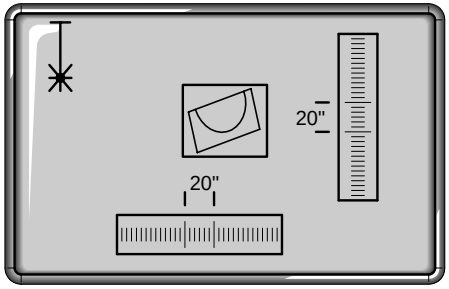


Positioning over pipes or depressions

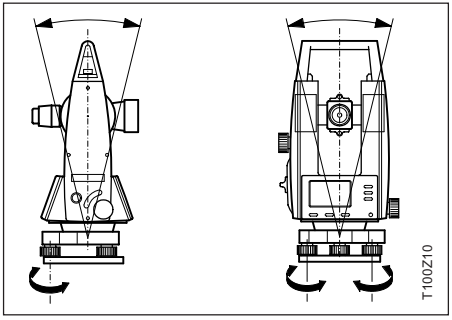
In some cases the laser plummet cannot be positioned because the laser spot is not visible. In such cases, place a transparent plate onto the pipe. As a result, the pipe perimeter remains visible and the laser spot is reflected by the plate.

Accurate levelling-up with electronic level

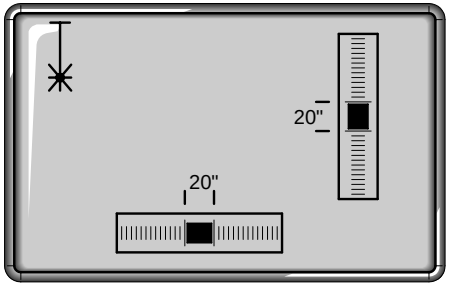
1. Switch on electronic level with  In case of insuffient levelling-up a inclined level symbol appears.



2. By turning the footscrews centre the electronic level.



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



3. Check centring with laser plummet and re-centring if necessary.
4. Switch off electronic level with  .

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

Depending on setting the following display appears:

Display 1

- **Hz-angle** in the unit selected *(see chapter "Configuration / Angle units")*
- **battery condition**

is indicated.

Display 2

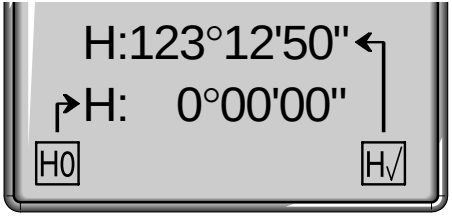
- **Hz-angle** in the unit selected
- **V-angle** in the unit selected and the setting concerning zenith or horizon *(see chapter "Configuration / Setting V-angle")*
- **battery condition**

is indicated.

Setting Hz-direction

Setting of Hz-orientation.

Back to measuring menu without modification.



Set Hz to 0°00'00"

- Aim on orientation point.
- Set Hz-angle with H0.
  Back to measuring menu automatically.

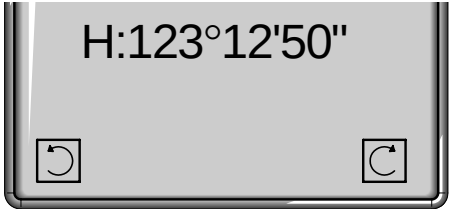
Set any Hz-angle

- Turn telescope to the desired Hz-angle.
- Hold indicated Hz-angle with H.
- Aim on orientation point.
- Set Hz-angle with H√.

Setting Hz-circle

Setting of Hz-circle.

Back to measuring menu without modification.



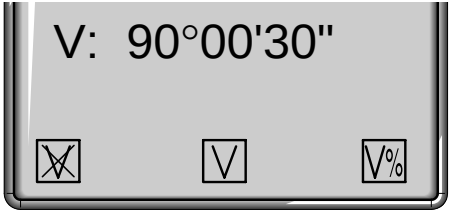
Set Hz to "Clockwise angle measurement".

Set Hz to "Counterclockwise angle measurement".

Setting is accepted immediately.

V-angle display

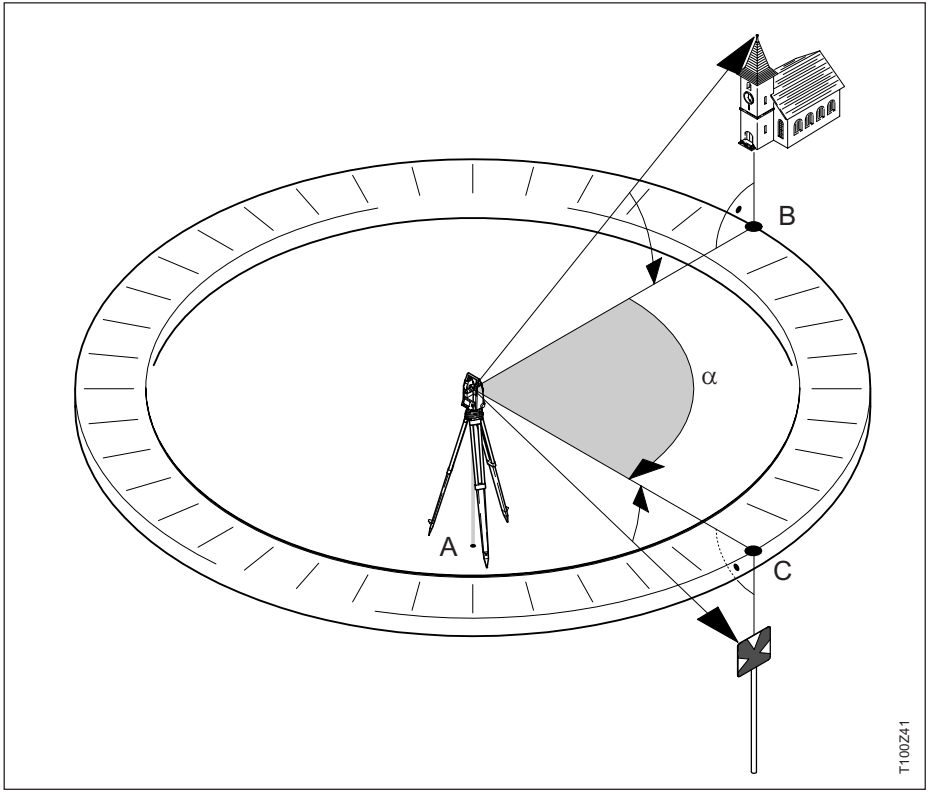
The indication of the V-angle can be directly switched on/off with V.



Switch off V-angle display.

Switch on V-angle display. Display of angle according to configuration setting.

Switch on V-angle dispaly. Indication of angle in "+/-% inclination" (valid range -300.00% to + 300.00 %).



Wanted:
Hz-angle α between BAC.

Procedure:
Set up instrument above point A and level-up.

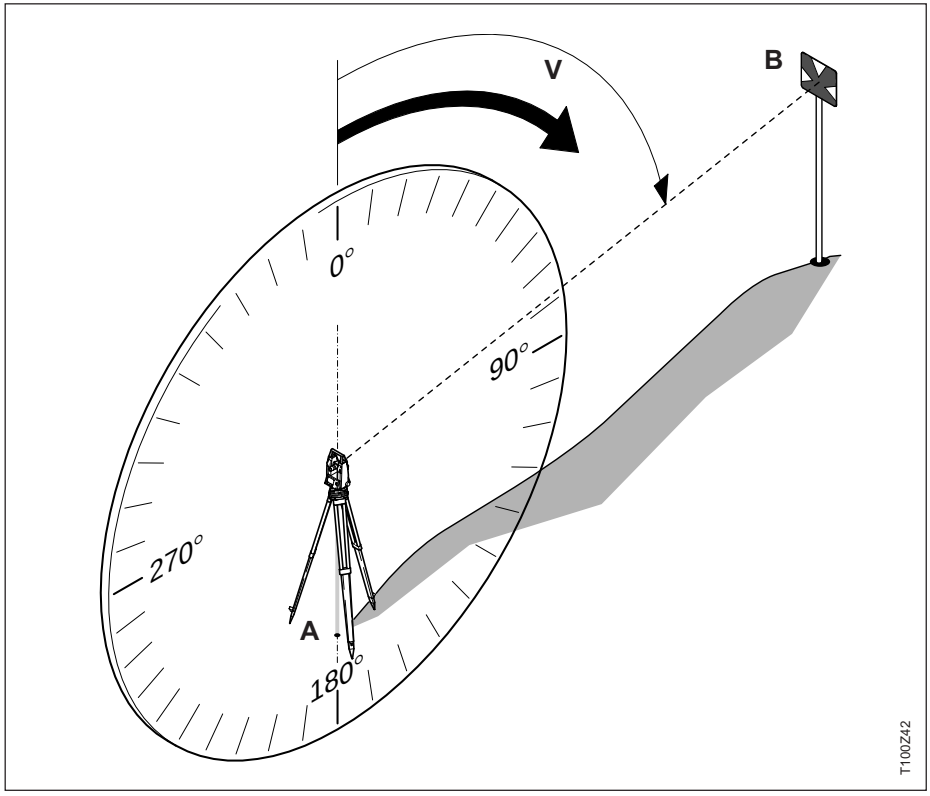
Two methods are possible:
1st method:
- Aim on point B and read Hz (e.g.: 23°38');
- Aim on point C and read Hz (e.g.: 94°40').

Result:
α = Hz (C) - Hz (B)

(e.g.: 94°40' - 23°38' = **71°02'**)

2nd method:
- Aim on point B and set Hz-angle to "0".
- Aim on point C.

Result:
Read α directly.



Wanted:
V-angle (zenith angle)

Procedure:
1. Set up instrument above point A and level-up.
2. Aim on the target plate.

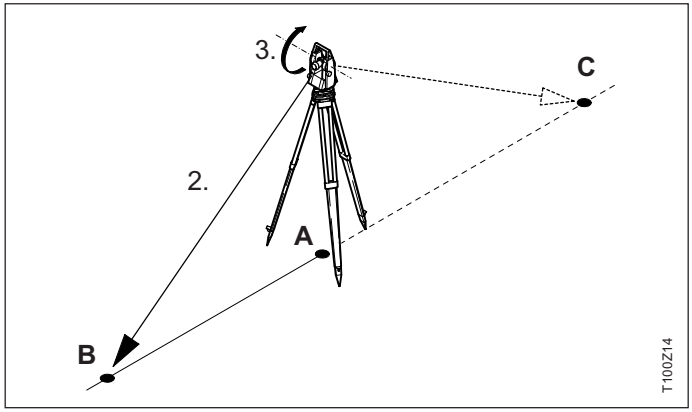
Result:
Read V directly.

Depending on setting either the zenith or the vertical angle is indicated *(see chapter "V-angle setting").*

Extending straight lines

Wanted: The straight line from A to B should be extended. A new point C is created.

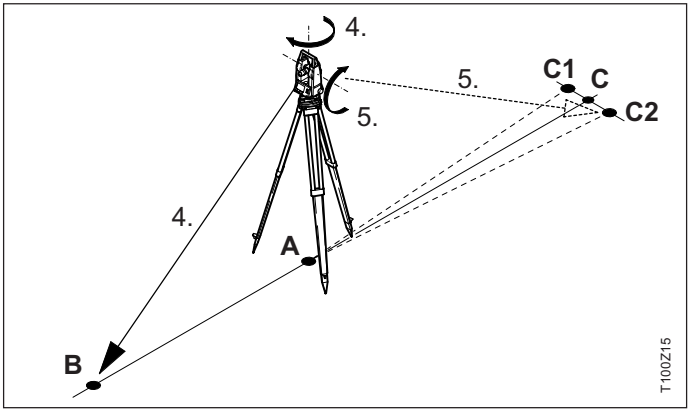
SIMPLE method



Procedure:

1. Set up instrument above point A and level up.
2. Aim on point B in face one.
3. Turn telescope around the tilt axis and stake-out point C1 in the desired distance.
   To ensure accuracy:
   distance A-C ≈ distance A-B

ACCURATE method



Procedure:

Carry out steps 1 to 3 (see SIMPLE method).

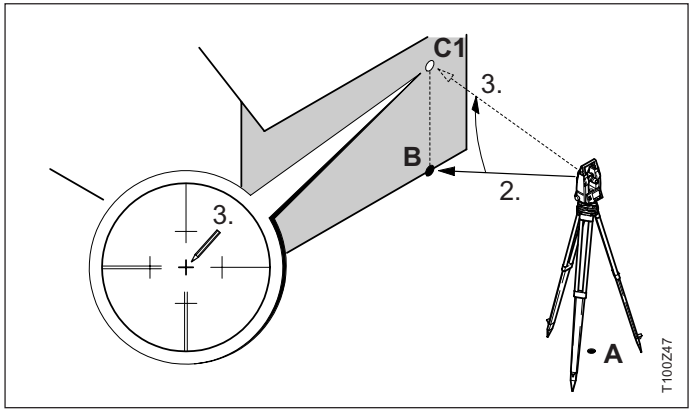
4. Turn instrument around the standing axis and aim on point B again.
5. Turn telescope around the tilt axis and stake-out an auxiliary point C2 in the same distance as C1.

Result:
Point C is in the middle of line C1 to C2.

Staking out vertical lines

Wanted: Point C should be staked out vertically over B.

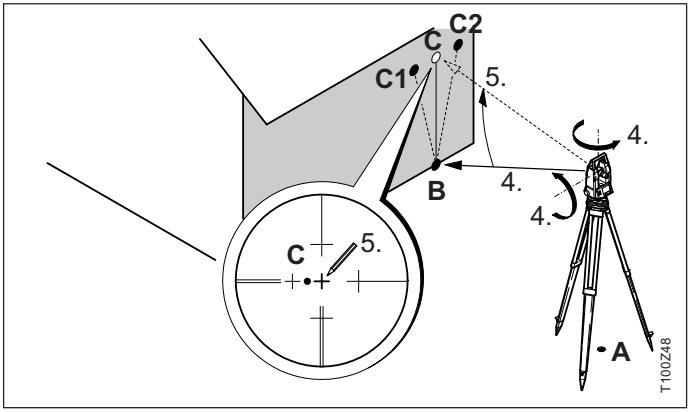
SIMPLE method



Procedure:

1. Set up instrument at any point A. It must be possible to aim on B and C1 easily.
2. Level up instrument and aim on point B.
3. Swivel telescope upwards and mark centre of telescope (C1) in the desired height.

ACCURATE method



Procedure:

Carry out steps 1 to 3 (see SIMPLE method).

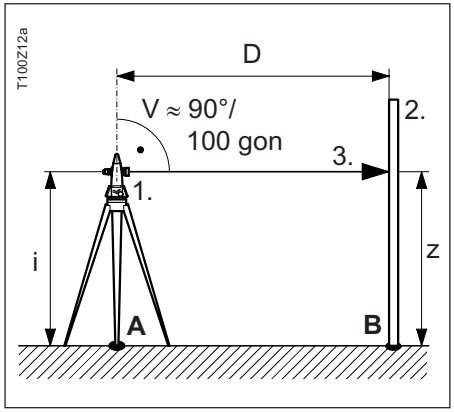
4. Change to face two and aim on point B again.
5. Swivel telescope upwards and mark centre of telescope (C2) again in the desired height.

Result: Point C is in the middle of the two markings C1 and C2.

Distance measuring with stadia lines

Wanted: Horizontal distance between station and target point.

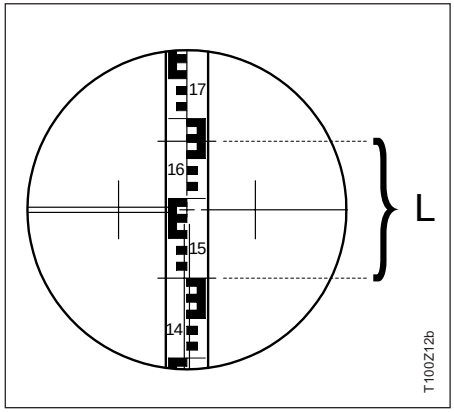
SIMPLE method



Procedure:

1. Set up instrument above point A and level up.
2. Erect levelling staff exactly vertical on point B.
3. Aim on staff (z=i) and read staff section L.

Result:
D = 100 x L

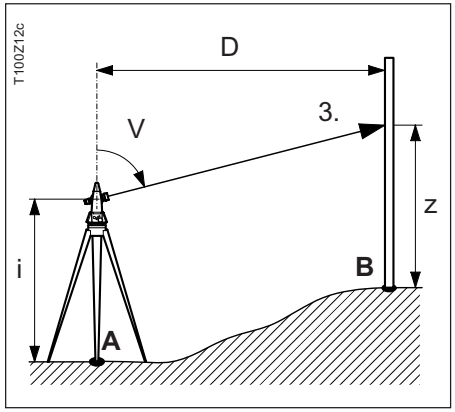


Reading:

Upper distance line:	166.2
Lower distance line:	150.0
Difference L:	16.2

Difference L in [cm] equals distance D in [m]

ACCURATE method



Procedure:

Carry out steps 1 and 2 (see SIMPLE method).

3. Aim on staff (z=i) and read staff section L. Simultaneously, take down zenith angle V.

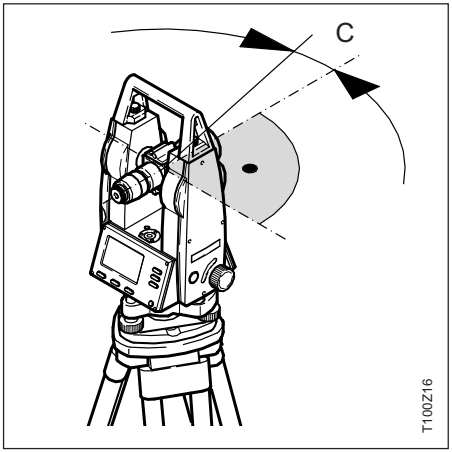
Result:
D = 100 x L x sin²V

The instruments are adjusted in the factory prior to shipping.

Index-errors and line-of-sight 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).

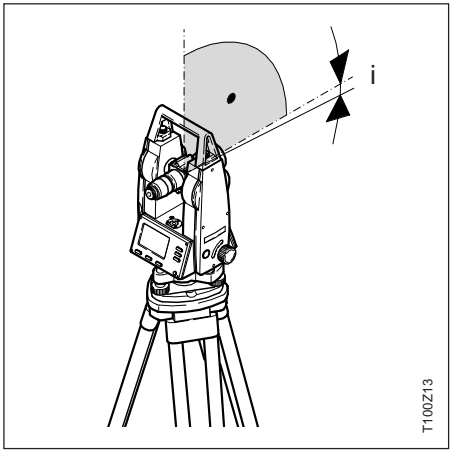
Line-of-sight error (Hz-collimation)



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

The effect of the line-of-sight error to the Hz-angle increases with the vertical angle.
For horizontal aimings the error of Hz equals the line-of-sight error.

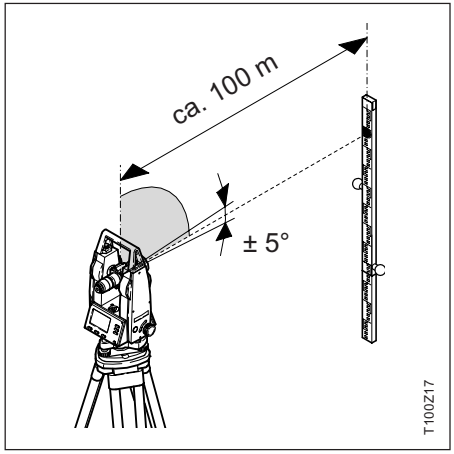
V-Index (Vertical index error)



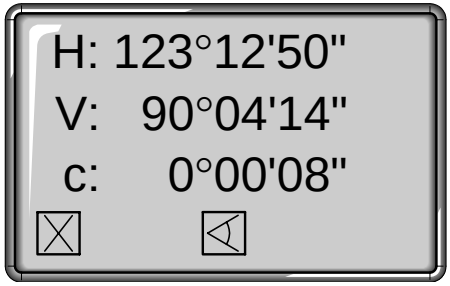
The vertical circle should read exactly 90° (100 gon) when the line of sight is horizontal. Any deviation from this figure is termed vertical index error (i).

1. Level up instrument exactly using the electronic level.

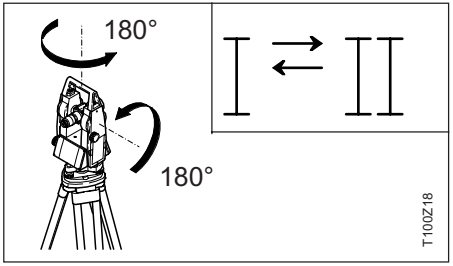
2. Aim at a point approximately 100m from the instrument wich is less than 5° from the horizontal. Check by activating the V-angle display.



3. Start calibration by pressing and H simultaneously.
4. Measure Hz-angle with ◁.
   or
   back to measuring menu with ☒ without modification.



5. Change telescope position and aim at the point again.
6. Again measure Hz-angle with ◁ line-of-sight error is computed.

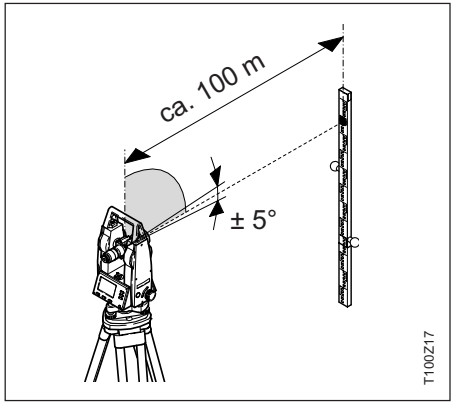


☒ Keep actual value.

OK Accept new computed value (arrow).

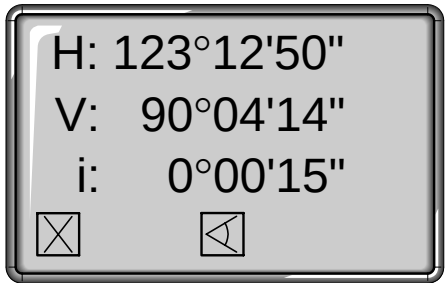
1. Level up instrument exactly using the electronic level.

2. Aim at a point approximtely 100m from the instrument which is less than 5° from the horizontal. Check by activating the V-angle display.

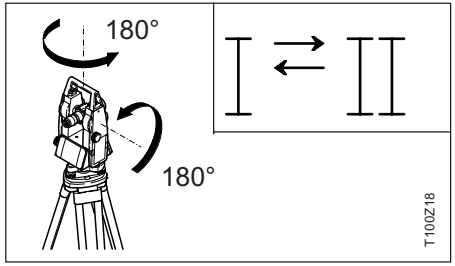


By determining the vertical index error the electronic level is adjusted automatically.

3. Start calibration by pressing and V simultaneously.
4. Measure V-angle with .
   or
   back to measuring menu with without modification.

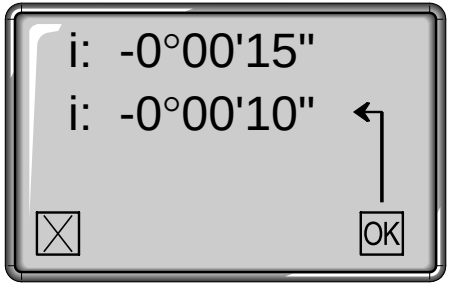


5. Change telescope position and aim on point again.
6. Again measure V-angle with vertical index error is computed.



Keep actual value.

OK Accept new computed value (arrow).



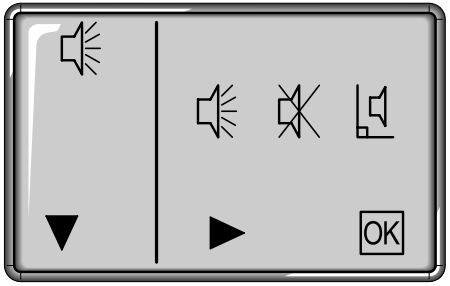
	Quick setting	Immediate access to functions: - compensator (on/off) - beep (on/off/90°) - display contrast
	Configuration menu	After pressing the keys simultaneously the following parameters can be selected: beep setting V-angle display contrast angle units indicated angle format compensator line-of-sight error correction
▼	Select parameter	Selecting the configuration parameters
▶	Change setting	Selected setting is displayed in the left display half
OK	Quit	Quit and set the setting

All settings remain active even after switching off.

The quick setting is an extract from the complete configuration.

Setting the beep

The beep is an acoustic signal after each key stroke or at right angles.



The setting of the beep can be changed via the configuration menu or directly via the quick setting.

Possible settings:

Beep is switched ON.

Beep is switched OFF.

Beep is switched ON and sounds at right angles.

Switch on beep:

1. Scroll to symbol / /
2. Select "Beep ON" with ▶.
3. Confirm selection with OK.

Switch off beep:

Same procedure but select .

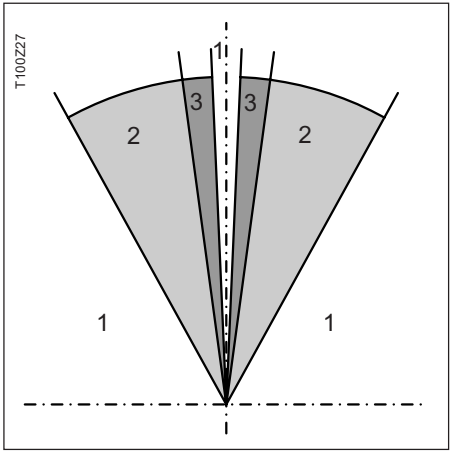
Switch on 90° beep for right angle stake-outs:

Same procedure but select .

The beep sounds at right angles (0°, 90°, 180°, 270° or 0, 100, 200, 300 gon).

Example:

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

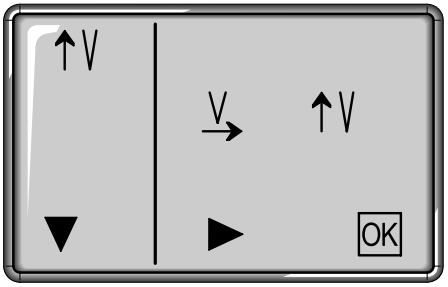


1 No beep
2 Fast beep
3 Permanent beep

Setting V-angle

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

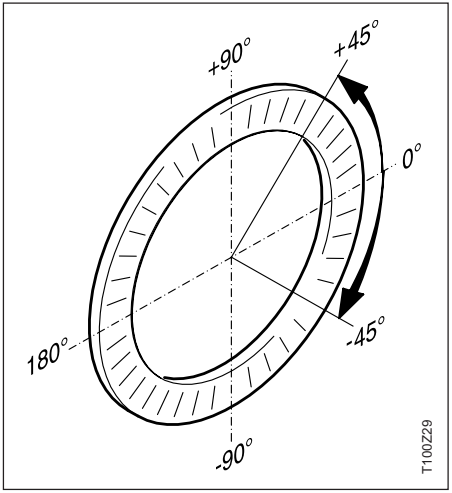
1. Scroll to symbol ↑V / V→
2. Select desired option with ▶



3. Confirm selection with OK.

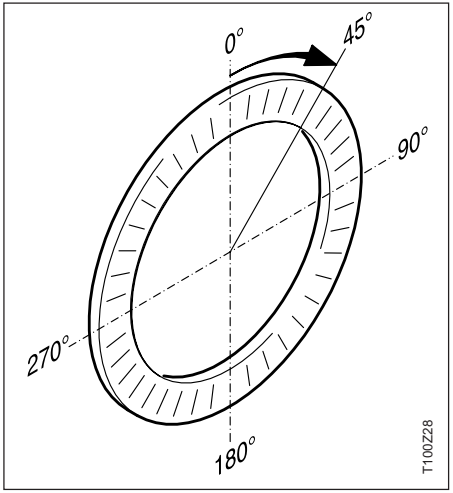
The setting is valid for all angle units and can only be changed via the configuration menu.

V-angle "0" for the horizontal plane V→ :



V-angles above the horizontal plane are indicated as positive values and below the horizontal plane as negative values. Up to the maximum value of 180° (200 gon) the V-angle decreases/increases.

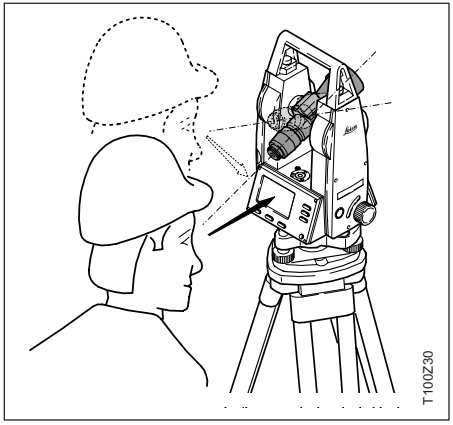
V-angle "0" for the zenith ↑V :



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

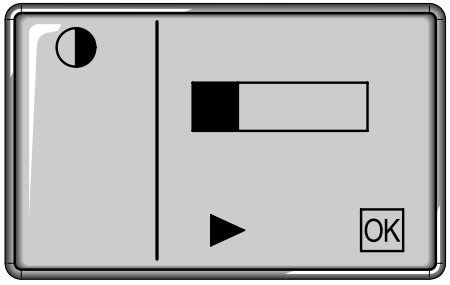
Setting display contrast

The readability of LCDs is influenced by external conditions (temperature, lighting) and by the reading angle. The display contrast can be adapted step by step until a perfect readability is reached.



The contrast setting can be changed via the configuration menu or directly via the quick setting.

1. Scroll to symbol ◑

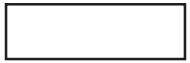


2. Select setting with ▶
3. Confirm selection with OK

The actual setting is indicated and the desired display contrast is set.

Setting of the contrast in five steps:

Minimum



Contrast 1/4

Contrast 1/2

Contrast 3/4

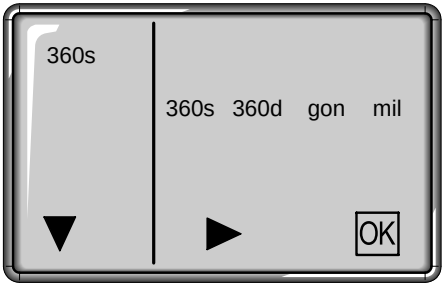
Maximum

The display contrast is immediately adjusted during the setting.

Setting the angle units

The setting of the angle units can be changed at any time.
The actual values are converted according to the selected unit.
Setting of the angle units can only be changed via the configuration menu.

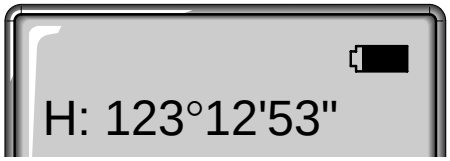
1. Scroll to symbol
   360s / 360d / gon / mil.



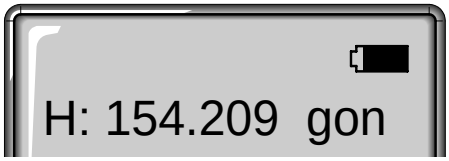
2. Select desired option with ▶
3. Confirm selection with OK.

Possible settings:

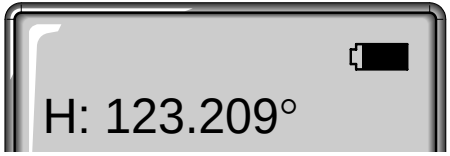
- 360s (degree sexagesimal)
  possible angle values:
  0° to 359°59'59"



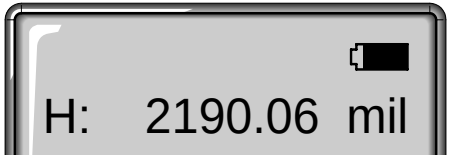
- gon
  possible angle values:
  0g to 399.999 gon

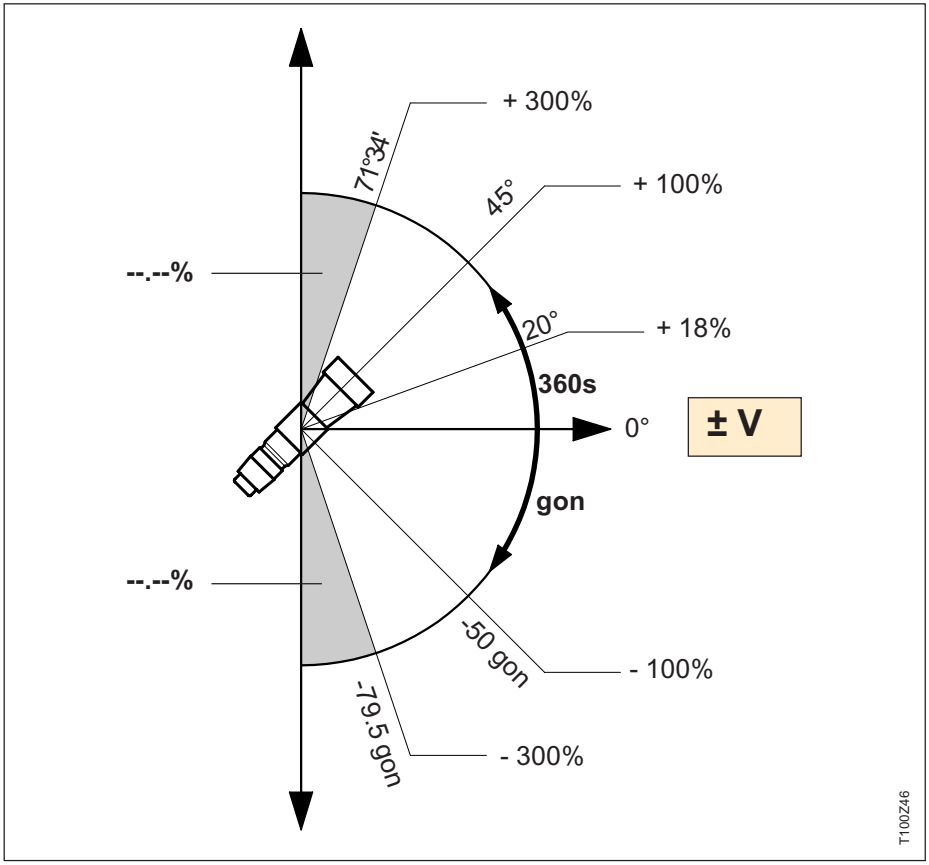


- 360d (degree decimal)
  possible angle values:
  0° to 359.999°



- mil
  possible angle values:
  0 to 6399.99mil





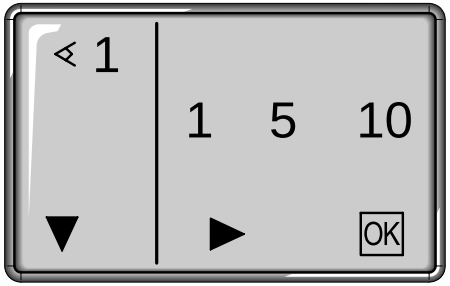
100% correspond to an angle of 45° (50 gon, 1600 mil).

The % value increases rapidly as the line of sight moves away from the horizontal.
That´s why "--.--%" appears on the display at approx. 70° (80 gon).

Displayed angle format

The displayed angle format can be selected in three steps (1, 5 or 10) and only changed via the configuration menu.

1. Scroll to symbol



2. Select desired option with ▶

3. Confirm selection with OK

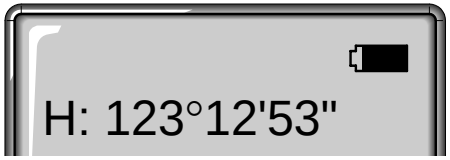
In the following examples always the option indicated in *Italics* is shown.

Possible settings:

For 360°"":

1 => *0° 00' 01"*
5 => 0° 00' 05"
10 => 0° 00' 10"

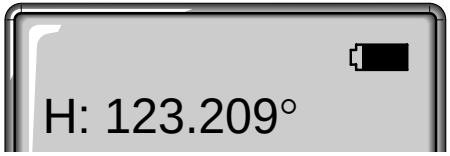
Always " are indicated.



For 360°:

1 => 0.001°
5 => 0.005°
10 => *0.010°*

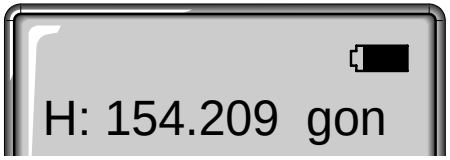
Always three decimals are indicated.



For gon:

1 => *0.001 gon*
5 => 0.005 gon
10 => 0.010 gon

Always three decimals are indicated.



For mil:

1 => 0.01 mil
5 => *0.05 mil*
10 => 0.10 mil

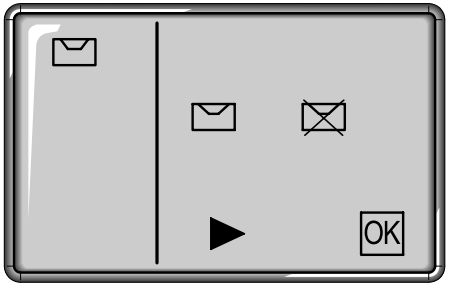
Always two decimals are indicated.

The compensator normaly remains switched on.

If the instrument is used on an unstable base (e.g. shaking platform, ship, etc.) **the compensator must be switched off.**
This avoids the compensator drifting out of it's measuring range and interupting the measuring process by indicating an error.

The working range of the compensator is at 5'24" (±0.1gon). This horizontal accuracy can is easily obtained with the electronic level.

1. Scroll to symbol ✉ / ✉



2. Select desired option with ▶
3. Confirm setting with OK.

Possible settings:

✉ The compensator is switched ON. V-angles relate to the plumb line.

✉ The compensator is switched OFF. V-angles relate to the standing axis.

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

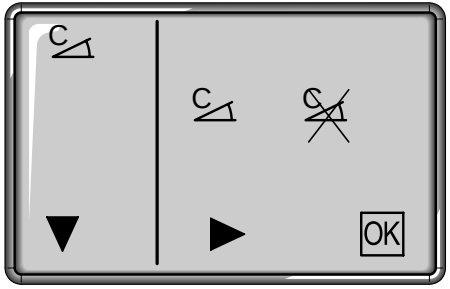
Switching on/off line-of-sight error correction

The T105/T110 can correct the line-of-sight error (Hz-collimation) automatically. This setting can only be changed via the configuration menu.

If option "Line-of-sight error correction ON" is active, each measured Hz-angle is corrected (depending on V-angle).

For normal operation the line-of-sight error correction remains switched on.

1. Scroll to symbol C / C



2. Select desired option with ▶
3. Confirm setting with OK

Possible settings:

C — The line-of-sight error correction is switched ON.

C — The line-of-sight error correction is switched OFF.

By measuring in both faces the line-of-sight error is eliminated.

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

Intended use of instrument

The following directions should enable the person responsible for the T105/T110, 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 adhere to them.

Permitted uses

The electronic total stations are intended to the following applications:

- Measuring horizontal and vertical angles
- 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
- 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.)

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

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.

Refer to section "Technical Data".

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 accessories:
The manufacturers of non-Leica accessories for the T105/T110 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.

Main hazards of use

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:
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 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.

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.
Precautions:
When viewing into the sun or against bright objects only use suitable accessories for this purpose.

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 around or between the instrument and the target (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 surreying 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.

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.

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:

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.

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

Laser plummet

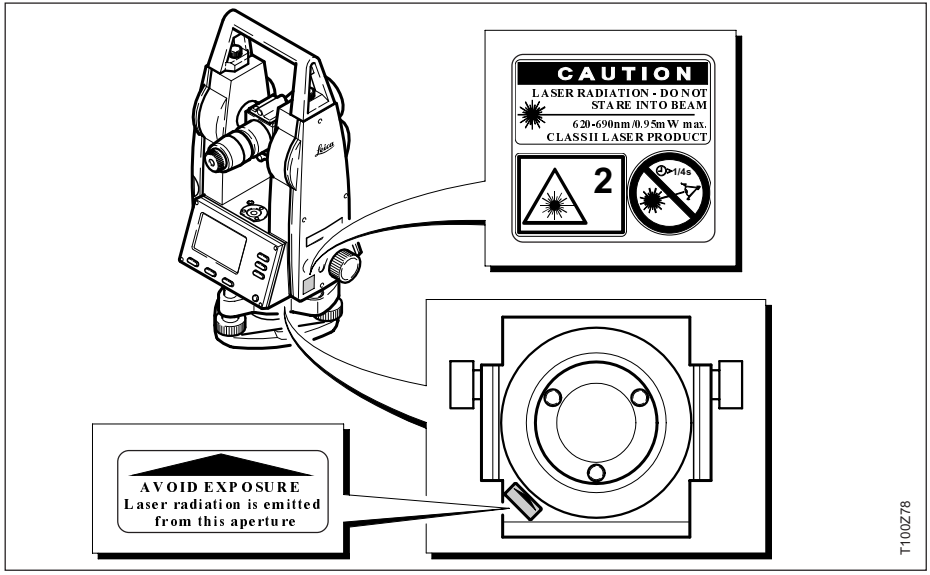
The integrated laser plummet produces a visible laser beam which emerges from the base of the instrument.

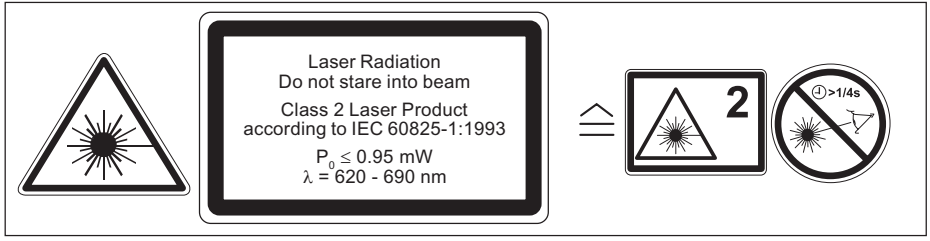
The product is a Class 2 laser product in accordance with:
- IEC 60825-1:1993 "Radiation safety of laser products".
- EN 60825-1:1994 + A11:1996 "Radiation safety of laser products".

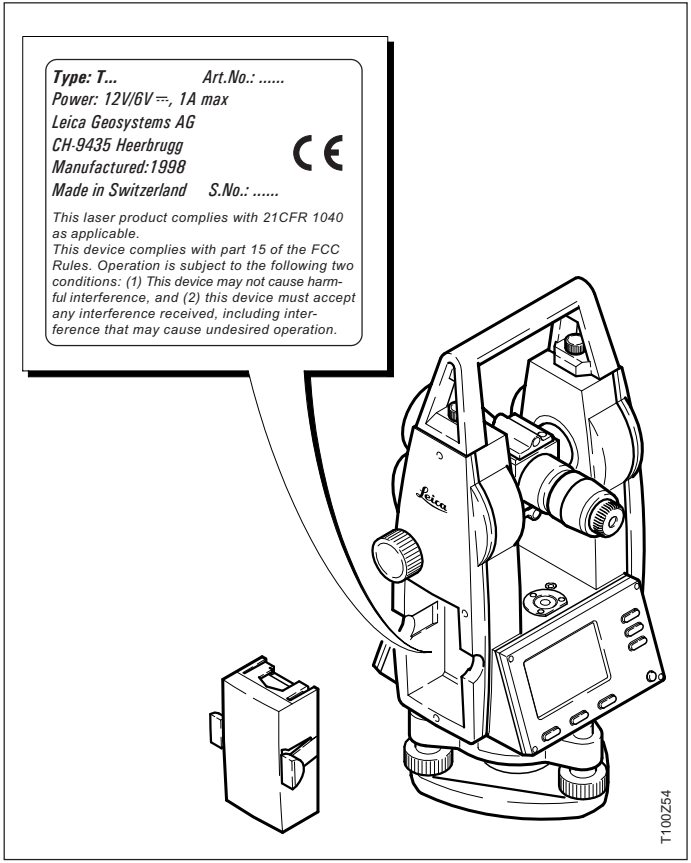
The product is a Class II laser product in accordance with:
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

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.

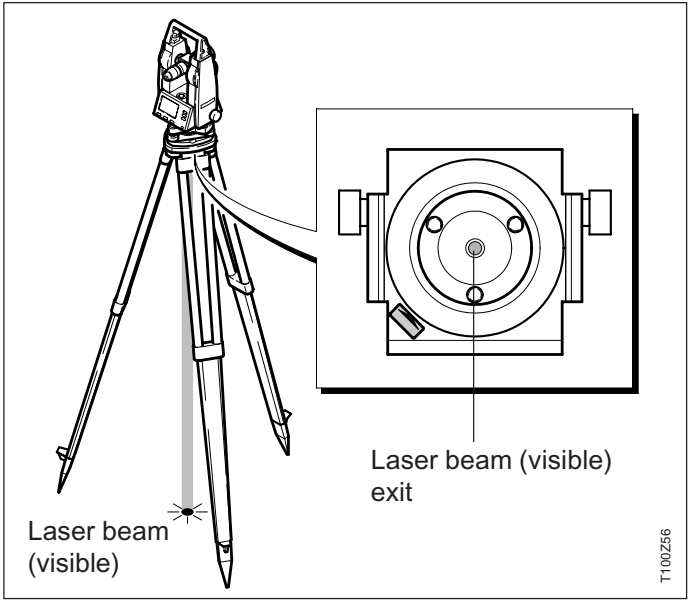
Labelling


CAUTION
LASER RADIATION - DO NOT STARE INTO BEAM
620-690nm/0.95mW max.
CLASS II LASER PRODUCT
2
>1/4s
AVOID EXPOSURE
Laser radiation is emitted from this aperture
T100Z78


Laser Radiation
Do not stare into beam
Class 2 Laser Product
according to IEC 60825-1:1993
$P_0 \leq 0.95$ mW
$\lambda = 620 - 690$ nm
2
>1/4s



Beam divergence	0.16 x 0.6 mrad
Impulse duration	c.w.
Maximum power output	0.95 mW
Measurement uncertainty	±5%



The term "electromagnetic acceptability" 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 teodolites meet the strict regulations and standards which are in force in this respect, Leica 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 teodolite is used in conjunction with accessories from other manufacturers (e.g. personal computers, walkie-talkies, ...).
Precautions:
Use only the equipment and accessories recommended by Leica Geosystems. When combined with teodolites, 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 teodolites meet the strict regulations and standards which are in force in this connection, Leica Geosystems cannot completely exclude the possibility that the teodolite 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:

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:

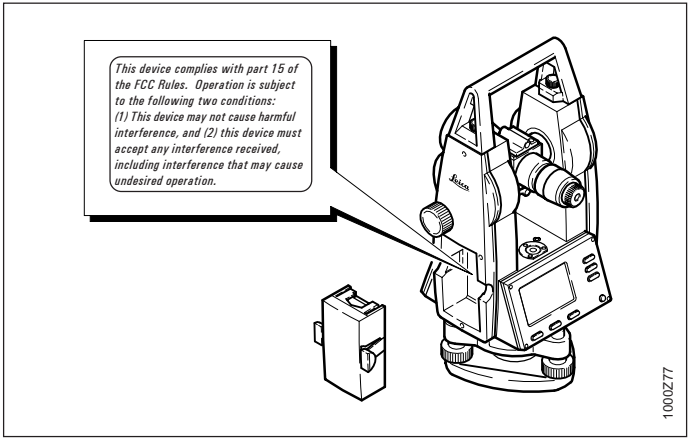
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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.

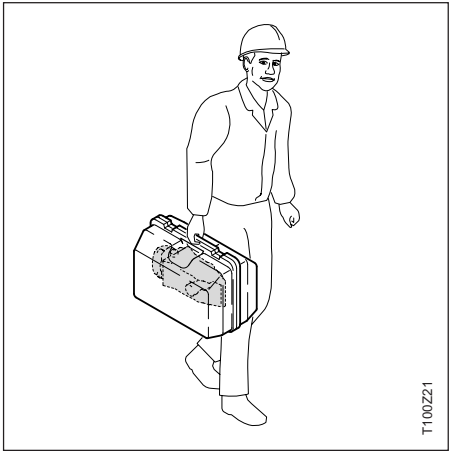


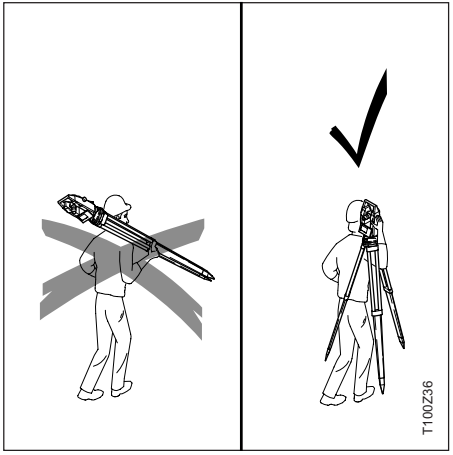
Transport

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

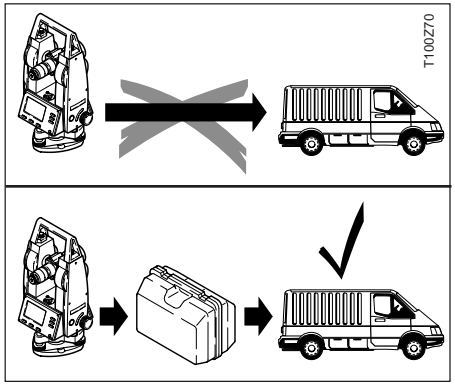




When transporting the equipment **in the field**, always make sure to

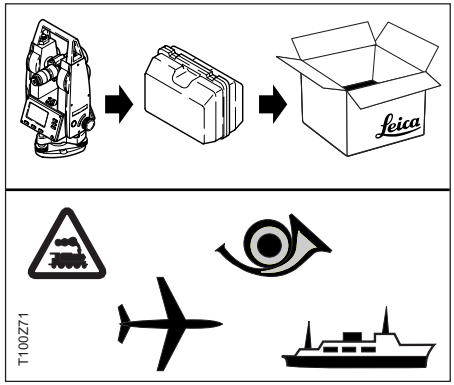
- either carry the instrument in its original transport case or,
- carry the tripod with its legs splayed across your shoulder, keeping the attached instrument upright.

Inside vehicle



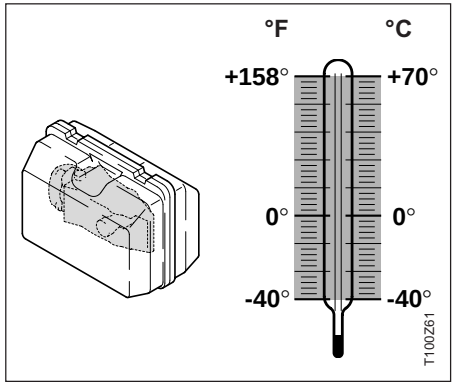
Never transport the instrument loose **inside the vehicle**.
The instrument can be damaged by blows and vibrations. It must always be transported in it's case and be properly secured.

Shipping



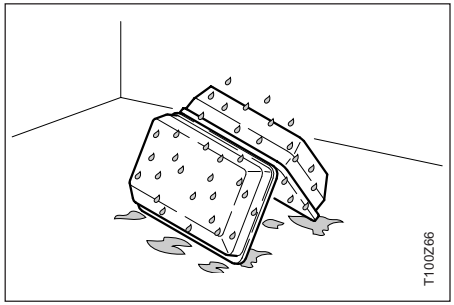
For shipping the instrument by **rail, aircraft** or **ship** use the Leica Geosystems original packaging (transport case or shipping cardboard) or another suitable packaging securing the instrument against blows and vibrations.

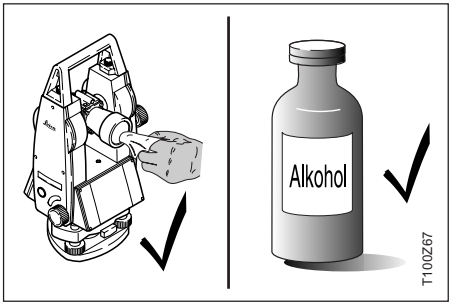
Storage



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.

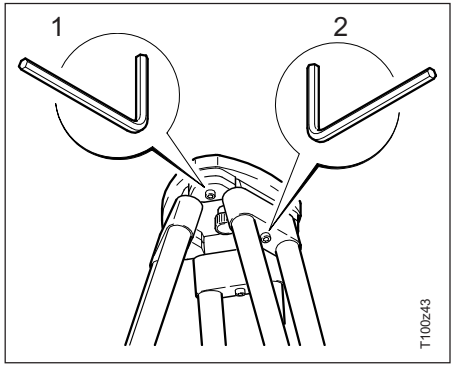
When using the instrument in the field always close the transport case.

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.

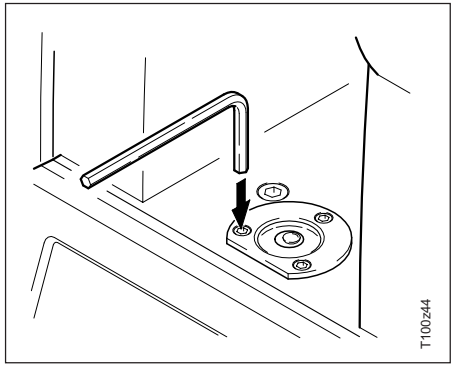
Tripod



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.

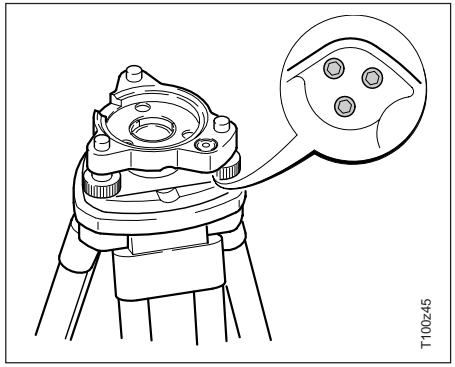
Circular level



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.

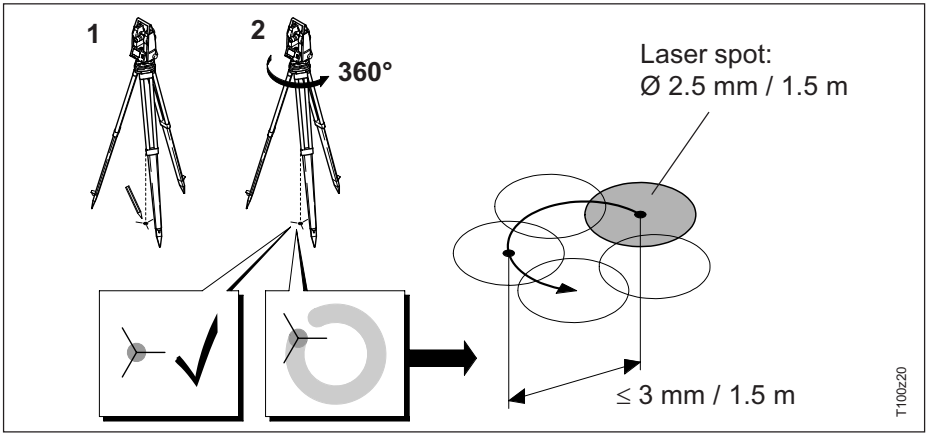
After adjustment no screw must be loose.

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 Geosystems 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).

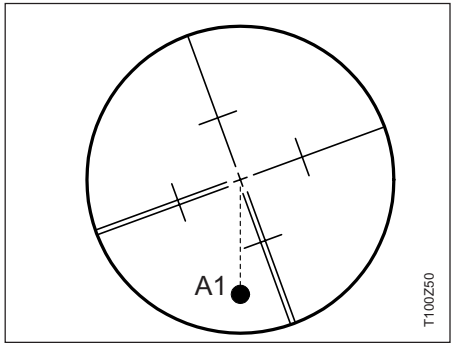


If the centre of the laser spot makes a clearly circular movement or if the centre of the point is moving away more than 3 mm from the first marked point an adjustment is possibly necessary. Call your nearest Leica Geosystems service department.

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.

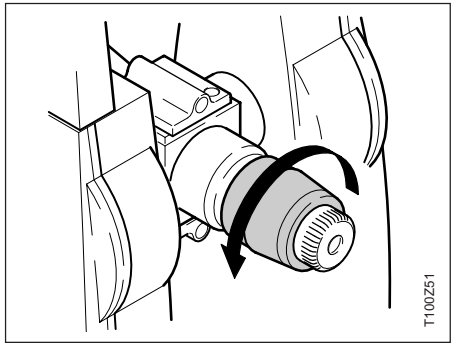
The max. diameter of the circular movement of the centre of the laser spot should not exceed 3 mm at a distance of 1.5 m.

Checking by turning the graticule

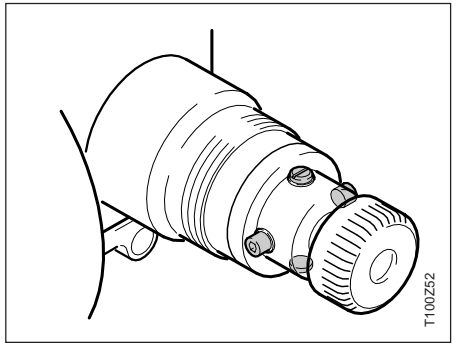


1. Aim on any point A in the centre of the graticule.
2. With the vertical drive move the instrument upwards to the edge of the range of vision (point A1).
3. If point A moves along the vertical line no more adjustment is necessary.

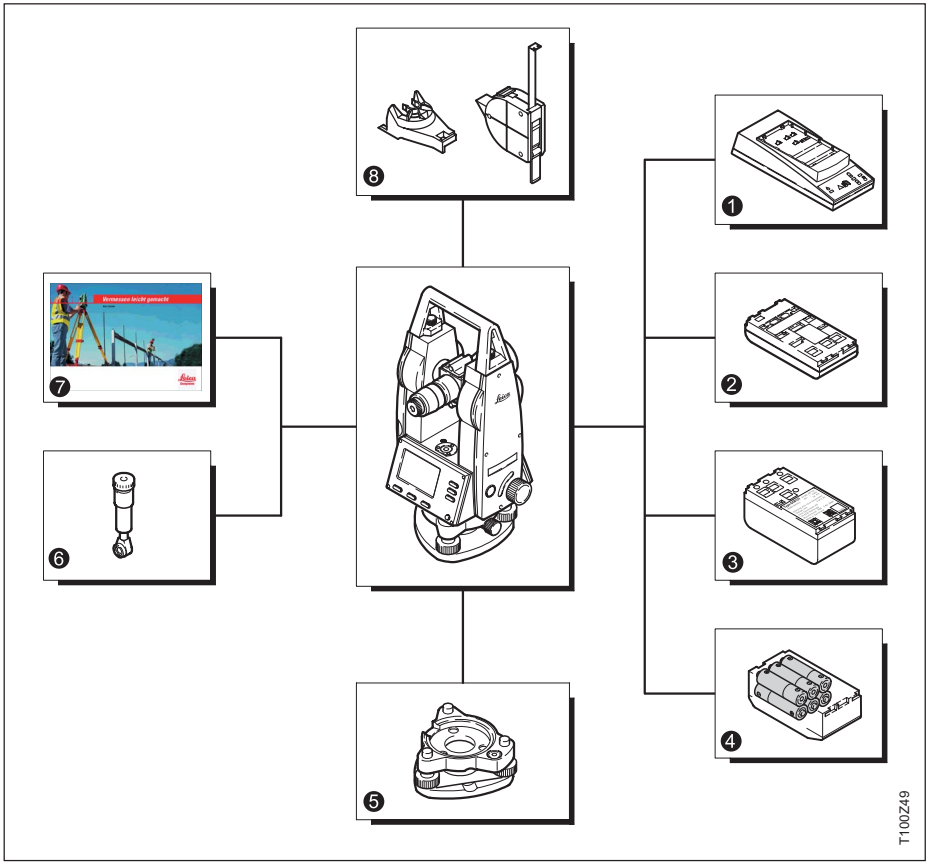
Adjusting



1. If point A does not move along the vertical line remove cover of adjusting screws on the eyepiece.
2. With the help of the supplied tool loosen all four adjusting screws symmetrically. Then turn the graticule around the centre until the vertical line covers point A1.

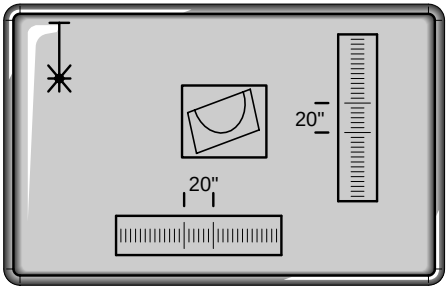


3. Subsequently, tighten adjusting screws symmetrically and repeat checking until adustment is correct.



1) **Battery charger (EU, US, UK, AU, JP)**
2) **Battery GEB111**
   (Art.No. 667318)
3) **Battery GEB121**
   (Art.No. 667123)
4) **Battery adapter GAD39**
   (Art.No. 712156)
5) **Removable tribrach GDF101**
   (Art.No. 714793)
6) **Diagonal eyepiece GFZ2**
   (Art.No. 721966)
7) **Booklet:**
   Surveying made easy
   (available in English (Art. No. 722510) and German (Art. No. 722383))
8) **GHM007 Instrument Height Meter**
   (Art.No. 667718)
   GHT196 Spacing Bracket
   (Art.No. 722045)

Compensator out of measuring range

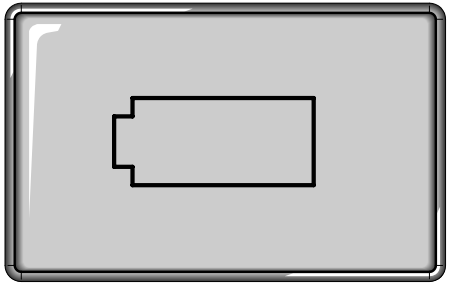


This warning appears as soon as the compensator is outside the measuring range.

The display is removed if the user:
- is levelling the instrument,
- is switching off the compensator.

During this display only and -OFF- are active.

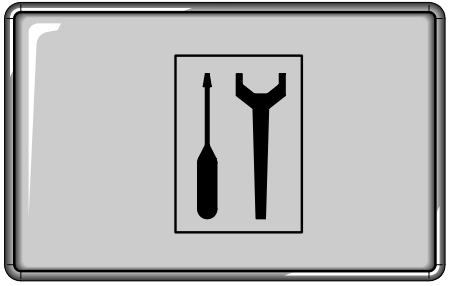
Battery empty



This warning appears as soon as the battery is empty and is indicated for a period of about 10 seconds.

Replace battery and continue with measurings.

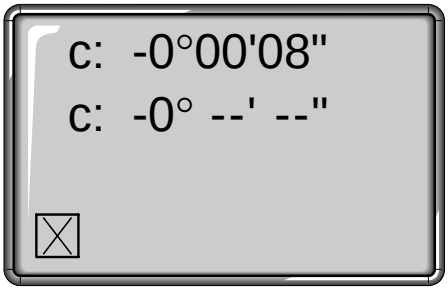
System error



This error message appears if a system error occurs requiring a service.
The real error no. is also indicated.

Rectifying this error by your local Leica Geosystems Service Station.

Hz-collimation (c)

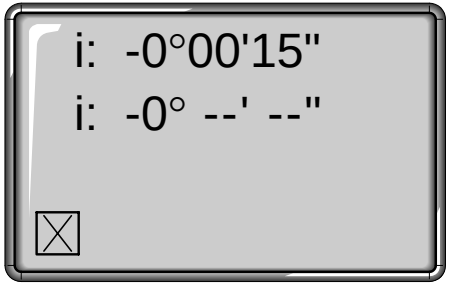


This error message appears if the new error value exceeds the limit (± 0.1 gon) during the Hz collimation determination.

The function is terminated and the old value for "c" remains active; back to measuring menu.

During this display only and -OFF- are active.

V-index (i)

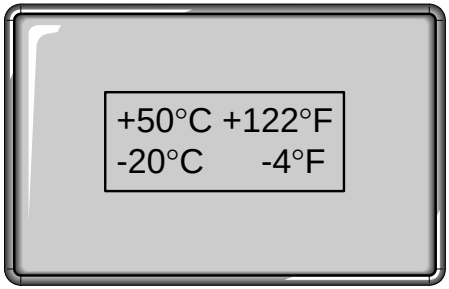


This error message appears if the new error value exceeds the limit (± 0.1 gon) during the V-index determination.

The function is terminated and the old value for "i" remains active; back to measuring menu.

During this display only and -OFF- are active.

Temperature



This error message appear if the ambient temperature is outside the specifications (-20°C to +50°C; -4°F bis +122°F).

The instrument is switched off automatically (saftey function!)

Telescope:
- Transit fully
- Vertical image
- Objective aperture 40 mm (1.57 in)
- Shortest focussing distance 1.6 m (5.2 ft)
- Field of view 1°21' 23.6 m/km (124.6 ft/ml)
- Magnification 30x

Angle measurement:
- absolute, continuous
- Angle units selectable:
  360° sexagesimal,
  400gon,
  360° dezimal,
  6400 mil
- Standard deviation
  (acc. to ISO 17123-3)

T105	5" (1.5 mgon)
T110	10" (3.0 mgon)

- Display resolution

360s	1"
gon	0.001 gon
360d	0.001°
mil	0.01 mil

Circular level:
- Level sensitivity: 6' / 2 mm

Laser plummet:
- In alidade, turns with instrument
- Accuracy: max. rot. diameter of laser spot: 3 mm / 1.5m
- Diameter of laser spot: 2.5 mm / 1.5m

Compensator:
- Oil compensator
- Working range:
  V-angle comp. ±4' (±0.07 gon)

Keyboard:
- Tilt angle 70°
- Base area: 110x75 mm
- No. of buttons: 7

Display:
- Backlit
- LCD: 144x64 Pixel
- Heatable (Temp. < -5°C)

Type of tribrach:
- Tribrach removable GDF101
  Thread diam.: 5/8"
  (DIN 18720 / BS 84)
- Tribrach shiftable GUS75
  Thread diam.: M35x2
  (DIN 13)
  with adapter 5/8"

Automatic corrections:
- Line-of-sight error
- Vertical index

Dimensions:
- Instrument:
  Height (including tribrach and carrying handle):
  - with tribrach GDF111
    360 mm ± 5 mm
  - with tribrach, shiftable
    357 mm ± 5 mm
  Width: 151 mm
  Length: 203 mm
- Weight
  including battery GEB111 and tribrach:
  - with tribrach GDF111
    4.46 kg
  - with tribrach, shiftable
    4.68 kg
  without battery and tribrach:
  3.69 kg
- Case: 468x254x355mm
  (LxBxH)

Tilting axis height:
- without tribrach 195.7 mm
- with tribrach GDF111
  240 mm ± 5 mm
- with tribrach, shiftable
  237 mm ± 5 mm

Power supply:
- Battery GEB111 NiMH
  (0% Cadmium)
  Voltage: 6V, 1800 mAh
  Operating life: 10h
- Battery GEB121 NiMH
  (0% Cadmium)
  Voltage: 6V, 3600 mAh
  Operating life: 20h
- Battery adapter GAD39:
  6 x LR6/AA/AM3, 1.5V,
  only alkaline batteries

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

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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