Leica TS10

User Manual
Version 1.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of the Leica TS10.

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "1 Safety Directions" for further information.

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

Product identification

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

Always refer to this information when you need to contact your agency or Leica Geosystems authorised service workshop.

Trademarks

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries
- *Bluetooth*® is a registered trademark of Bluetooth SIG, Inc.
- SD Logo is a trademark of SD-3C, LLC.

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to the Leica TS10.

Available documentation

Name	Description/Format		
TS10 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
TS10 User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	-	✓
Name	**Description/Format**		
Leica Captivate Technical Reference Manual	Overall comprehensive guide to the product and apps. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists.	-	✓

Refer to the following resources for documentation/software:

- the Leica Captivate USB documentation card
- https://myworld.leica-geosystems.com

Leica Geosystems address book

On the last page of this manual, you can find the address of Leica Geosystems headquarters. For a list of regional contacts, please visit **http://leica-geosystems.com/contact-us/sales_support**.

myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**) offers a wide range of services, information and training material.

With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
mySupport	Create new support requests for your products that will be answered by your local Leica Geosystems Support Team. View the complete history of your support requests and view detailed information on each request in case you want to refer to previous support requests.
myTraining	Enhance your product knowledge with Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material on your products and register for seminars or courses in your country.
myTrustedServices	Add your subscriptions and manage users for Leica Geosystems Trusted Services, the secure software services, that assist you to optimise your workflow and increase your efficiency.

Table of Contents

1 Safety Directions

1.1 General

Description

The following directions 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.

About warning messages

Warning messages are an essential part of the safety concept of the instrument. They appear wherever hazards or hazardous situations can occur.

Warning messages...

- make the user alert about direct and indirect hazards concerning the use of the product.
- contain general rules of behaviour.

For the users' safety, all safety instructions and safety messages shall be strictly observed and followed! Therefore, the manual must always be available to all persons performing any tasks described here.

DANGER, **WARNING**, **CAUTION** and **NOTICE** are standardised signal words for identifying levels of hazards and risks related to personal injury and property damage. For your safety, it is important to read and fully understand the following table with the different signal words and their definitions! Supplementary safety information symbols may be placed within a warning message as well as supplementary text.

Type	Description
⚠ **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.
NOTICE	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in 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.

1.2 Definition of Use

Intended use

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

Reasonably forseeable misuse

- Use of the product without instruction.
- Use outside of the intended use and limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with recognisable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Deliberate dazzling of third parties.
- Controlling of machines, moving objects or similar monitoring application without additional control and safety installations.
- Aiming directly into the sun.
- Inadequate safeguards at the working site.

1.3 Limits of Use

Environment

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

⚠WARNING

Working in hazardous areas, or close to electrical installations or similar situations.

Life Risk.

Precautions:

- ▸ Local safety authorities and safety experts must be contacted by the person responsible for the product before working in such conditions.

1.4 Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the User Manual.
- To ensure that it is used in accordance with the instructions.
- 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.
- To ensure that the national laws, regulations and conditions for the operation of the product are respected.

1.5 Hazards of Use

NOTICE

Dropping, misusing, modifying, storing the product for long periods or transporting the product

Watch out for erroneous measurement results.

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 as well as before and after important measurements.

⚠DANGER

Risk of electrocution

Because of the risk of electrocution, it is dangerous to use poles, levelling staffs 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

Lightning strike

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

Precautions:

- ▸ Do not use the product in a thunderstorm.

⚠WARNING

Distraction/loss of attention

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

Precautions:

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

⚠WARNING

Inadequate securing of the working site.

This can lead to dangerous situations, for example in traffic, on building sites and at industrial installations.

Precautions:

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

⚠CAUTION

Pointing product toward the sun

Be careful when pointing the product toward 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.

⚠CAUTION

Not properly secured accessories.

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 can sustain injury.

Precautions:

- When setting up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.
- Avoid subjecting the product to mechanical stress.

⚠WARNING

Inappropriate mechanical influences to batteries

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 it, discharge the batteries by 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

Exposure of batteries to high mechanical stress, high ambient temperatures or immersion into fluids

This can cause leakage, fire or explosion of the batteries.

Precautions:

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

⚠WARNING

Short circuit of battery terminals

If battery terminals are short circuited e.g. by coming in contact with jewellery, keys, metallised paper or other metals, the battery can overheat and cause injury or fire, for example by storing or transporting in pockets.

Precautions:

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

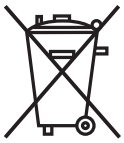
⚠WARNING

Improper disposal

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 unauthorised 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.
- The product does include parts of Beryllium inside. Any modification of some internal parts can release Beryllium dust or fragments, creating a health hazard.

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 unauthorised personnel.

Product-specific treatment and waste management information can be received from your Leica Geosystems distributor.

⚠WARNING

Improperly repaired equipment

Risk of injuries to users and equipment destruction due to lack of repair knowledge.

Precautions:

▸ Only authorised Leica Geosystems Service Centres are entitled to repair these products.

1.6 Laser Classification

1.6.1 General

General

The following chapters provide instructions and training information about laser safety according to international standard IEC 60825-1 (2014-05) and technical report IEC TR 60825-14 (2004-02). The information enables the person responsible for the product and the person who actually uses the equipment, to anticipate and avoid operational hazards.

☞ According to IEC TR 60825-14 (2004-02), products classified as laser class 1, class 2 and class 3R do not require:

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

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

☞ National laws and local regulations could impose more stringent instructions for the safe use of lasers than IEC 60825-1 (2014-05) and IEC TR 60825-14 (2004-02).

1.6.2 Distancer, Measurements with Reflectors

General

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

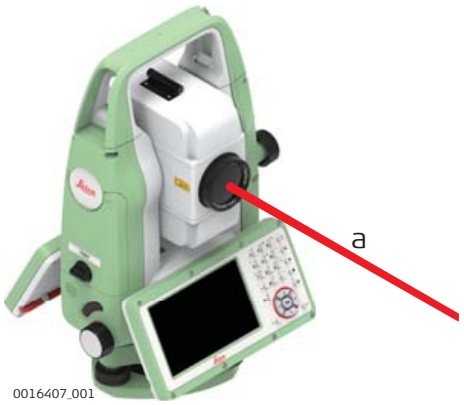
The laser product described in this section is classified as laser class 1 in accordance with:

- IEC 60825-1 (2014-05): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this User Manual.

Description	Value
Wavelength	658 nm
Pulse duration	800 ps
Pulse repetition frequency	100 MHz
Maximum average radiant power	0.34 mW
Beam divergance	1.5 mrad x 3 mrad

Labelling



a Laser beam

1.6.3 Distancer, Measurements without Reflectors

General

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

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

- IEC 60825-1 (2014-05): "Safety of laser products"

Direct intrabeam viewing may be hazardous (low eye hazard level), in particular for deliberate ocular exposure. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions. The risk of injury for laser class 3R products is limited because of:

a) unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
b) inherent safety margin in the maximum permissible exposure to laser radiation (MPE)
c) natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value (R500/R1000)
Wavelength	658 nm
Maximum average radiant power	4.8 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25s	44 m

⚠CAUTION

Class 3R laser products

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

Precautions:

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

⚠CAUTION

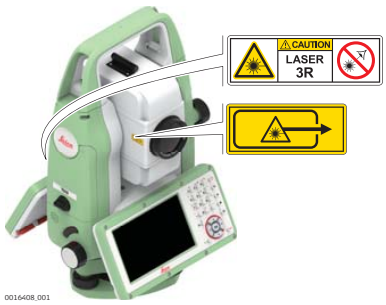
Reflected beams aimed at reflecting surfaces

Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces, etc.

Precautions:

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

Labelling



1.6.4 Red Laser Pointer

General

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

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

- IEC 60825-1 (2014-05): “Safety of laser products”

Direct intrabeam viewing may be hazardous (low eye hazard level), in particular for deliberate ocular exposure. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions. The risk of injury for laser class 3R products is limited because of:

a) unintentional exposure would rarely reflect worst case conditions of (e.g.) beam alignment with the pupil, worst case accommodation,
b) inherent safety margin in the maximum permissible exposure to laser radiation (MPE)
c) natural aversion behaviour for exposure to bright light for the case of visible radiation.

Description	Value (R500/R1000)
Wavelength	658 nm
Maximum average radiant power	4.8 mW
Pulse duration	800 ps
Pulse repetition frequency (PRF)	100 MHz
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25 s	44 m / 144 ft

⚠CAUTION

Class 3R laser products

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

Precautions:

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

⚠CAUTION

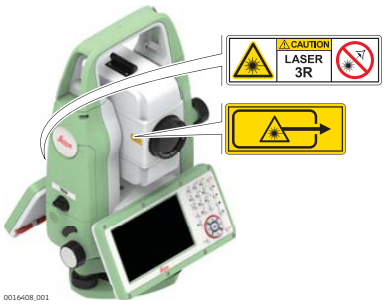
Reflected beams aimed at reflecting surfaces

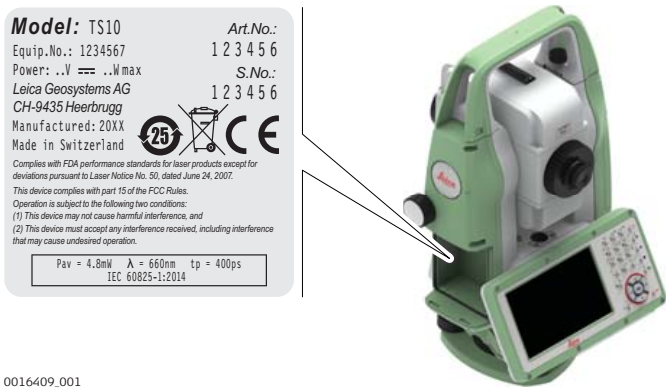
Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces, etc.

Precautions:

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

Labelling



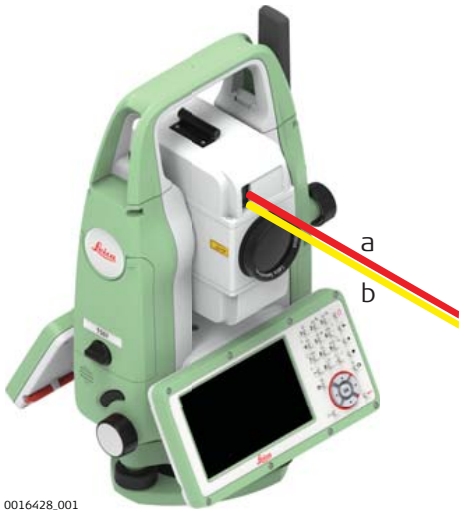


1.6.5 Electronic Guide Light EGL

General

The Electronic Guide Light built into the product produces a visible LED beam which emerges from the front side of the telescope.

☞ The product described in this section, is excluded from the scope of IEC 60825-1 (2014-05): "Safety of laser products".
The product described in this section, is classified as exempt group in accordance with IEC 62471 (2006-07) and does not pose any hazard provided that the product is used and maintained in accordance with this user manual.



1.6.6 AutoHeight Laser Plummet

General

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

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

- IEC 60825-1 (2014-05): “Safety of laser products”

These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam. The beam may cause dazzle, flash-blindness and after-images, particularly under low ambient light conditions.

Description	Value
Wavelength	640 nm
Maximum average radiant power	0.95 mW
Pulse duration	< 1 ns
Pulse repetition frequency (PRF)	320 MHz
Beam divergence	< 1.5 mrad

⚠ CAUTION

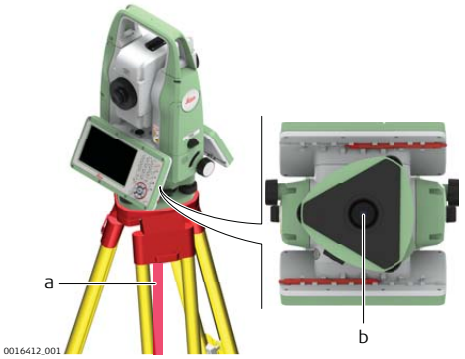
Class 2 laser product

From a safety perspective, class 2 laser products are not inherently safe for the eyes.

Precautions:

- ▸ Avoid staring into the beam or viewing it through optical instruments.
- ▸ Avoid pointing the beam at other people or at animals.

Labelling



a Laser beam
b Exit for laser beam

1.7 Electromagnetic Compatibility EMC

Description

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

⚠WARNING

Electromagnetic radiation

Electromagnetic radiation can cause disturbances in other equipment.

Precautions:

- 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

Use of the product with accessories from other manufacturers. For example field computers, personal computers or other electronic equipment, non-standard cables or external batteries

This may cause disturbances in other equipment.

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, two-way radios or other electronic equipment, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

⚠CAUTION

Intense electromagnetic radiation. For example, near radio transmitters, transponders, two-way radios or diesel generators

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that function of the product may be disturbed in such an electromagnetic environment.

Precautions:

- ▸ Check the plausibility of results obtained under these conditions.

⚠CAUTION

Electromagnetic radiation due to improper connection of cables

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

Precautions:

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

Radios or digital cellular phones

⚠WARNING

Use of product with radio or digital cellular phone devices:

Electromagnetic fields can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.

Precautions:

- ▸ Although the product meets the strict regulations and standards which are in force in this respect, Leica cannot completely exclude the possibility that other equipment can be disturbed or that humans or animals can be affected.
  - Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
  - Do not operate the product with radio or digital cellular phone devices near to medical equipment.
  - Do not operate the product with radio or digital cellular phone devices in aircraft.

1.8 FCC Statement, Applicable in U.S.

☞ The greyed paragraph below is only applicable for products without radio.

⚠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 radio 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 the 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.

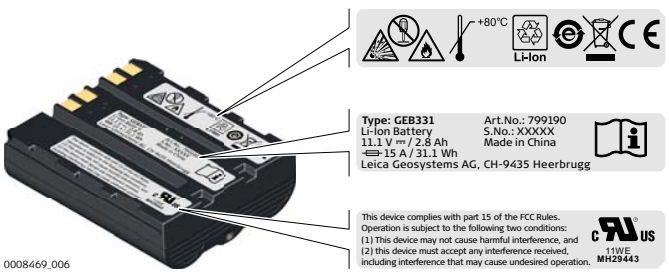
⚠CAUTION

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

Labelling TS10

0016409_001

Labelling GEB331



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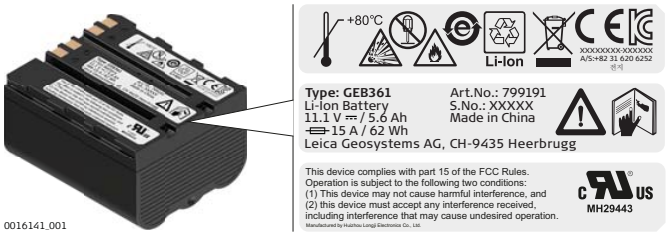
Labelling GEB361



1.9 ICES-003 Statement, Applicable in Canada

⚠WARNING

This Class (B) digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe (B) est conforme à la norme NMB-003 du Canada.

Canada Compliance Statement

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:

1. This device may not cause interference; and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Canada Déclaration de Conformité

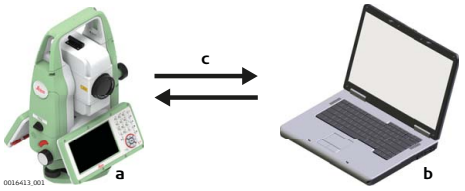
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage;
2. l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

2 Description of the System

2.1 System Components

Main components



a TS10 instrument with Captivate firmware
b Computer with Leica Infinity software
c Data transfer

Component	Description
TS10	An instrument for measuring, calculating and capturing data. Ideally suited for tasks from simple surveys to complex applications. Equipped with a Captivate firmware package to complete these tasks. The various lines have a range of accuracy classes and support different features. All lines can be connected with Leica Infinity to view, exchange and manage data.
Captivate firmware	The firmware package installed on the instrument. Consists of a standard base operating system with optional additional features.
Leica Infinity software	An office software consisting of a suite of standard and extended programs for the viewing, exchanging, managing and post processing of data.
Data transfer	Data can be transferred between a TS10 and a computer via USB cable, USB-stick, SD card and data transfer cable.

2.2 System Concept

2.2.1 Software Concept

Description

All instruments use the same software concept.

Software for TS models

Software type	Description
TS firmware (xx.fw)	The Leica Captivate software is running on the TS instrument and covers all functions of the instrument. The main applications and languages are integrated into the firmware and cannot be deleted. The languages released with Leica Captivate are included in the firmware file.
Applications (xx.axx)	Many optional survey-specific applications are available for the TS instruments. All applications are included in the Leica Captivate firmware file and can be loaded separately. Some of the applications are activated freely and require no licence key; others require purchasing and are only activated with a licence key.

Software type	Description
	If the licence is not loaded to the instrument, applications requiring a licence key run for a trial period. For a trial run, the Measure&Stakeout licence must be available on the TS.
Customised applications (xx.axx)	Customised software, specific to user requirements, can be developed using the GeoC++ development kit. Information on the GeoC++ development environment is available on request from a Leica Geosystems representative.

Software upload

☞ Uploading software can take some time. Ensure that the battery is at least 80% full before you start the upload. Do not remove the battery during the upload process.

Software update instructions for all TS models:

1. Download the most recent firmware file from https://myworld.leica-geosystems.com. Refer to "Introduction".
2. Copy the firmware file into the **System** folder on the memory device.
3. Start the instrument. Select **Settings\Tools\Update software**. Select the firmware file and start the update.
4. When the update is complete, a message appears.

2.2.2 Power Concept

General

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

Power options

Model	Power supply
all TS models	Internally by GEB331 or GEB361 battery, OR Externally by GEV52 cable and GEB371 battery. If an external power supply is connected and the internal battery is inserted, then the external power is used.

2.2.3 Data Storage Concept

Description

Data is stored on a memory device. The memory device can be an SD card or internal memory. For data transfer an USB stick can also be used.

Memory device

Device	Description
SD card	All instruments have an SD card slot fitted as standard. An SD card can be inserted and removed. Available capacity: 1 GB and 8 GB.
USB stick	All instruments have a USB port fitted as standard.
Internal memory	All instruments have an internal memory fitted as standard. Available capacity: 2 GB.

☞ While other SD cards/USB sticks can be used, Leica Geosystems recommends to only use Leica SD cards/USB sticks and is not responsible for data loss or any other error that can occur while using a non-Leica SD card/USB stick.

☞ Unplugging connecting cables or removing the SD card or USB stick during the measurement can cause loss of data. Only remove the SD card or USB stick or unplug connecting cables when the TS instrument is switched off.

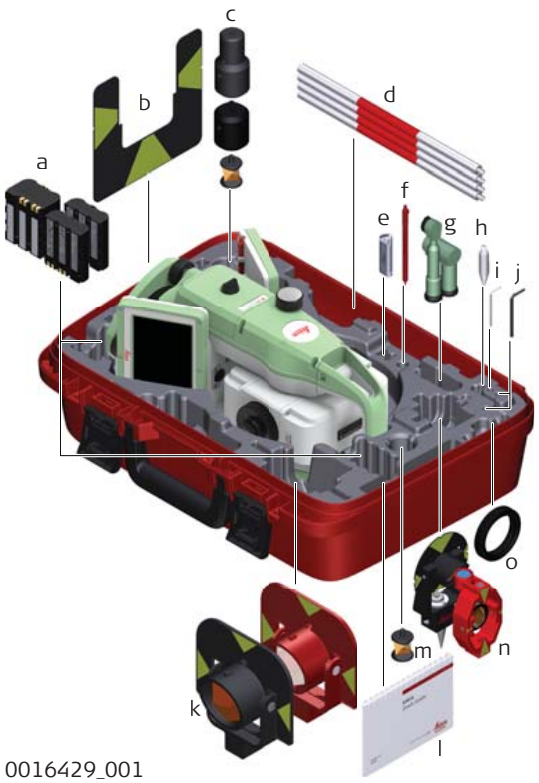
Transfer data

Data can be transferred in various ways. Refer to "4.2 Connecting to a Personal Computer".

☞ SD cards can directly be used in an OMNI drive as supplied by Leica Geosystems. Other PC card drives can require an adaptor.

2.3 Container Contents

Container contents part 1 of 2



a GEB331 or GEB361 battery
b GZT4 target plate
c GRZ101 mini prism, GAD103 and GAD105 adapter
d GLS115 mini prism pole
e Leica industrial grade USB memory stick
f Stylus
g GFZ3 and GOK6 diagonal eyepiece*
h Tip for mini prism
i Adjustment tool
j Allen key
k GPR111 and GPR121 round prism
l Manuals
m GRZ101 360° mini prism
n GMP101 and GMP111 mini prism*
o Counterweight for diagonal eyepiece*

* Optional

Container contents part 2 of 2

0016355_001

a SD card
b CPR105 flat prism*
c GHT196 holder for height metre*
d GHM007 height metre*
e GLI115 clip-on bubble*
f GKL311 charger
g Protective cover / Lens hood / Cleaning cloth
h Data cable

* Optional

Instrument components part 1 of 2

a Compartment for SD card, USB memory stick and USB cable ports
b Optical sight
c Detachable carrying handle with mounting screw
d Telescope, integrating EDM, EGL*, overview camera*
e Objective with integrated Electronic Distance Measurement (EDM). Exit for EDM laser beam
f Vertical drive
g Loudspeaker
h Trigger key
i Serial interface RS232, located behind keyboard on rotation part
j Horizontal drive
k Second keyboard* with display; identical to first keyboard

* Optional

Instrument components part 2 of 2

l LTE antenna*
m Focusing telescope image
n Eyepiece; focusing graticule
o Battery cover
p Foot screw
q Stylus
r Keyboard with display, model may vary depending on instrument

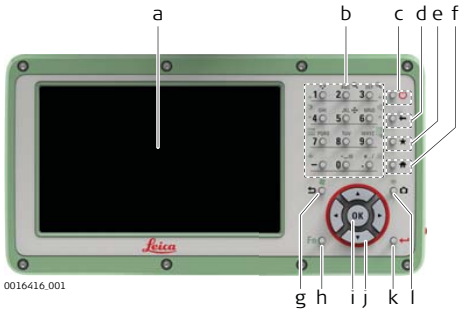
* Optional

3 User Interface

3.1 Keyboard

3.1.1 Standard Keyboard

Keyboard



a Display
b Alphanumeric keys
c ON/OFF
d Backspace
e Favourites
f Home
g Esc
h Fn
i OK
j Arrow keys
k Enter
l Camera

Keys

Key		Function
Alphanumeric keys		To type letters and numbers.
Camera		To capture an image with the camera.
Esc		Leaves the current screen without storing any changes.
Fn		Switches between first and second level of any key on the keyboard.
Enter		Selects the highlighted line and leads to the next logical menu / dialog. Starts the edit mode for editable fields. Opens a selectable list.
ON/OFF		If the instrument is already off: Turns on the instrument when held for 2 s. If the instrument is already on: Turns to Power Options menu when held for 2 s.
Favourites		Goes to a favourites menu.
Home		Switches to the Home Menu.
Arrow keys		Move the focus on the screen.
OK		Selects the highlighted line and leads to the next logical menu / dialog. Starts the edit mode for editable fields. Opens a selectable list.

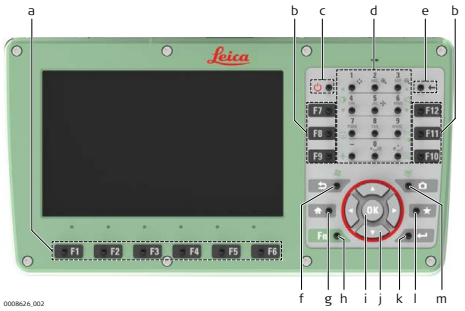
Key	Function
Backspace	Deletes the job in the centre of the job carousel.

Key combinations

Key	Function
Fn +	Hold **Fn** while pressing . Switch to Windows.
Fn +	Hold **Fn** while pressing . Take a screenshot of the current screen.
Fn + 1	Hold **Fn** while pressing **1**. Increase the screen brightness.
Fn + GHI 4	Hold **Fn** while pressing **4**. Decrease the screen brightness.
Fn + DEF 3	Hold **Fn** while pressing **3**. Increase the volume for acoustic warning signals, beeps and keypresses on the instrument.
Fn + MNO 6	Hold **Fn** while pressing **6**. Decrease the volume for acoustic warning signals, beeps and keypresses on the instrument.
Fn + PQRS 7	Hold **Fn** while pressing **7**. Lock/unlock the keyboard.
Fn + WXYZ 9	Hold **Fn** while pressing **9**. Lock/unlock the touch screen.
Fn +	Hold **Fn** while pressing . Enter a plus sign instead of a minus sign.
Fn +	Hold **Fn** while pressing . Turn the keyboard illumination on/off.

3.1.2 Optional Keyboard

Keyboard



a Function keys F1-F6
b Function keys F7-F12
c ON/OFF
d Alphanumeric keys
e Backspace
f Esc
g Home
h Fn
i OK
j Arrow keys
k Enter
l Favourites
m Camera

Keys

Key		Function
Function keys **F1 to F6**		Correspond to six softkeys that appear on the bottom of the screen when the screen is activated.
Function keys **F7 to F12**		User definable keys to execute chosen commands or access chosen screens.
Alphanumeric keys		To type letters and numbers.
Camera		To capture an image with the camera.
Esc		Leaves the current screen without storing any changes.
Fn		Switches between first and second level of any key on the keyboard.
Enter		Selects the highlighted line and leads to the next logical menu / dialog. Starts the edit mode for editable fields. Opens a selectable list.
ON/OFF		If the instrument is already off: Turns on the instrument when held for 2 s. If the instrument is already on: Turns to Power Options menu when held for 2 s.
Favourites		Goes to a favourites menu.
Home		Switches to the Home Menu.
Arrow keys		Move the focus on the screen.
OK		Selects the highlighted line and leads to the next logical menu / dialog. Starts the edit mode for editable fields. Opens a selectable list.
Backspace		Deletes the job in the centre of the job carousel.

Key combinations

Key			Function
Fn	+		Hold **Fn** while pressing . Switch to Windows.
Fn	+		Hold **Fn** while pressing . Take a screenshot of the current screen.
Fn	+	1	Hold **Fn** while pressing **1**. Increase the screen brightness.
Fn	+	4 GHI	Hold **Fn** while pressing **4**. Decrease the screen brightness.

Key	Function
Fn + 3 DEF ▲	Hold **Fn** while pressing **3**. Increase the volume for acoustic warning signals, beeps and keypresses on the instrument.
Fn + 6 MNO ▼	Hold **Fn** while pressing **6**. Decrease the volume for acoustic warning signals, beeps and keypresses on the instrument.
Fn + 7 PQRS	Hold **Fn** while pressing **7**. Lock/unlock the keyboard.
Fn + 9 WXYZ	Hold **Fn** while pressing **9**. Lock/unlock the touch screen.
Fn + −	Hold **Fn** while pressing −. Enter a plus sign instead of a minus sign.
Fn + #-/	Hold **Fn** while pressing #-/. Turn the keyboard illumination on/off.

3.2 Operating Principles

Keyboard and touch screen

The user interface is operated either by the keyboard or by the touch screen with supplied stylus. The workflow is the same for keyboard and touch screen entry, the only difference lies in the way information is selected and entered.

Operation by keyboard

Information is selected and entered using the keys.

Operation by touch screen

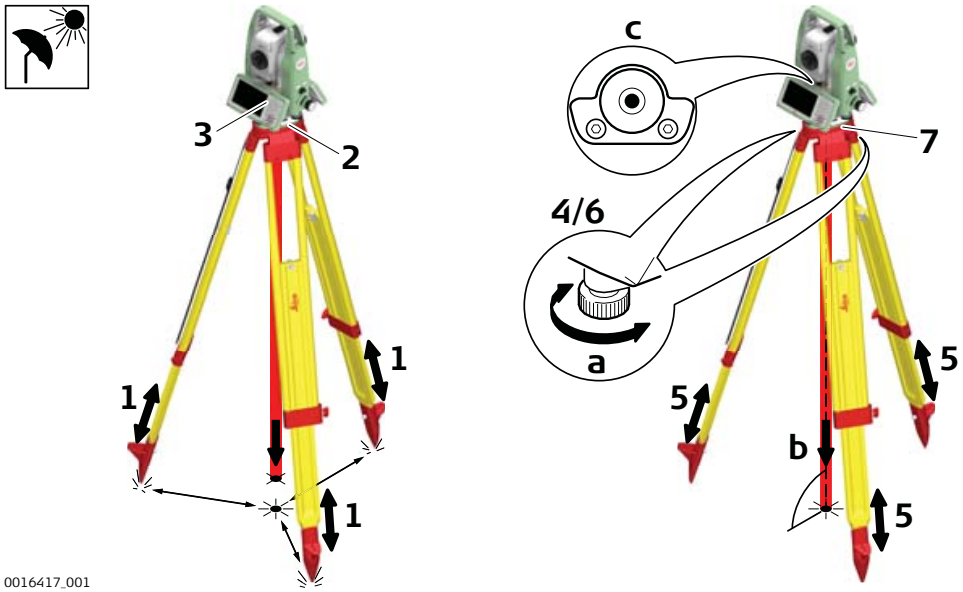
Information is selected and entered on the screen using the supplied stylus.

Operation	Description
To select an item	Tap on the item.
To start the edit mode in editable fields	Tap on the editable field.
To highlight an item or parts of it for editing	Drag the supplied stylus from the left to the right.
To accept data entered into an editable field and exit the edit mode	Tap on the screen outside of the editable field.
To open a context-sensitive menu	Tap on the item and hold for 2 s.

4 Operation

4.1 Instrument Setup

Instrument setup step-by-step



☞	Shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
1.	Extend the tripod legs to allow for a comfortable working posture. Position the tripod above the marked ground point, centring it as good as possible. Ensure that the tripod plate is roughly horizontal.
2.	Fasten the tribrach and instrument onto the tripod.
3.	Turn on the instrument by pressing ⏻ ◎. Select **Settings/TS instrument/Level & compensator** to activate the laser plummet and electronic level.
4.	Use the tribrach footscrews (a) to centre the plummet (b) above the ground point.
5.	Adjust the tripod legs to level the circular level (c).
6.	By using the electronic level, turn the tribrach footscrews (a) to level the instrument precisely.
7.	Centre the instrument precisely over the ground point (b) by shifting the tribrach on the tripod plate.
8.	Repeat steps 6. and 7. until the required accuracy is achieved.

☞ Use the optional AutoHeight laser plummet for vertically setting up the instru-ment over a ground point and for measuring the instrument height when set-ting up the station.

4.2 Connecting to a Personal Computer

Description

Remote **N**etwork **D**river **I**nterface **S**pecification is a standard for a network connection via USB. RNDIS enables a PC and a Windows mobile-based pocket PC to communicate.

Leica USB drivers support Windows 7, Windows 8 (8.1) and Windows 10 operating systems.

Cables

Leica USB drivers support:

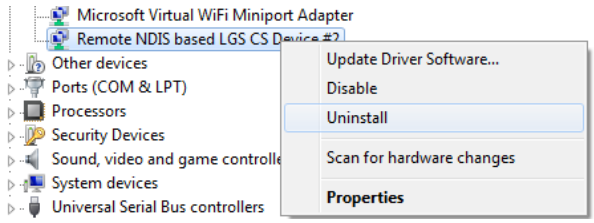
Name	Description
GEV223	USB data cable, 1.8 m, connects instrument to Mini-USB to USB
GEV187	Y-cable, 2.0 m, allows connects instrument, external battery and computer

Uninstalling the previous drivers

Skip the following steps if you have never installed Leica USB drivers before.

If older drivers were previously installed on the PC, follow the instructions to uninstall the drivers prior the installation of the new drivers.

1. Connect your instrument to the PC via cable.
2. On your PC, select to **Control Panel** › **Device Manager**.
3. In **Network Adapters**, right-click on **Remote NDIS based LGS...**.
4. Click on **Uninstall**.



5. Set **Delete the driver...** as checked. Press **OK**.

Install Leica USB drivers

1. Start the PC.

2. Run the **Setup_Leica_USB_XXbit.exe** to install the drivers necessary for Leica devices. Depending on the version (32bit or 64bit) of the operating system on your PC, you have to select between the three setup files following:
   - Setup_Leica_USB_32bit.exe
   - Setup_Leica_USB_64bit.exe
   - Setup_Leica_USB_64bit_itanium.exe

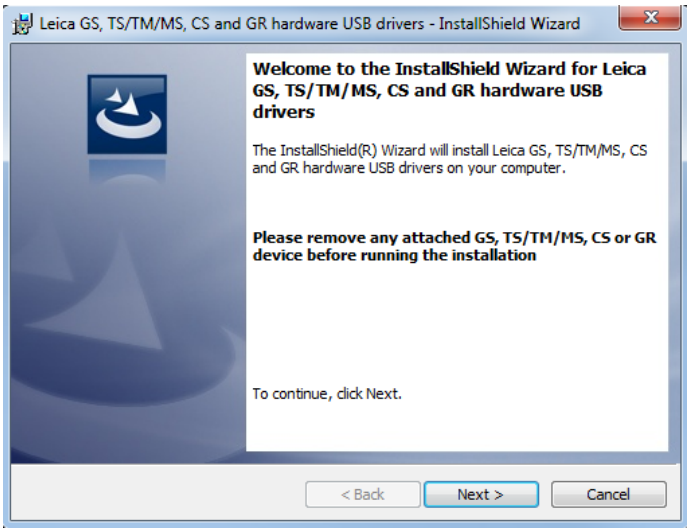
   ☞ To check the version of your operating system, go to **Control Panel** › **System** › **System type**.

   ☞ The setup requires administrative privileges.

   ☞ The setup has to be run only once for all Leica devices.

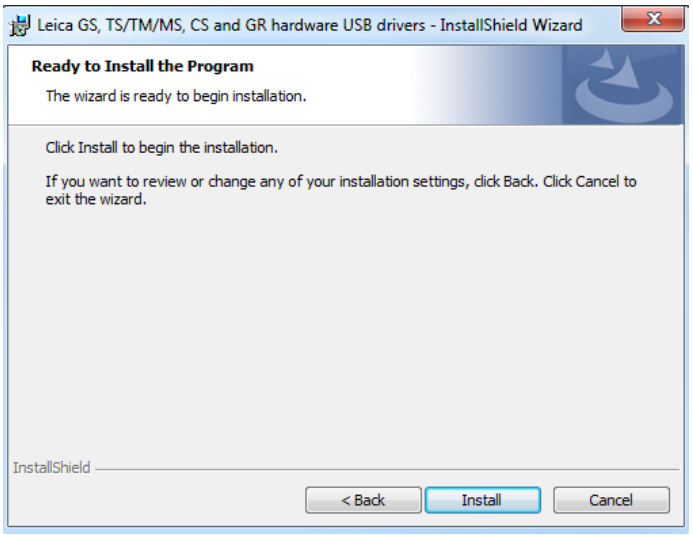
3. The **Welcome to InstallShield Wizard for Leica GS, TS/TM/MS, CS and GR USB drivers** window appears.

   ☞ Ensure that all Leica devices are disconnected from your PC before you continue!



4. **Next›**.

5. The **Ready to Install the Program** window appears.



6. **Install**. The drivers will be installed on your PC.

	7.	The **InstallShield Wizard Completed** window appears.
	8.	Click **Finish** to exit the wizard.

Connect to PC via USB cable step-by-step

1.	Start the PC.
2.	Plug the cable into the instrument.
3.	Turn on the instrument.
4.	Plug the cable into the USB port of the PC.
5.	Press the Windows Start button at the bottom left corner of the screen.
6.	Type the IP address of the device into the search field. • \\192.168.254.1\ for field controller • \\192.168.254.3\ for other instruments
7.	Press **Enter**. A file browser opens. You can now browse within the folders on the instrument.

4.3 Power Functions

Turning the instrument on

Press and hold power key (◎) for 2s.

☞ The instrument must have a power supply.

Power options menu

Press and hold power key (◎) for 2 s to open **Power Options** menu.

☞ Instrument must be on.

Option	Description
Turn off	Turn TS instrument off.
Stand-by	Put TS instrument into stand-by mode. ☞ In stand-by mode, the TS instrument shuts down and reduces power consumption. Rebooting from stand-by mode is quicker than a cold start after turning off.
Reset...	Performs one of the following options: • **Restart** (restarts Windows EC7) • **Reset Windows EC7** (resets Windows EC7 and communication settings to factory defaults) • **Reset installed software** (resets settings of all installed software) • **Reset Windows EC7 and installed software** (resets Windows EC7 and settings of all installed software)

4.4 Batteries

4.4.1 Operating Principles

First-time use/ charging batteries

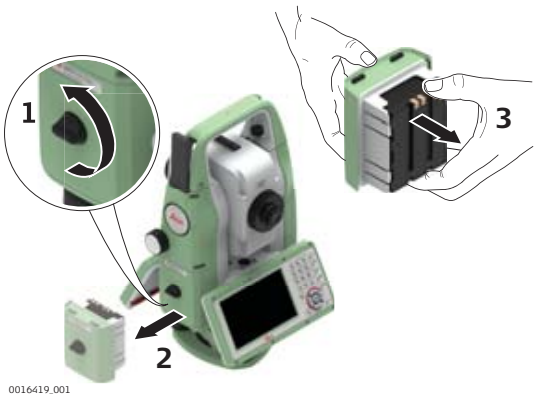
- The battery must be charged before using it for the first time because it is delivered with an energy content as low as possible.
- The permissible temperature range for charging is from 0 °C to +40 °C/ +32 °F to +104 °F. For optimal charging, we recommend charging the batteries at a low ambient temperature of +10 °C to +20 °C/+50 °F to +68 °F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Leica Geosystems, it is not possible to charge the battery once the temperature is too high.
- For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make only one charge/discharge cycle.
- For Li-Ion batteries, a single discharging and charging cycle is sufficient. We recommend carrying out the process when the battery capacity indicated on the charger or on a Leica Geosystems product deviates significantly from the actual battery capacity available.

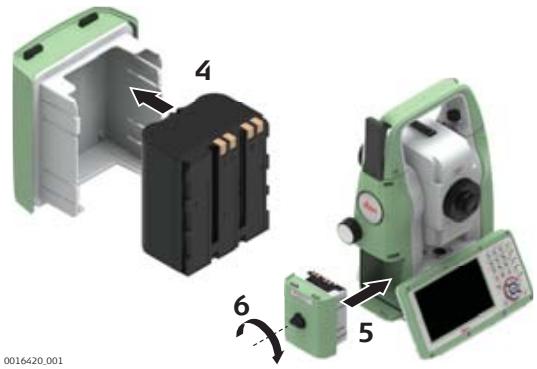
Operation/ discharging

- 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; high operating temperatures reduce the service life of the battery.

4.4.2 Battery for the TS Instrument

Change battery step-by-step





1. Face the instrument so that the vertical drive screw is on the left. The battery compartment is below the vertical drive. Turn the knob to the vertical position, opening the lid of the battery compartment.
2. Pull out the battery housing.

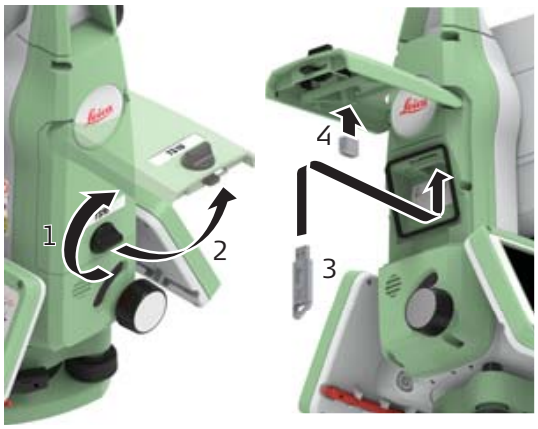
3.	Pull the battery out of the battery housing.
4.	At the top of the battery is a notch which corresponds to the inner surface of the battery housing. This notch helps you to place the battery correctly. Place the battery into the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
5.	Place the battery housing into the battery compartment. Push the battery housing in until it fits completely into the battery compartment.
6.	Turn the knob to lock the battery compartment. Ensure that the knob is returned to its original horizontal position.

4.5 Working with the Memory Device

☞
- Keep the card dry.
- Use it only within the specified temperature range.
- Do not bend the card.
- Protect the card from direct impacts.

☞ Failure to follow these instructions could result in data loss and/or permanent damage to the card.

Insert and remove a USB stick step-by-step



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☞ The USB stick is inserted into the USB host port inside the Communication side cover of the instrument.

1.	Turn the knob on the Communication side cover to the vertical position to unlock the communication compartment.
2.	Open the lid of the communication compartment to access the communication ports.
3.	Slide the USB stick with the Leica logo facing you firmly into the USB host port until it clicks into position. ☞ Do not force the USB stick into the port.
4.	If desired, store the lid of the USB stick on the underside of the compartment lid.
5.	Close the lid and turn the knob to the horizontal position to lock the compartment.

6. To remove the USB stick, open the lid of the compartment and slide the USB stick out of the port.

Insert a SIM card step-by-step

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☞ The SIM card is inserted into a slot behind the lid with the logo, almost in the middle of the housing.

1.	Turn the knob on the lid to unlock.
2.	Open the lid.
3.	Hold the SIM card with the contacts facing to the instrument and the cut edge of SIM card facing downwards. ☞ Sliding in the SIM card differently could break the SIM card holder of the instrument.
4.	Slide the SIM card firmly into the slot until it clicks into position.
5.	Close the lid. Turn to lock.
6.	To remove the SIM card, gently press on the top of the card to release it from the slot.

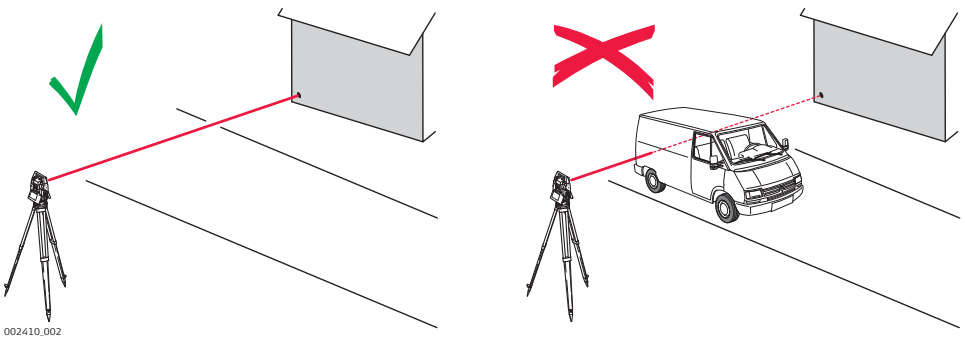
4.6 Distance Measurements - Guidelines for Correct Results

Description

An EDM is incorporated into the instrument. In all versions, the distance can be determined by using a visible red laser beam which emerges coaxially from the telescope objective. There are two EDM modes:

- Prism measurements
- Non-Prism measurements

Non-prism measurements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- When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If a temporary obstruction, for example a passing vehicle, heavy rain, fog or snow is between the instrument and the point to be measured, the EDM may measure to the obstruction.
- Be sure that the laser beam is not reflected by anything close to the line of sight, for example highly reflective objects.
- Avoid interrupting the measuring beam while taking Non-Prism measurements or measurements using reflective foils.
- Do not measure with two instruments to the same target simultaneously.

Prism measurements

- Accurate measurements to prisms should be made in **Once** mode.
- Measurements to strongly reflecting targets such as traffic lights in Prism mode without a prism should be avoided. The measured distances may be wrong or inaccurate.
- When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. If for example people, cars, animals, or swaying branches cross the laser beam while a measurement is being taken, a fraction of the laser beam is reflected from these objects and may lead to incorrect distance values.
- Measurements to prisms are only critical if an object crosses the measuring beam at a distance of 0 to 30 m and the distance to be measured is more than 300 m.
- In practice, because the measuring time is very short, the user can always find a way of avoiding unwanted objects from interfering in the beam path.

⚠WARNING

Due to laser safety regulations and measuring accuracy, using the Long Range Reflectorless EDM is only allowed to prisms that are more than 1000m (3300ft) away.

Red laser to prism

- **Any surface** mode enables distance measurements of over 4.0 km to standard prisms using the visible red laser beam.

Red laser to reflector tape

- The visible red laser beam can also be used to measure to reflective foils. To guarantee the accuracy the red laser beam must be perpendicular to the reflector tape and it must be well adjusted.
- Make sure the additive constant belongs to the selected target (reflector).

5 Check & Adjust

5.1 Overview

Description

Leica Geosystems instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument from time to time. This check and adjust can be done in the field by running through specific measurement procedures. The procedures are guided and must be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

Electronic adjustment

The following instrument errors can be checked and adjusted electronically:

Instrument error	Description
l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Horizontal collimation error, also called line of sight error
a	Tilting axis error

If the compensator and the horizontal corrections are activated in the instrument configuration, every angle measured in the daily work is corrected automatically. Check whether the tilt correction and the horizontal correction are turned on.

The results are displayed as errors but used with the opposite sign as corrections when applied to measurements.

Checking parts

The following instrument parts can be checked:

- Circular level on the instrument and tribrach.
- Laser plummet.
- Screws on the tripod.

Precise measurements

To get precise measurements in the daily work, it is important:

- To check and adjust the instrument from time to time.
- To take high precision measurements during the check and adjust procedures.
- To measure targets in two faces. Some of the instrument errors are eliminated by averaging the angles from both faces.

☞

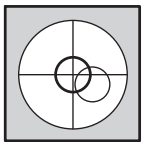
During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned, these errors can change and it is highly recommended to redetermine them in the following situations:

- Before the instrument is used for the first time.
- Before every high precision survey.
- After rough or long periods of transport.
- After long periods of work or storage.
- If the temperature difference between current environment and the temperature at the last calibration is more than 10°C (18°F).

Summary of errors to be adjusted electronically

Instrument error	Effects Hz	Effects V	Elimination with two face measurement	Automatically corrected with proper adjustment
c - Line of sight error	✓	---	✓	✓
a - Tilting axis error	✓	---	✓	✓
l - Compensator index error	---	✓	✓	✓
t - Compensator index error	✓	---	✓	✓
i - Vertical index error	---	✓	✓	✓

5.2 Preparation



Before determining the instrument errors, the instrument has to be levelled using the electronic level.
The tribrach, the tripod and the underground should be stable and secure from vibrations or other disturbances.

The instrument should be protected from direct sunlight to avoid thermal warming.
It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are early in the morning or with overcast sky.

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

5.3 Combined Adjustment (l, t, i and c)

Description

The combined adjustment procedure determines the following instrument errors in one process:

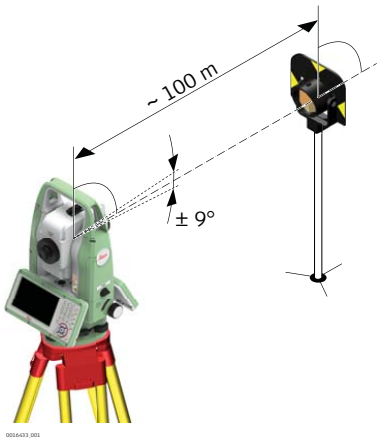
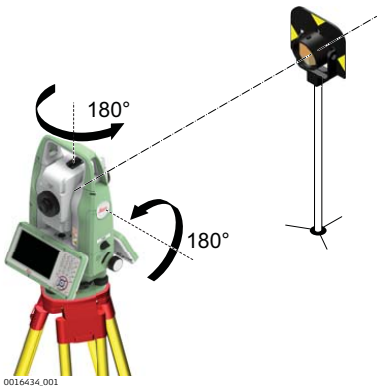
Instrument error	Description
l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Horizontal collimation error, also called line of sight error

Combined adjustment procedure step-by-step

The following table explains the most common settings.

1. **Leica Captivate - Home**: **Settings\TS instrument\Check & adjust**
2. **Check & Adjust**

Select the option: **Check & adjust the compensator, index error & line of sight error**

3.	**Next**
4.	**Face I measurement** ☞ Use a clean Leica standard prism as the target. Do not use a 360° prism.
5.	Aim the telescope accurately at a target at about 100 m distance. The target must be positioned within ±9°/±10 gon of the horizontal plane. The procedure can be started in any face. 
6.	**Measure** to measure and to continue to the next screen. Non-motorised instruments guide to the other face. ☞ The fine pointing has to be performed manually in both faces. 
7.	**Face II measurement** **Measure** to measure the same target in the other face and to calculate the instrument errors.
☞	If one or more errors are bigger than the predefined limits, the procedure must be repeated. All measurements of the current run are rejected and none of them is averaged with the results from previous runs.
8.	Adjustment Status **Number of measurements**: Shows the number of runs completed. One run consists of a measurement in face I and face II. **l Component quality (1 σ)**: and similar lines show the standard deviations of the determined adjustment errors. The standard deviations can be calculated from the second run onwards.
☞	Measure at least two runs.
9.	**Next** to continue with the check & adjust procedure.

	10.	Select **Add another calibration loop** if more runs have to be added. **Next** and continue with step 4. OR Select **Finish the calibration & store the results** to finish the calibration process. **Next** to view the adjustment results.
	11.	Select **Finish** to accept the results. No more runs can be added later. OR Select **Redo** to decline all measurements and to repeat all calibration runs. OR **Back** returns to the previous screen.

Next step

IF the results are	THEN
to be stored	If the Use status is set to Yes, **Next** overwrites the old adjustment errors with the new ones.
to be determined again	**Redo** rejects all new determined adjustment errors and repeats the whole procedure. Refer to paragraph "Combined adjustment procedure step-by-step".

5.4 Adjusting the Tilting Axis Error

Description

The tilting axis error is caused by the deviation between the mechanical tilting axis and the line perpendicular to the vertical axis. This error affects horizontal angles. To determine this error, it is necessary to point to a target located significantly below or above the horizontal plane.

☞ The horizontal collimation error has to be determined before starting this procedure.

Access

1.	**Leica Captivate - Home**: **Settings\TS instrument\Check & adjust**
2.	**Check & Adjust**
3.	Select the option: **Check & adjust the tilting axis**
4.	**Next**

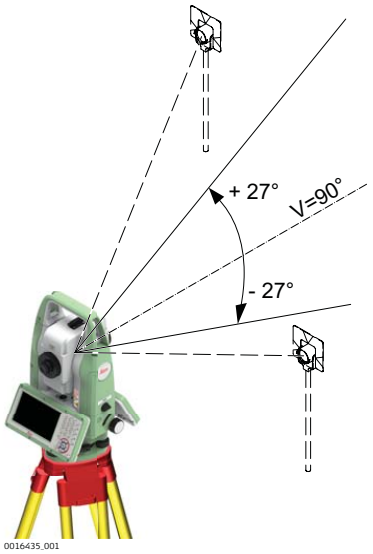
Determination of tilting axis error step-by-step

The following table explains the most common settings.

☞ Determine the horizontal collimation error (c) before starting this procedure.

1.	**Leica Captivate - Home**: **Settings\TS instrument\Check & adjust**
2.	**Check & Adjust** Select the option: **Check & adjust the tilting axis**

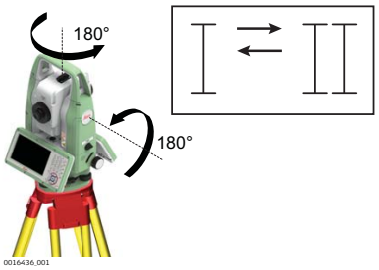
3. **Face I measurement**
Aim the telescope accurately at a target at about 100 m distance (or at least 20 m). The target must be positioned at least 27°/30 gon above or beneath the horizontal plane. The procedure can be started in any telescope face.



4. **Measure** to measure and to continue to the next screen. Motorised instruments change automatically to the other face.

Non-motorised instruments guide to the other face.

☞ The fine pointing must be performed manually in both faces.



5. **Face II measurement**

Measure to measure the same target in the other face and to calculate the tilting axis error.

☞ If the error is bigger than the predefined limit, the procedure must be repeated. The tilting axis measurements of the current run are then rejected and not averaged with the results from previous runs.

6. Adjustment Status

Number of measurements: Shows the number of runs completed. One run consists of a measurement in face I and face II.

a T-axis quality (1 σ): shows the standard deviation of the determined tilting axis error. The standard deviation can be calculated from the second run onwards.

☞ Measure at least two runs.

7. **Next** to continue with the check & adjust procedure.

8. Select **Add another calibration loop** if more runs have to be added. **Next** and continue with step 3.

OR

Select **Finish the calibration & store the results** to finish the calibration process. No more runs can be added later. **Next** to view the adjustment results.

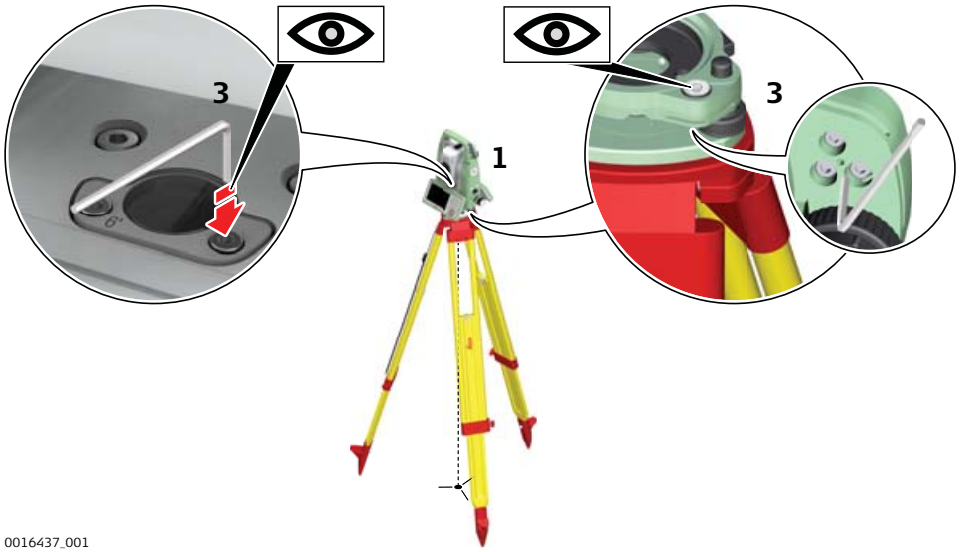
9. Select **Finish** to accept the results. No more runs can be added later.

OR

Select **Redo** to decline all measurements and to repeat all calibration runs.

5.5 Adjusting the Circular Level of the Instrument and Tribrach

Adjusting the circular level step-by-step



1. Place and secure the instrument into the tribrach and onto a tripod.
2. Using the tribrach footscrews, level the instrument with the electronic level.
   Select **Settings\TS instrument\Level & compensator** to access the **Level & Compensator** panel.
3. Check the position of the circular level on the instrument and tribrach.
4. a If both circular levels are centred, no adjustments are necessary
   b If one or both circular levels are not centred, adjust as follows:

   Instrument: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws. Turn the instrument by 200 gon (180°). Repeat the adjustment procedure if the circular level does not stay centred.

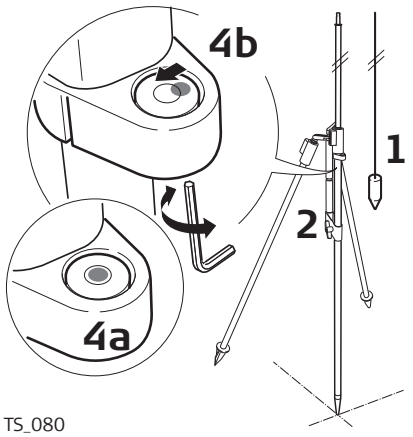
   Tribrach: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws.

☞ After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

5.6 Adjusting the Circular Level of the Prism Pole

Adjusting the circular level step-by-step

1. Suspend a plumb line.
2. Use a pole bipod, to align the prism pole parallel to the plumb line.
3. Check the position of the circular level on the prism pole.
4. a If the circular level is centred, no adjustment is necessary.
   b If the circular level is not centred, use an allen key to centre it with the adjustment screws.



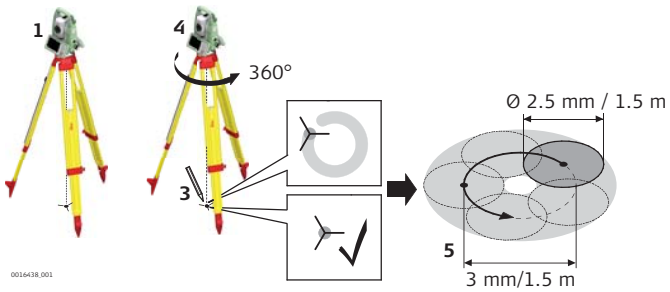
TS_080

☞ After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

5.7 Inspecting the Laser Plummet of the Instrument

☞ The laser plummet is located in the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, return the instrument to any Leica Geosystems authorised service workshop.

Inspecting the laser plummet step-by-step



The following table explains the most common settings.

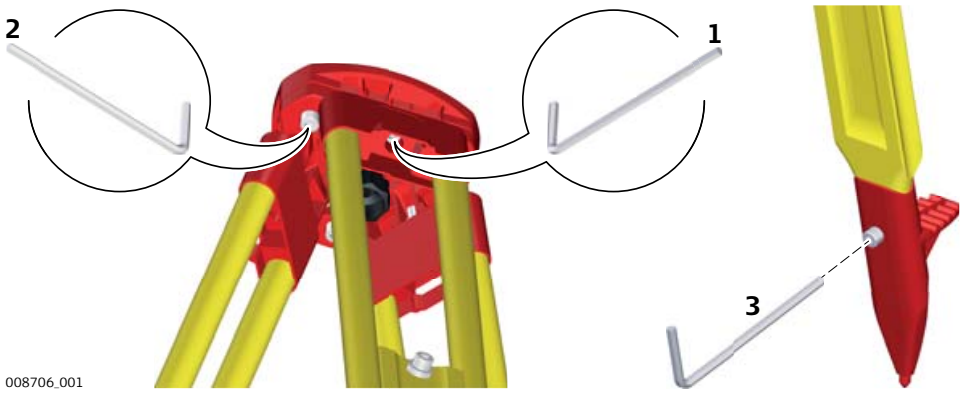
1. Set up the instrument on the tripod approximately 1.5 m above the ground and level up.
2. Select **Settings\TS instrument\Level & compensator** to access the **Level & Compensator** panel.
   The laser plummet is switched on when the **Level & Compensator** panel is entered. Adjust the laser plummet intensity.
   ☞ Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, such as a sheet of paper.
3. Mark the centre of the red laser dot on the ground.
4. Turn the instrument slowly through 360°, carefully observing the movement of the red laser dot.

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

5.	If the centre of the laser dot describes a perceptible circular movement or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems authorised service centre. Depending on brightness and surface, the diameter of the laser dot can vary. At 1.5 m, it is about 2.5 mm.

5.8 Servicing the Tripod

Servicing the tripod step-by-step



The following table explains the most common settings.

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

1.	Tighten the leg cap screws moderately, with the supplied allen key.
2.	Tighten the articulated joints on the tripod head enough to keep the tripod legs open when lifting the tripod off the ground.
3.	Tighten the allen screws of the tripod legs.

6 Care and Transport

6.1 Transport

Transport in the field

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

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

Transport in a road vehicle

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

For products for which no container is available use the original packaging or its equivalent.

Shipping

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

Shipping, transport of batteries

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

Field adjustment

Exposing the product to high mechanical forces, for example through frequent transport or rough handling, or storing the product for a long time may cause deviations and a decrease in the measurement accuracy. Periodically carry out test measurements and perform the field adjustments indicated in the User Manual before using the product.

6.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "7 Technical Data" for information about temperature limits.

Li-Ion batteries

- Refer to "7 Technical Data" for information about storage temperature range.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- A storage temperature range of 0 °C to +30 °C / +32 °F to +86 °F in a dry environment is recommended to minimize self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.

6.3 Cleaning and Drying

Product and accessories

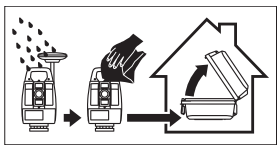
- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Fogging of prisms

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

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C /104°F and clean them. Remove the battery cover and dry the battery compartment. Do not repack until everything is completely dry. Always close the transport container when using in the field.



Cables and plugs

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

7 Technical Data

7.1 Angle Measurement

Accuracy

Available angular accuracies	Standard deviation Hz, V, ISO17123-3	Display resolution			
["]	[mgon]	["]	[°]	[mgon]	[mil]
1	0.3	0.1	0.0001	0.1	0.01
2	0.6	0.1	0.0001	0.1	0.01
3	1.0	0.1	0.0001	0.1	0.01
5	1.5	0.1	0.0001	0.1	0.01

Characteristics

Absolute, continuous, diametric. Updates each 0.1 to 0.3 s.

7.2 Distance Measurement with Reflectors

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1800	6000	3000	10000	3500	12000
3 prisms (GPR1)	2300	7500	4500	14700	5400	17700
360° prism (GRZ4, GPZ122)	800	2600	1500	5000	2000	7000
Reflector tape 60 mm x 60 mm						
Prism mode	150	500	250	800	250	800
Non-prism mode, R500	300	1000	500	1600	>500	>1600
Non-prism mode, R1000	600	1950	1000	3300	>1000	>3300
Mini prism (GMP101)	800	2600	1200	4000	2000	7000
360° Mini prism (GRZ101)	450	1500	800	2600	1000	3300
Shortest measuring distance:			1.5m			

Atmospheric conditions

Range	Description
A	Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
B	Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
C	Overcast, no haze, visibility about 40km; no heat shimmer

Accuracy

Accuracy refers to measurements to standard prisms.

Distance measuring mode	std. dev. ISO 17123-4, standard prism	std. dev. ISO 17123-4, tape	Measurement time, typical [s]
Once	1 mm + 1.5 ppm	3 mm + 2 ppm	2.4
Once & fast	2 mm + 1.5 ppm	3 mm + 2 ppm	2.0
Continuously	3 mm + 1.5 ppm	3 mm + 2 ppm	< 0.15
Repeatedly & average	1 mm + 1.5 ppm	1 mm + 1.5 ppm	-

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

The display resolution is 0.1 mm.

Characteristics

Type	Description
Principle	Phase measurement
Type	Coaxial, visible red laser
Carrier wave	658 nm
Measuring system	System Analyzer Basis 100 MHz - 150 MHz

7.3 Distance Measurement without Reflectors (Non-Prism mode)

Range

Pinpoint R500 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side 90% reflective	250	820	500	1640	>500	>1640
Grey side 18% reflective	100	330	150	490	>200	>820

Pinpoint R1000 (without reflector)

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side 90% reflective	800	2630	1000	3280	>1000	>3280
Grey side 18% reflective	400	1320	500	1640	>500	>1640
Range of measurement:	1.5 m to 1200 m					
Display unambiguous:	up to 1200 m					

Atmospheric conditions

Range	Description
D	Object in strong sunlight, severe heat shimmer
E	Object in shade, or overcast
F	Underground, night and twilight

Accuracy

Standard measuring	ISO17123-4	Measure time, typical [s]	Measure time, maximum [s]
0m - 500m	2 mm + 2 ppm	3 - 6	15
>500m	4 mm + 2 ppm	3 - 6	15

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

Tracking measuring*	Standard deviation	Measure time, typical [s]
Tracking	5 mm + 3 ppm	0.25

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

Characteristics

Type	Description
Type	Coaxial, visible red laser
Carrier wave	658 nm
Measuring system	System Analyzer Basis 100 MHz - 150 MHz

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 30	7 x 10
at 50	8 x 20
at 100	16 x 25

7.4 Distance Measurement Reflector (>4.0km)

Range

R500, R1000	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	2200	7300	7500	24600	>10000	>33000
Reflector tape 60 mm x 60 mm	600	2000	1000	3300	1300	4200
Range of measurement:	From 1000 m up to 12000 m					
Display unambiguous:	Up to 12 km					

Atmospheric conditions

Range	Description
A	Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
B	Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
C	Overcast, no haze, visibility about 40km; no heat shimmer

Accuracy

Measurement Mode	ISO17123-4	Measure time, typical [s]	Measure time, maximum [s]
P-Long (>4.0 km)	5 mm + 2 ppm	2.5	12

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

Characteristics

Type	Description
Principle	Phase measurement
Type	Coaxial, visible red laser
Carrier wave	658nm
Measuring system	System Analyzer Basis 100MHz - 150MHz

7.5 Conformity to National Regulations

7.5.1 TS10

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG declares that the radio equipment type TS10 is in compliance with Directive 2014/53/EU and other applicable European Directives.
  The full text of the EU declaration of conformity is available at the following Internet address: http://www.leica-geosystems.com/ce.

  CE Class 1 equipment according to European Directive 2014/53/EU (RED) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15 or European Directive 2014/53/EU has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
TS10, Bluetooth	2402 - 2480
TS10, WLAN	2400 - 2473, channel 1 to 11
TS10, Cellular phone (EN, CN)	Dual-Band GSM 900 / 1800 & Tri-Band UMTS 900 / 1800 / 2100 & Penta-Band LTE 800 (B20) / 900 (B8) / 1800 (B3) / 2100 B(7) / 2600 (B1)
TS10, Cellular phone (NAFTA)	Quad-Band GSM 850 / 900 / 1800 / 1900 & Tri-Band UMTS 850 / AWS 1700/2100 / 1900 & Penta-Band LTE 700 (B13) / 700 (B17) / 850 (B5) / AWS 1700/2100 (B4) / 1900 (B2)
TS10, Cellular phone (Japan)	Tri-Band UMTS 800 B6 / 800 B19 / 2100 B1 & Tri-Band LTE 800 (B19) / 1800 (B3) / 2100 (B1)

Output power

Type	Output power [mW]
Bluetooth	< 10
WLAN (802.11b)	50
WLAN (802.11gn)	32

Antenna

Type	Antenna	Gain [dBi]	Connector
Bluetooth/WLAN	Internal Patch antenna	2 max.	-
GSM/UMTS/LTE	Internal antenna	2 max.	-

7.5.2 Dangerous Goods Regulations

Dangerous Goods Regulations

Many products of Leica Geosystems are powered by Lithium batteries.

Lithium batteries can be dangerous under certain conditions and can pose a safety hazard. In certain conditions, Lithium batteries can overheat and ignite.

☞ When carrying or shipping your Leica product with Lithium batteries onboard a commercial aircraft, you must do so in accordance with the **IATA Dangerous Goods Regulations**.

☞ Leica Geosystems has developed **Guidelines** on "How to carry Leica products" and "How to ship Leica products" with Lithium batteries. Before any transportation of a Leica product, we ask you to consult these guidelines on our web page (http://www.leica-geosystems.com/dgr) to ensure that you are in accordance with the IATA Dangerous Goods Regulations and that the Leica products can be transported correctly.

☞ Damaged or defective batteries are prohibited from being carried or transported onboard any aircraft. Therefore, ensure that the condition of any battery is safe for transportation.

7.6 General Technical Data of the Product

Telescope

Type	Value
Magnification	30 x
Free Objective aperture	40 mm
Focusing	1.55 m/5.08 ft to infinity
Field of view	1°30'/1.66 gon. 2.7 m at 100 m

Compensation

Angular accuracy	Setting accuracy		Setting range	
["]	["]	[mgon]	[]	[gon]
1	0.5	0.2	±4	0.07
2	0.5	0.2	±4	0.07
3	1	0.3	±4	0.07
5	1.5	0.5	±4	0.07

Level

Type	Value
Circular level sensitivity	6′/2 mm
Electronic level resolution	2"

Control unit

Type	Description
Display	WVGA (800 x 480 pixels), colour, graphics capable LCD, illumination, touch screen
Standard keyboard	25 keys
Optional keyboard	37 keys including 12 function keys and 12 alphanumeric keys, illumination
Angle Display	360°′″, 360° decimal, 400 gon, 6400 mil, V %
Distance Display	m, ft int, ft us, ft int inch, ft us inch
Position	In both faces, face two is optional
Touch screen	Screen protection foil on glass

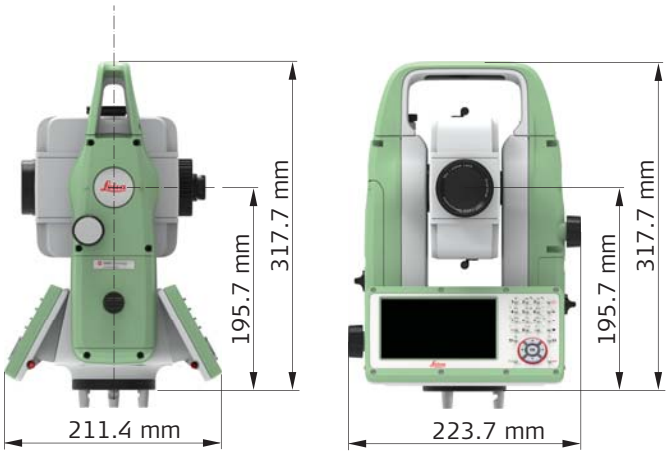
Instrument ports

Name	Description
RS232	5 pin LEMO-0 for power, communication, data transfer This port is located on the rotation part of the instrument.
SD card port	SD card port for data transfer
USB host port	USB memory stick port for data transfer
USB device port	Cable connections from USB devices for communication and data transfer
Bluetooth	Bluetooth connections for communication and data transfer
WLAN (TS10)	WLAN connection for Internet access, communication and data transfer
LTE (optional)	Internet access

Pin assignments of the 5 pin LEMO-0 port

a Pin 1: Power input
b Pin 2: not used
c Pin 3: Single ground
d Pin 4: RxD (RS232, receive data, In)
e Pin 5: TxD (RS232, transmit data, Out)

Instrument dimensions



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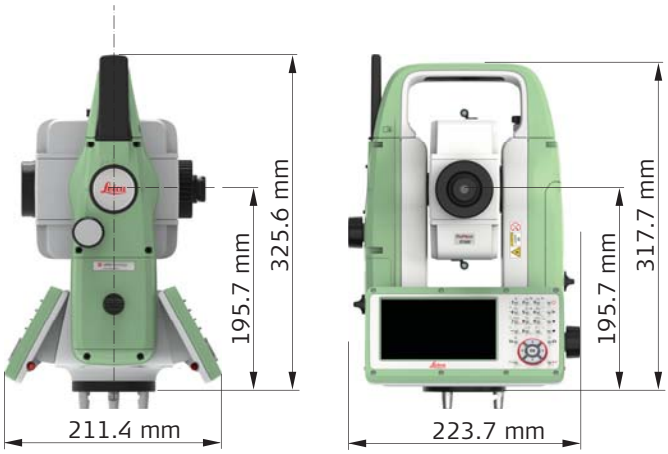

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Weight

Type	Value
Instrument	4.4 kg - 4.9 kg (depending on hardware configuration)
Tribrach	760 g
Battery GEB331	110 g
Battery GEB361	340 g

Tilting axis height

Type	Description
Without tribrach	196 mm
With tribrach (GDF111)	240 mm

Recording

Data can be recorded onto an SD card or into internal memory.

Type	Capacity [MB]	Number of measurements per MB
SD card	• 1024 • 8192	1750

Type	Capacity [MB]	Number of measurements per MB
Internal memory	• 2048	1750

AutoHeight plummet

Type	Description
Type	Visible red laser class 2
Location	In standing axis of instrument
Centering accuracy	Deviation from plumb line: 1.5 mm at 1.5 m instrument height
Diameter of laser point	2.5 mm at 1.5 m instrument height
Height accuracy[1,2]	1.0 mm
Measurement range[3]	0.7 m to 2.7 m
Measurement time, typically	< 3 s

1 Standard deviation (1 sigma) over measurement range

2 Object in shade, sky overcast, Kodak Grey Card (18% reflective), balanced tribrach foot screws

3 Instrument height from tilting axis

☞ Avoid dirt on cover glass.

☞ Avoid line-of-sight obstructions. The full spot needs to be on target.

☞ For best performance use the new Leica tripods. For older tripods, an upgrade of the screw is recommended.

Power

Type	Description
External supply voltage (via serial interface)	Nominal voltage 13.0 V DC Range 12.0 V - 15.0 V

Internal battery

Type	Battery	Voltage	Capacity	Operating time, typically*
GEB331	Li-Ion	11.1 V	2.8 Ah	≤ 9 h
GEB361	Li-Ion	11.1 V	5.6 Ah	≤ 18 h

* Based on a single measurement every 30 s at 25°C. Operating time may be shorter if battery is not new.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
All instruments	-20 to +50	-40 to +70
Battery	-20 to +50	-40 to +70
USB memory stick	-40 to +85	-50 to +95

Protection against water, dust and sand

Type	Protection
All instruments	IP66 (IEC 60529)

Humidity

Type	Protection
All instruments	Max 95% non condensing. The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

Arctic model

Operating temperature [°C]	Storage temperature [°C]
-35 to +50	-40 to +70

Reflectors

Type	Additive Constant [mm]
Standard prism, GPR1	0.0
Mini prism, GMP101	+17.5
360° prism, GRZ4 / GPZ122	+23.1
360° Mini prism, GRZ101	+30.0
Reflector tape S, M, L	+34.4
Reflectorless	+34.4
Machine Automation power prism, MPR122	+28.1

Electronic Guide Light EGL

Type	Description
Working range	5 m to 150 m (15 ft to 500 ft)
Position accuracy	5 cm at 100 m (1.97" at 330 ft)

Automatic corrections

The following automatic corrections are made:

- Line of sight error
- Tilting axis error
- Earth curvature
- Standing axis tilt
- Vertical index error
- Refraction
- Compensator index error
- Circle eccentricity

7.7 Scale Correction

Use of scale correction

By entering a scale correction, reductions proportional to distance can be taken into account.

- Atmospheric correction.
- Reduction to mean sea level.
- Projection distortion.

Atmospheric correction ΔD1

The slope distance displayed is correct 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
- Relative humidity

For highest precision distance measurements, the atmospheric correction should be determined with an accuracy of 1 ppm. The following parameters must be redetermined:

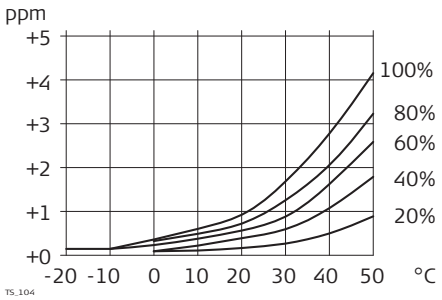
- Air temperature to 1 °C
- Air pressure to 3 mbar
- Relative humidity to 20 %

Air humidity

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

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

Air humidity correction



pp Air humidity correction
m [mm/km]
% Relative humidity [%]
C° Air temperature [°C]

Index n

Type	Index n	Carrier wave [nm]
Combined EDM	1.0002863	658

The index n is calculated from the formula of the IAG Resolutions (1999), and is valid for:

Air pressure p:	1013.25 mbar
Air temperature t:	12 °C
Relative air humidity h:	60 %

Formulas

Formula for visible red laser

$$\Delta D_1 = 286.338 - \left[\frac{0.29535 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^{x} \right]$$

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ΔD_1	Atmospheric correction [ppm]
p	Air pressure [mbar]
t	Air temperature [°C]
h	Relative humidity [%]
α	$\frac{1}{273.15}$
x	(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 is 2 ppm, 2 mm/km.

Reduction to mean sea level ΔD_2

The values for ΔD_2 are always negative and are derived from the following formula:

$$\Delta D_2 = -\frac{H}{R} \cdot 10^6$$

TS_106

ΔD_2	Reduction to mean sea level [ppm]
H	Height of EDM above sea level [m]
R	6.378 * 10^6 m

Projection distortion ΔD_3

The magnitude of the projection distortion is in accordance with the projection system used in a particular country, for which official tables are generally available. The following formula is valid for cylindrical projections such as that of Gauss-Krüger:

$$\Delta D_3 = \frac{X^2}{2R^2} \cdot 10^6$$

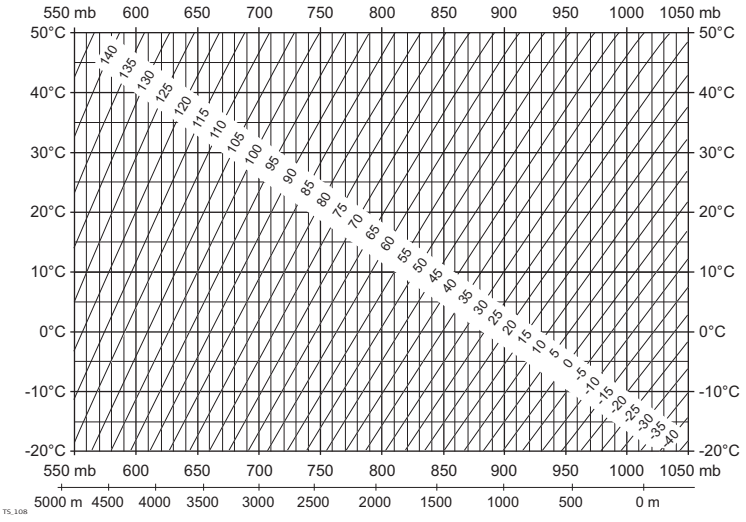
TS_107

ΔD_3	Projection distortion [ppm]
X	Easting, distance from projection zero line with the scale factor 1 [km]
R	6.378 * 10^6 m

In countries where the scale factor is not unity, this formula cannot be directly applied.

Atmospheric corrections °C

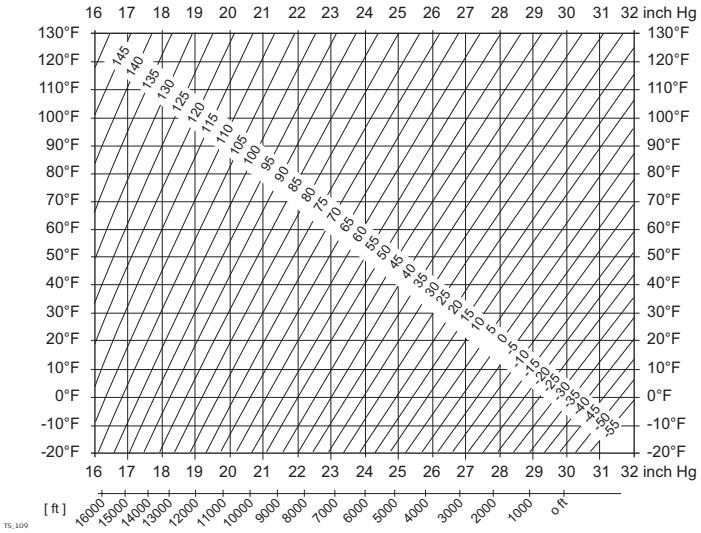
Atmospheric corrections in ppm with temperature [°C], air pressure [mb] and height [m] at 60% relative humidity.



TS_108

Atmospheric corrections °F

Atmospheric corrections in ppm with temperature [°F], air pressure [inch Hg] and height [ft] at 60% relative humidity.



7.8 Reduction Formulas

Reflector types

The reduction formulas are valid for measurements to all reflector types:

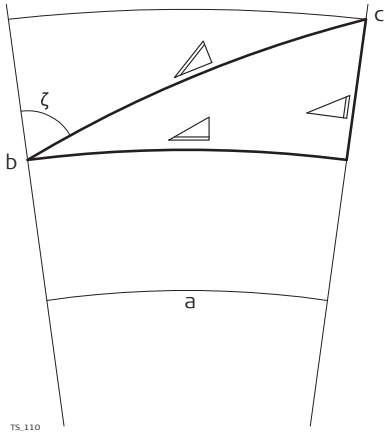
- To prisms
- To reflector tape
- Reflectorless measurements

Slope distance - corrections

Available formats depend on the instrument.

Format	Description
• Instrument display • DBX • ASCII • GSI	• Corrections for the atmospheric ppm are applied to the slope distances according to the formulas.
• XML export	• Output without corrections for the atmospheric ppm • ppm is stored as metadata • Corrections are applied during later input, for example to Leica Infinity

Formulas



a Mean Sea Level
b Instrument
c Reflector
◿ Slope distance
◿ Horizontal distance
◿ Height difference

The instrument calculates the slope distance, horizontal distance, height difference in accordance with the following formulas:

$$\text{◿} = D_0 \cdot (1 + ppm \cdot 10^{-6}) + AC$$
002425_002

◿ Displayed slope distance [m]
D_0 Uncorrected distance [m]
ppm Atmospheric scale correction [mm/km]
AC Additive constant of the reflector [m]

$$\text{◿} = Y - A \cdot X \cdot Y$$
TS_112

$$\text{◿} = X + B \cdot Y^2$$
TS_113

◿ Horizontal distance [m]
◿ Height difference [m]
Y ◿ * |sinζ|
X ◿ * cosζ
ζ Vertical circle reading
A $(1 - k / 2) / R = 1.47 * 10^{-7}$ [m^{-1}]
B $(1 - k) / (2 * R) = 6.83 * 10^{-8}$ [m^{-1}]
k 0.13 (mean refraction coefficient)
R $6.378 * 10^6$ m (radius of the earth)

Earth curvature (1/R) and mean refraction coefficient (k) are automatically taken into account when calculating the horizontal distance and height difference. The calculated horizontal distance relates to the station height and not to the reflector height.

Distance measuring program Averaging

In the distance measuring program Averaging, the following values are displayed:

D Slope distance as arithmetic mean of all measurements
s Standard deviation of a single measurement
n Number of measurements

These values are calculated as follows:

$$\bar{D} = \frac{1}{n} \cdot \sum_{i=1}^{n} D_i$$

TS_114

$\bar{D}$	Slope distance as arithmetic mean of all measurements
$\sum$	Sum
D_i	Single slope distance measurement
n	Number of measurements

$$s = \sqrt{\frac{\sum_{i=1}^{n} (D_i - \bar{D})^2}{n - 1}} = \sqrt{\frac{\sum_{i=1}^{n} D_i^2 - \frac{1}{n} \left(\sum_{i=1}^{n} D_i \right)^2}{n - 1}}$$

TS_115

s	Standard deviation of a single slope distance measurement
$\sum$	Sum
$\bar{D}$	Slope distance as arithmetic mean of all measurements
D_i	Single slope distance measurement
n	Number of distance measurements

The standard deviation $s_{\bar{D}}$ of the arithmetic mean of the distance can be calculated as follows:

$$s_{\bar{D}} = \frac{s}{\sqrt{n}}$$

TS_116

$s_{\bar{D}}$	Standard deviation of the arithmetic mean of the distance
s	Standard deviation of a single measurement
n	Number of measurements

8 Software Licence Agreement

Software Licence Agreement

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