

# Leica iCON Construction Layout Tool iCT30



User Manual  
Version 2.0  
English

- when it has to be **right**

**Leica**  
Geosystems

# Introduction

## Purchase

Congratulations on the purchase of the Leica iCON Construction Layout Tool iCT30.



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.



The content of this document is subject to change without prior notice. Ensure that the product is used in accordance with the latest version of this document.

Updated versions are available for download at the following Internet address:

**<https://myworld.leica-geosystems.com> > myDownloads.**

## 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 centre.

## Trademarks

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

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## Validity of this manual

This manual applies to the Leica iCON iCT30.

## Available documentation

Name	Description/Format		
iCT30 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
iCT30 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.	-	✓
iCON build How-To Guide	Overall comprehensive guide to the product and application functions. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists.	-	✓

### Refer to the following resources for all iCT30 documentation/software:

- the supplied data storage device
- <https://myworld.leica-geosystems.com>



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](http://leica-geosystems.com/contact-us/sales_support).

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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.

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# 1 Safety Directions

## 1.1 General Introduction

### 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
 <b>DANGER</b>	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.
<b>NOTICE</b>	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
- Automatic target search, recognition and tracking
- Visualising the aiming direction and vertical axis
- Remote control of product

**In combination with a field controller:**

- Recording measurements
- Computing with software

**Reasonably foreseeable 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 damage or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Inadequate safeguards at the working site.
- Aiming directly into the sun.

**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.

**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.

**NOTICE****Remote control of product**

With the remote control of products, it is possible that extraneous targets will be picked out and measured.

**Precautions:**

- ▶ When measuring in remote control mode, always check your results for plausibility.

**⚠ 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.

#### **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 (PRF)	100 MHz
Maximum average radiant power	0.33 mW
Beam divergance	1.5 mrad × 3 mrad



16531.001

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 (R80)
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 × 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



### 1.6.4

## 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 (R80)
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 × 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

#### Automatic Target Aiming (ATR)

##### General

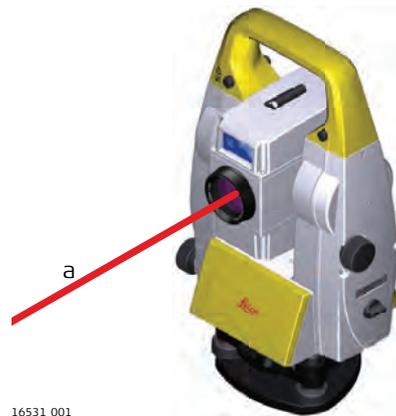
The Automatic Target Aiming built into the product produces an invisible laser beam which emerges from the telescope objective.

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	785 nm
Maximum radiant peak power per pulse	10 mW
Pulse duration	≤ 15 ms
Pulse repetition frequency (PRF)	≤ 213 Hz
Beam divergence	25 mrad



16531\_001

a Laser beam

### 1.6.6

#### AutoSearch

##### General

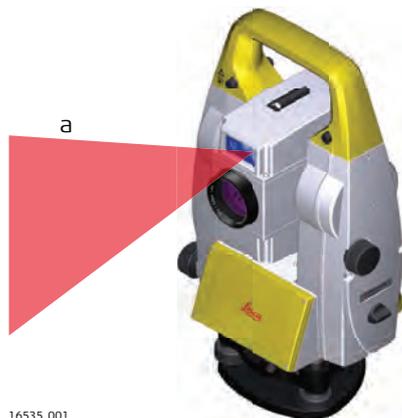
The AutoSearch built into the product produces an invisible laser beam which emerges from the front side of the telescope.

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	850 nm
Maximum average radiant power	11 mW
Pulse duration	20 ns, 40 ns
Pulse repetition frequency (PRF)	24.4 kHz
Beam divergence	0.4 mrad × 700 mrad



16535\_001

a Laser beam

### 1.6.7

### Electronic Guide Light (EGL)

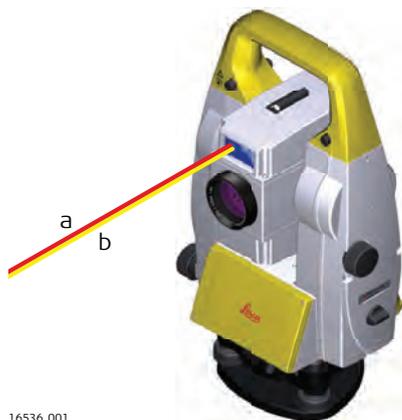
#### General

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.



16536\_001

a LED beam red  
b LED beam yellow

## 1.6.8

## 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- cw (continuous wave)	10 ms
Pulse repetition frequency (PRF)	1 kHz
Beam divergence	<1.5 mrad

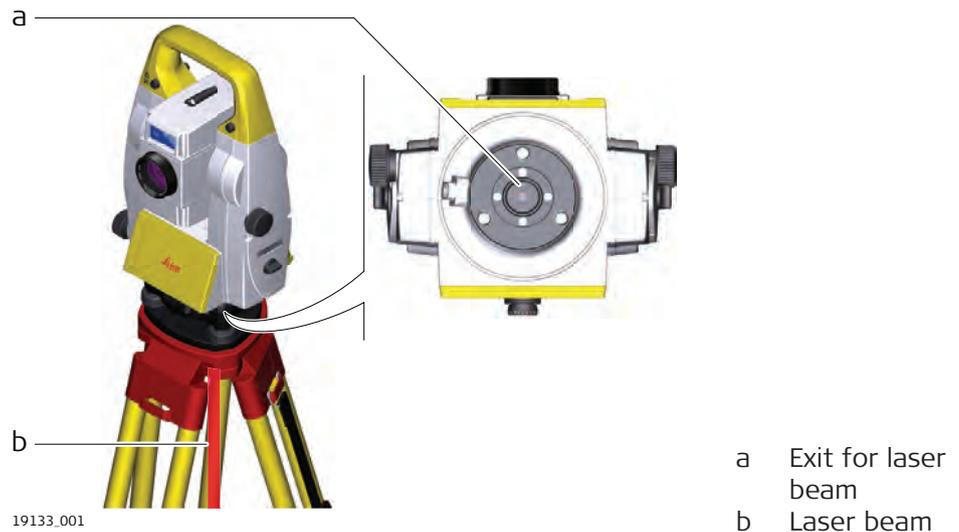
### CAUTION

#### 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.



## 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 radi-

ation 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.
-

**⚠ 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 aircrafts. Electromagnetic fields 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 aircrafts.
- ▶ Do not operate the product with radio or digital cellular phone devices for long periods with the product immediately next to your body.

**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.

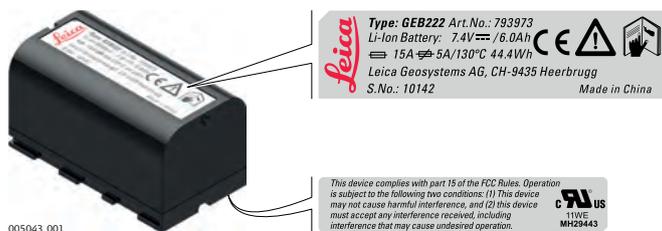
**⚠ CAUTION**

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

## Labelling iCT30



## Labelling internal battery GEB222



## Labelling Communication-Handle

### CCD6



## 2

## Description of the System

### 2.1

### System Components

#### Main Components



Component	Description
iCT30 instrument	<ul style="list-style-type: none"><li>a layout tool for measuring, calculating and capturing data.</li><li>combined with the multi-purpose construction field controller to conduct remote control surveys.</li></ul>
CC80 field controller	A multipurpose field controller allowing the remote control of the iCT30 via Bluetooth.

#### Terms and abbreviations

The following terms and abbreviations can be found in this manual:

Term	Description
EDM	<b>E</b> lectronic <b>D</b> istance <b>M</b> easurement EDM refers to the laser distancer incorporated into the instrument which enables distance measurement. Two measuring modes are available: <ul style="list-style-type: none"><li>Prism mode. This mode refers to the ability to measure distances to prisms.</li><li>Reflectorless mode. This mode refers to the ability to measure distances without prisms.</li></ul>
PinPoint	PinPoint R80 refers to the Reflectorless EDM technology which enables an increased measuring range with a smaller laser spot size.
ATR	Automatic Target Aiming. ATR refers to the instrument sensor which enables the automatic target aiming and locking.
AutoSearch	AutoSearch refers to the instrument sensor which enables the automatic rapid finding of a prism.
Communication-Handle CCD6	The CCD6 CommunicationHandle is an instrument carry handle with an integrated radio modem with attached antenna.
Communication side cover	Communication side cover with integrated Bluetooth, SD card slot and USB port is standard for a iCT30 instrument.
Setup Pilot	A method to carry out the setup of the iCT30 to a number of existing control points in a fully automated way.

Term	Description
Target Snap	A prism search method. Snaps to the desired prism by ignoring other prisms, which are known from the database.

## Features of iCT30

- Angle measurement
- Distance measurement to prism
- Distance measurement to any surface (reflectorless)
- Motorised
- Automatic Target Aiming
- AutoSearch
- RS232, USB and SD card interface
- Bluetooth
- Hotshoe interface for CommunicationHandle
- Guide Light (EGL)

## 2.2

### System Concept

### 2.2.1

#### Software Concept

#### Description

All instruments use the same software concept.

#### Software

Software type	Description
System software	This software comprises the central functions of the instrument. It is also referred to as firmware.
iCON Field software	It is recommended to control the instrument with Leica Geosystems field software. Refer to the respective software manual for more information.

#### Software update

-  The iCON software is stored in the flash RAM of the iCON iCT30.
  -  For the update process, a CC80 field controller is needed. Updating software can take some time. Ensure that the battery is at least 75% full before beginning the update, and do not remove the battery during the update process. Ensure that an instrument profile for the iCT30 is available on the field controller. Refer to the iCON software manual for information about how to create an instrument profile.
1. Download the most recent iCT30 firmware file from <https://myworld.leica-geosystems.com>.
  2. Insert an SD card or USB stick into the computer. Copy the iCT30 firmware file into the \SYSTEM directory on the storage device. If no \SYSTEM directory is available, then create the directory first.
  3. Take the storage device out of the computer and insert it into the iCT30. Refer to "Working with the Memory Device".
  4. Start the iCT30 and the iCON software on the CC80 field controller.
  5. In the iCON software on the field controller:
    - Select **Devices** from the Home Menu.
    - Select the matching instrument profile to connect to the iCT30.



6. Tap the arrow button to the right of the iCT30 profile.  
Select **Sensor Utilities > Upload Firmware**.  
*If several firmware files are available on the storage device, the software automatically selects and displays the most recent firmware file.*
- 
7. Tap **Start Update** to start the firmware update.
- 
-  *A pop up informs you when the update is complete.*

## Licence activation

-  For licence activation, a field controller is needed. Ensure that an instrument profile for the iCT30 is available on the field controller. Refer to the iCON software manual for information about how to create an instrument profile.
- 
-  Licences are key codes to enable software functions and applications which run on the device.  
You can order new licences on myWorld or by contacting your local service partner.
- 
1. Store the licence key file (\*.key) in the \SYSTEM directory of a USB Stick.
- 
2. Insert the USB Stick into the iCT30. Refer to "Insert and remove a USB stick step-by-step".
- 
3. In the iCON software on the field controller:  
Select **Devices** from the Home Menu.  
Select the matching instrument profile to connect to the iCT30.
- 
4. Select **Sensor Utilities > Upload Licence key**.
- 
5. Upload the licence key file.
    - Select the licence key file.
    - Click **Start Upload** to start the activation process.*A pop up informs you about the licence activation status.*  
Confirm the message.
- 
-  If the software maintenance licence has expired:  
Contact your local service partner to update the software on the product.
- 
-  If the licence activation fails:  
Contact your local service partner or create a support request on myWorld.

### 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

- Internally by GEB222 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 storage is only possible on the connected controller. On a CC80, the available data storage devices are an SD card, a USB stick and an internal memory.

### 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.
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 iCT instrument is switched off.

### Transfer data

Data can be transferred in various ways.



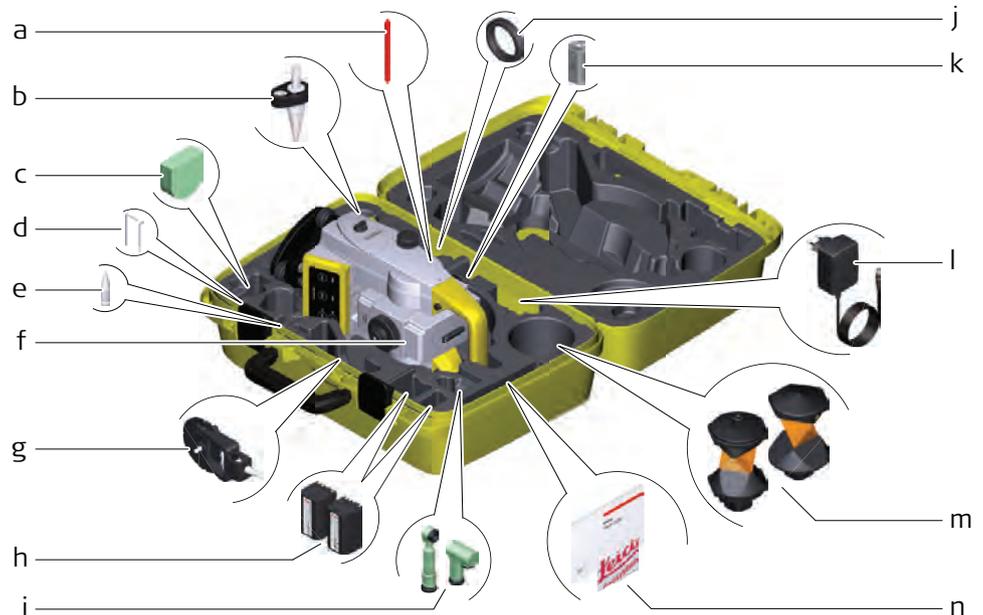
SD cards can directly be used in an OMNI drive as supplied by Leica Geosystems. Other PC card drives can require an adaptor.

## 2.3

## Container Contents

### Container contents for instrument and accessories

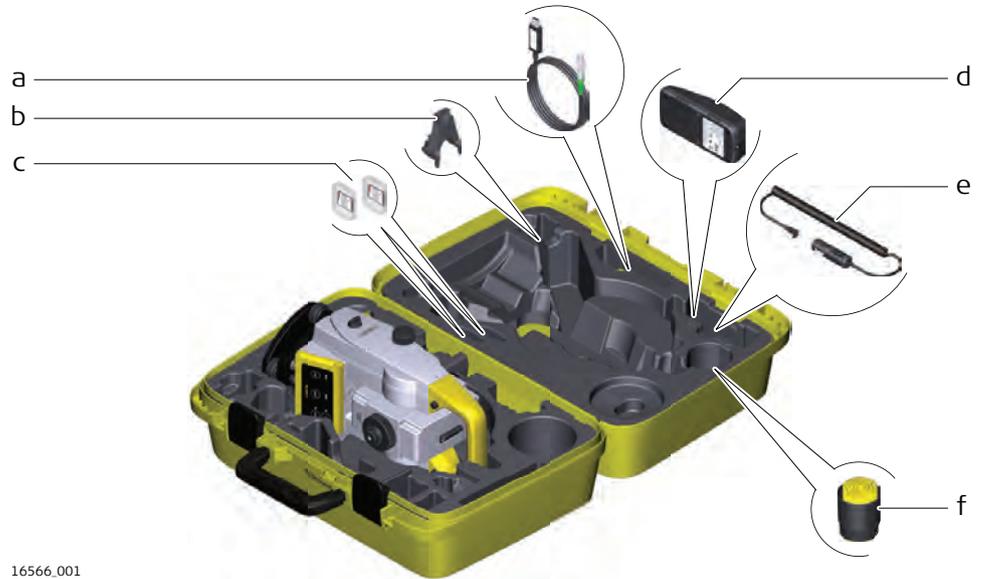
#### Bottom part



16523\_001

- a Stylus
- b GLS14 mini pole
- c GHM007 Instrument height meter
- d Allen key and adjustment tool
- e Tip for GMP101 mini prism
- f Instrument with tribrach and standard handle or Communication-Handle
- g GMP101 mini prism
- h GEB222 batteries
- i GFZ3 or GOK6 diagonal eyepiece
- j Counterweight for diagonal eyepiece
- k MS1, 1 GB USB memory stick
- l GEV192 AC power supply for battery charger
- m GRZ4 or GRZ122 prism
- n Manuals and USB documentation card

## Top part



16566.001

- a Cables
- b GHT196 tribrach bracket for height meter
- c SD cards and covers
- d GKL311 battery charger
- e Car adapter power plug for battery charger (stored under battery charger)
- f Protective cover for instrument, sunshade for objective lens and cleaning cloth

## 2.4

### Instrument Components

#### iCT30 Instrument Components Part 1 of 2



18378.001

- a Carry handle
- b Optical sight
- c Telescope, integrating EDM, ATR, EGL and AutoSearch
- d EGL flashing diode - yellow and red
- e AutoSearch, transmitter
- f AutoSearch, receiver
- g Coaxial optics for angle and distance measurement, and exit port of visible laser beam for distance measurements
- h Compartment for SD Card and USB stick
- i Loudspeaker
- j Horizontal drive
- k Tribrach footscrew

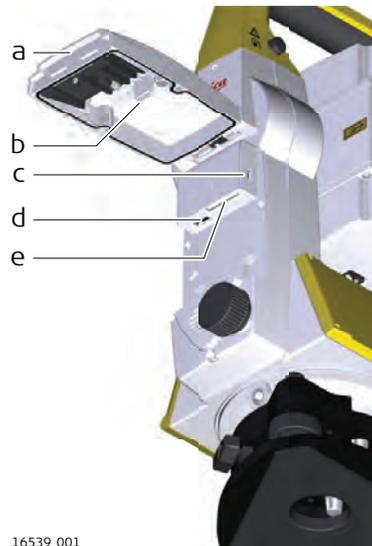
**iCT30 Instrument  
Components Part 2 of  
2**



- a Vertical drive
- b Focusing ring
- c Interchangeable eyepiece
- d Circular level
- e Battery compartment
- f Keyboard

16065\_001

**Communication Side  
Cover**



- a Compartment lid
- b USB stick cap storage
- c USB device port (mini AB OTG)
- d USB host port for USB stick
- e SD card port

16539\_001

**Instrument compon-  
ents for remote mode**



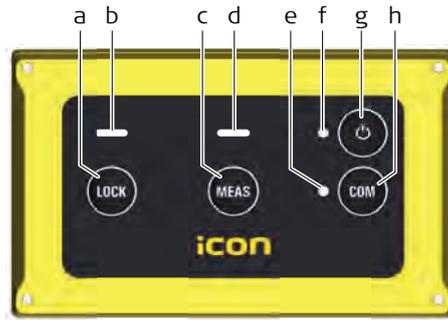
- a CommunicationHandle
- b Communication side cover

16088\_001

# 3 User Interface

## 3.1 Keyboard

### iCT30 Keyboard



16069.001

- a LOCK key
- b LED for locking status
- c MEAS key
- d LED for measurement status
- e LED for communication status
- f LED for power status
- g ON/OFF key
- h COM key

### iCT30 key functions and LED behaviour



The following description of key functions and LED behaviours applies to the iCT30 being connected to a field controller.

#### Key functions

LOCK	<ul style="list-style-type: none"> <li>• Press to start prism search and lock onto prism.</li> <li>• If already locked: Press to unlock from prism.</li> </ul>
MEAS	<p>Depending on the currently active settings: Press to start a measurement or to store a measurement.</p>
ON/OFF	<ul style="list-style-type: none"> <li>• Press for 2 s to turn on the instrument.</li> <li>• Press and hold for more than 2 s to shut down the instrument.</li> <li>• Press and hold for more than 5 s to reset the sensor.</li> <li>• Press and hold for more than 8 s to do a hard shutdown.</li> </ul>
COM	<ul style="list-style-type: none"> <li>• To toggle through the communication modes, press the key repeatedly. Communication modes: <ul style="list-style-type: none"> <li>- RS232</li> <li>- Bluetooth</li> <li>- Long-range Bluetooth</li> </ul> </li> <li>• If a connection is already established, press and hold for 2 s to disconnect.</li> </ul>

#### LED behaviours

LOCK	<ul style="list-style-type: none"> <li>• Off: Prism not locked.</li> <li>• Solid green: Prism found and locked.</li> </ul>
MEAS	<ul style="list-style-type: none"> <li>• Off: No active measurement.</li> <li>• Solid green: Measurement is executed.</li> </ul>
ON/OFF	<ul style="list-style-type: none"> <li>• Off: No active measurement.</li> <li>• Solid red after switching on: Instrument is booting.</li> <li>• Solid green/yellow/red: Indicator for the battery status. <ul style="list-style-type: none"> <li>- Green: more than 40% of battery charge remaining.</li> <li>- Yellow: more than 20% of battery charge remaining.</li> <li>- Red: remaining battery charge is very low.</li> </ul> </li> <li>• Flashing green: Instrument is shutting down.</li> </ul>

**iCT30 key functions and LED behaviour in standalone mode**

**LED behaviours**

- |     |   |
|-----|---|
| COM | <ul style="list-style-type: none"> <li>• Off: RS232 Serial port selected.</li> <li>• Solid green: Internal Bluetooth selected.</li> <li>• Solid red: Long-range Bluetooth using Communication-Handle is selected.</li> <li>• Solid blue: Bluetooth communication established using Internal Bluetooth or long-range Bluetooth.</li> </ul> |
|-----|---|



The following description of key functions and LED behaviours applies to the iCT30 being used without a field controller.

**Key functions**

- |        |   |
|--------|---|
| LOCK   | <ul style="list-style-type: none"> <li>• Press to start prism search and lock onto prism.</li> <li>• If already locked: Press to unlock from prism.</li> </ul>  |
| MEAS   | No functionality in standalone mode.  |
| ON/OFF | <ul style="list-style-type: none"> <li>• Press for 2 s to turn on the instrument.</li> <li>• Press and hold for more than 2 s to shut down the instrument.</li> <li>• Press and hold for more than 5 s to reset the sensor.</li> <li>• Press and hold for more than 8 s to do a hard shutdown.</li> </ul> |
| COM    | <ul style="list-style-type: none"> <li>• To toggle through the communication modes, press the key repeatedly.</li> </ul> <p>Communication modes:</p> <ul style="list-style-type: none"> <li>- RS232</li> <li>- Bluetooth</li> <li>- Long-range Bluetooth</li> </ul>                                       |

**LED behaviours**

- |        |   |
|--------|---|
| LOCK   | <ul style="list-style-type: none"> <li>• Off: Prism not locked.</li> <li>• Solid green: Prism found and locked.</li> </ul>  |
| MEAS   | <ul style="list-style-type: none"> <li>• Off: No active measurement.</li> <li>• Solid green: Measurement is executed.</li> </ul>  |
| ON/OFF | <ul style="list-style-type: none"> <li>• Off: No active measurement.</li> <li>• Solid red after switching on: Instrument is booting.</li> <li>• Solid green/yellow/red: Indicator for the battery status. <ul style="list-style-type: none"> <li>- Green: more than 40% of battery charge remaining.</li> <li>- Yellow: more than 20% of battery charge remaining.</li> <li>- Red: remaining battery charge is very low.</li> </ul> </li> <li>• Flashing green: Instrument is shutting down.</li> </ul> |
| COM    | <ul style="list-style-type: none"> <li>• Off: RS232 Serial port selected.</li> <li>• Solid green: Internal Bluetooth selected.</li> <li>• Solid red: Long-range Bluetooth using Communication-Handle is selected.</li> </ul>  |

## 3.2

## CommunicationHandle

### LED indicators on Communication-Handle

#### Description

The CommunicationHandle has Light Emitting Diode (LED) indicators. They indicate the basic CommunicationHandle status.

#### Diagram of the LED Indicators



- a Power LED
- b Link LED
- c Data Transfer LED
- d Mode LED

#### Description of the LED Indicators

LED	LED Status	Description
Power LED	off	Power is off.
	green	Power is on.
Link LED	off	No radio link to field controller.
	red	Radio link to field controller.
Data Transfer LED	off	No data transfer to/from field controller.
	green or green flashing	Data transfer to/from field controller.
Mode LED	off	Data mode.
	red	Configuration mode.

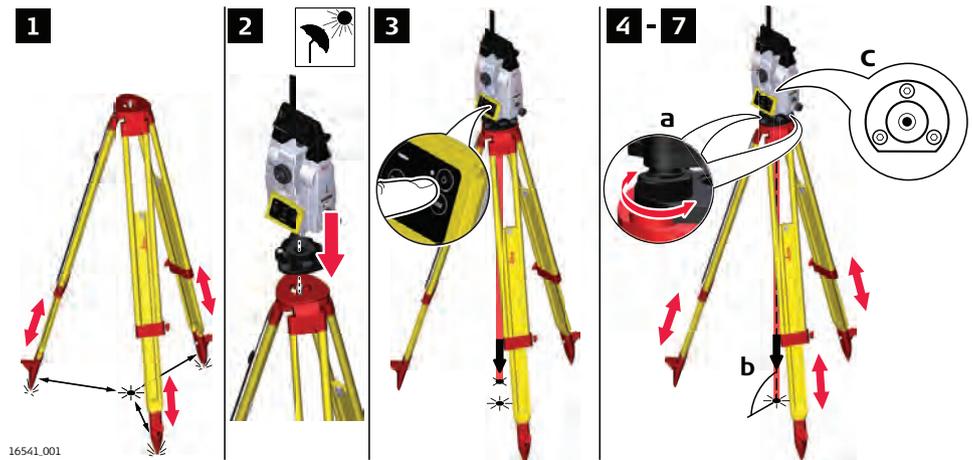
## 4

## Operation

### 4.1

### Instrument Setup

#### Instrument setup step-by-step



A field controller is necessary for this procedure.

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.



Shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.

3. Turn on the instrument.

Connect the instrument to the field controller.

To activate the laser plummet, display the Compensator screen on the field controller:

- Select **Devices** from the Home Menu.
- Tap the arrow button to the right of the device name.
- Tap **Compensator**.

4. Use the tribrach footscrews (a) to centre the plummet above the ground point (b).

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.

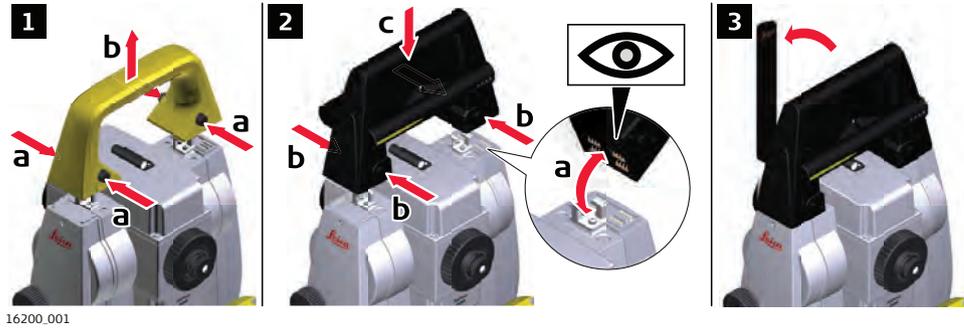
7. Centre the instrument precisely over the ground point (b) by shifting the tribrach on the tripod plate.

8. Repeat steps 6. and 7. until the required accuracy is achieved.

## 4.2

## Remote Control Setup

### Attaching the CommunicationHandle step-by-step



Refer to "4.1 Instrument Setup" for the initial instrument setup onto a tripod.

1. To remove the instrument carry handle: Press and hold the four unlock push buttons and lift off the handle.
2. To install the CommunicationHandle, first make sure that the interface connection on the lower part of the handle is on the same side as the Communication side cover. Then press and hold the four unlock push buttons and attach the handle.



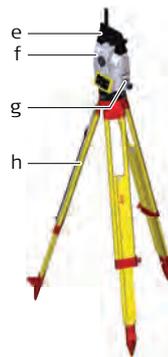
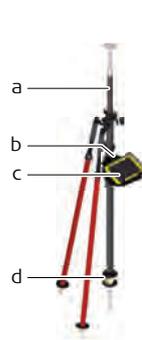
Ensure that there is a tight fit with the instrument after releasing the push buttons. If no connection can be found, re-check that handle is seated firmly.

3. Swing the antenna of the CommunicationHandle into an upright position.



Refer to field software manual for additional information.

### Setup for Remote Control with CommunicationHandle

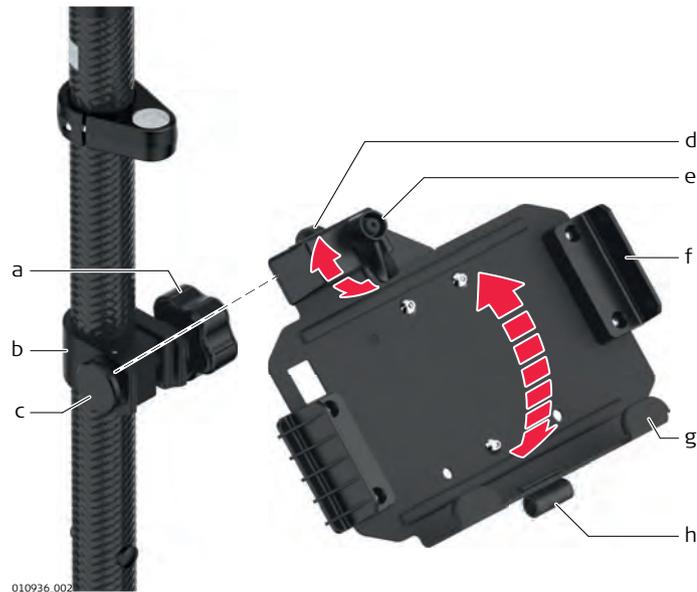


- a Prism pole
- b GHT63 clamp
- c CC80 field controller on CMB10 holder
- d 360° prism
- e CCD6/RH16/RH17 CommunicationHandle
- f Instrument
- g Communication side cover
- h Tripod

## 4.3

## Holder and Clamp for Field Controller

### Holder for iCON CC80



010936.002

#### Holder

- d Mounting arm
- e Locking lever
- f Mounting brackets (side)
- g Mounting brackets (bottom)
- h Holder for stylus

#### Clamp

- a Tightening screw
- b Pole clamp
- c Clamping bolt

### Fixing the CC80 tablet to a pole step-by-step



For an aluminium pole, fit the plastic sleeve to the pole clamp.

1. Insert the pole into the clamp hole.
2. Attach the holder to the clamp using the clamp bolt.
3. Adjust the angle and the height of the holder on the pole to a comfortable position.
4. Tighten the clamp with the clamp bolt.
5. Before placing the CC80 tablet onto the mounting plate, ensure that the locking lever is set to the unlocked position (see illustration).



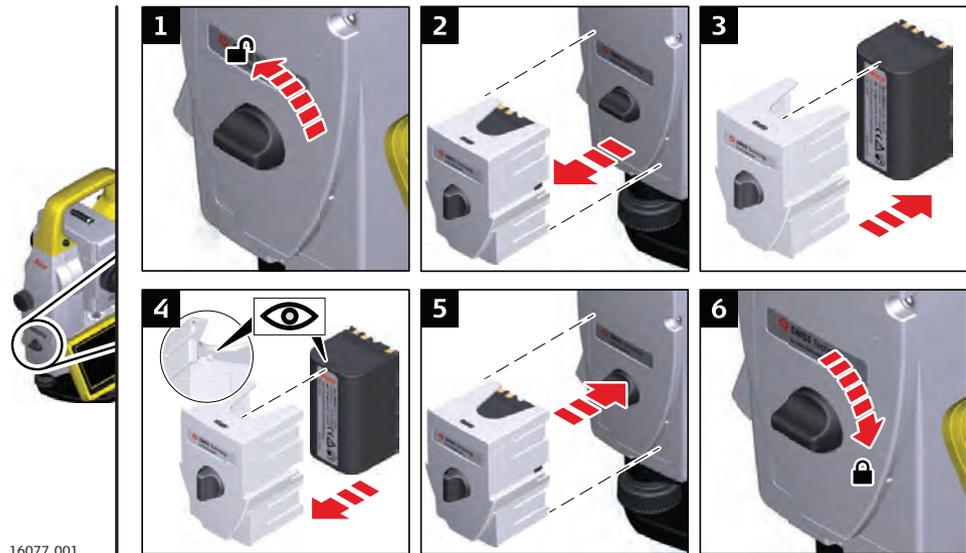
16447.001

6. Lower the bottom side of the tablet and slide it into the bottom mounting brackets of the holder.



16448.001

- After placing the tablet onto the mounting plate, set the locking lever to the locked position (see illustration).



- 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.
- Pull out the battery housing.
- Pull the battery out of the battery housing.
-  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.
- Place the battery housing into the battery compartment. Push the battery housing in until it fits completely into the battery compartment.
- Turn the knob to lock the battery compartment. Ensure that the knob is returned to its original horizontal position.

## Detaching the tablet from the holder/pole step-by-step

1. Set the locking lever of the holder to the unlocked position.



2. Lift the top side of the tablet and slide the tablet to the top and out of the holder.



## 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.

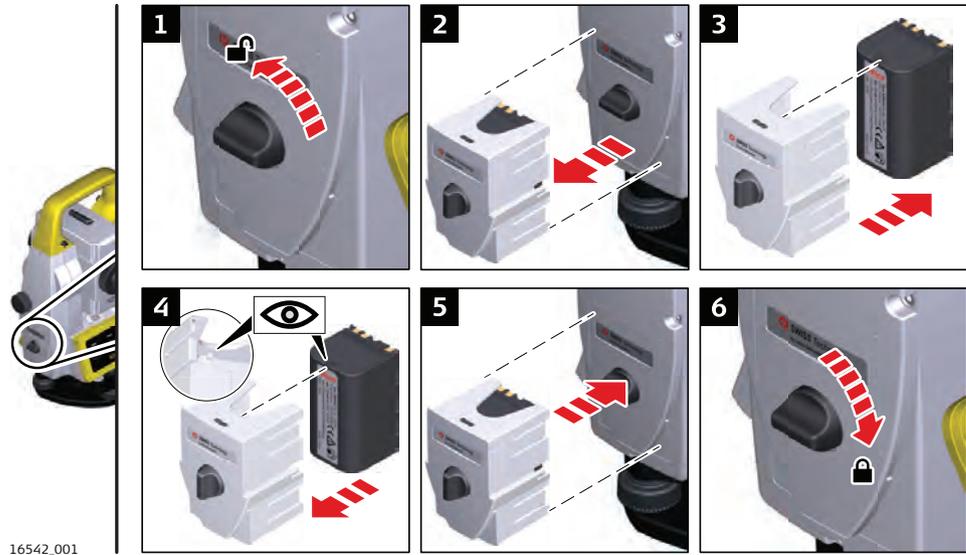
#### Operation/discharging

- 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 iCT Instrument

### Change battery step-by-step



16542.001

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

## Power Functions

### Power functions

Option	Key	Description
Turn on	ON/OFF	Press and hold for 2 s.  The instrument must have a power supply.
Turn off	ON/OFF	Press and hold for 2 s.  For instruments set up in permanent installations with external power sources, for example monitoring, ensure external power remains available until the instrument has successfully completed the power down process.

Option	Key	Description
Reset	ON/OFF	Press and hold for more than 5 s. Parts of the internal memory are reset.
Hard shutdown	ON/OFF	Press and hold for more than 8 s.

## 4.6

### Working with the Memory Device

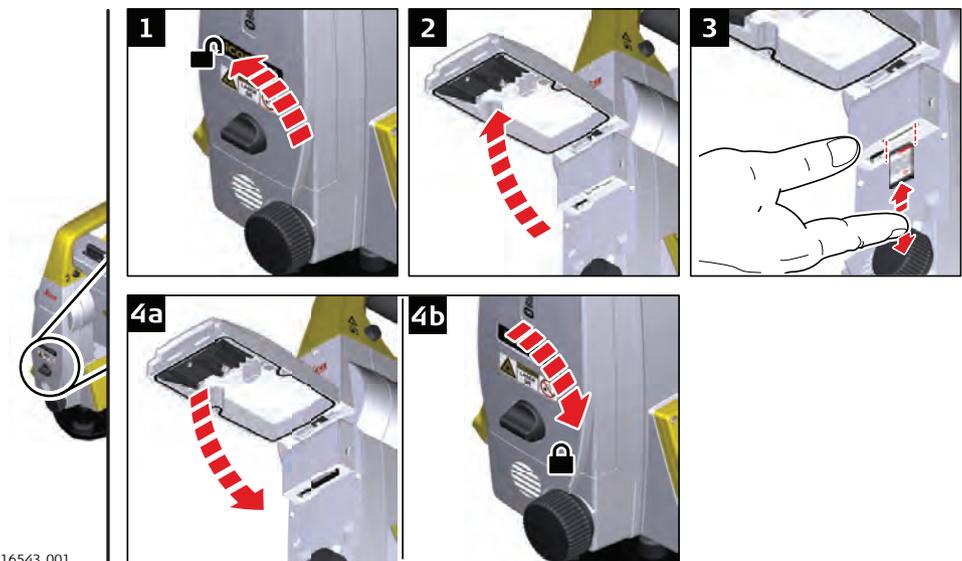


- Keep the card dry.
- Use it only within the specified temperature range.
- Do not bend the card.
- Protect the card from direct impacts.



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

#### Insert and remove an SD card step-by-step



16543\_001



The SD card is inserted into a slot 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.
  - To insert the SD card, slide it firmly into the SD slot until it clicks into position.
  - To remove the SD card, gently press on the top of the card to release it from the slot.



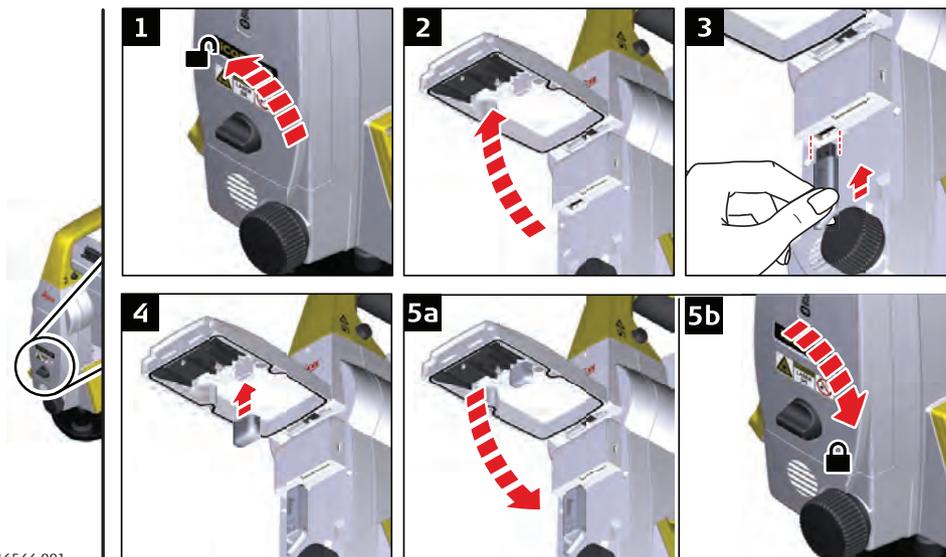
The card must be held with the contacts at the top and facing toward the instrument.



Do not force the card into the slot.

4. Close the lid and turn the knob to the horizontal position to lock the communication compartment.

## Insert and remove a USB stick step-by-step



16544\_001

 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.  
To remove the USB stick, slide the USB stick out of 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.

## 4.7

### Connecting to a Personal Computer

#### Description

Windows Mobile Device Center for PC with Windows 7/Windows 8/Windows 10 operating system is the synchronization software for Windows mobile-based pocket PC. WMDC 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:

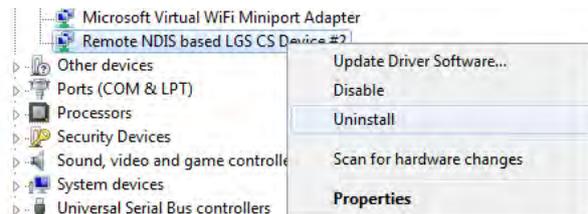
Name	Description
GEV223	USB data cable, 1.8 m, connects instrument to Mini-USB to USB
GEV234	USB data cable, 1.65 m, connects CC to iCG or CC to PC (USB)
GEV261	Y-cable, 1.8 m, connects instrument to PC – battery

## 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

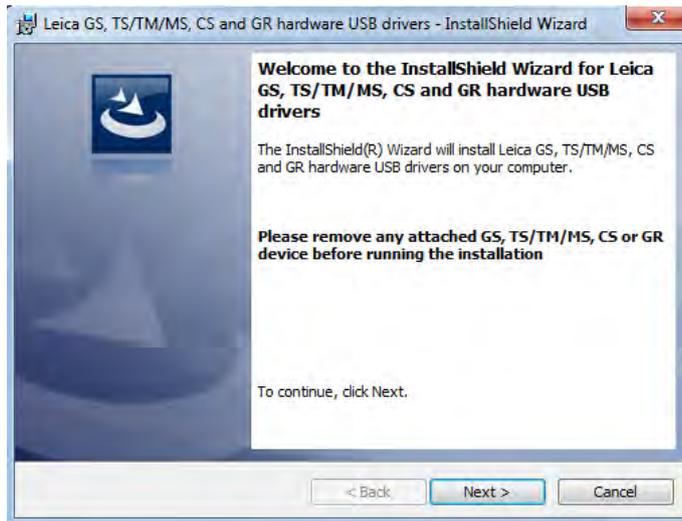
☞ To check the version of your operating system, go to **Control Panel > System > System type**.

☞ The setup requires administrative privileges.

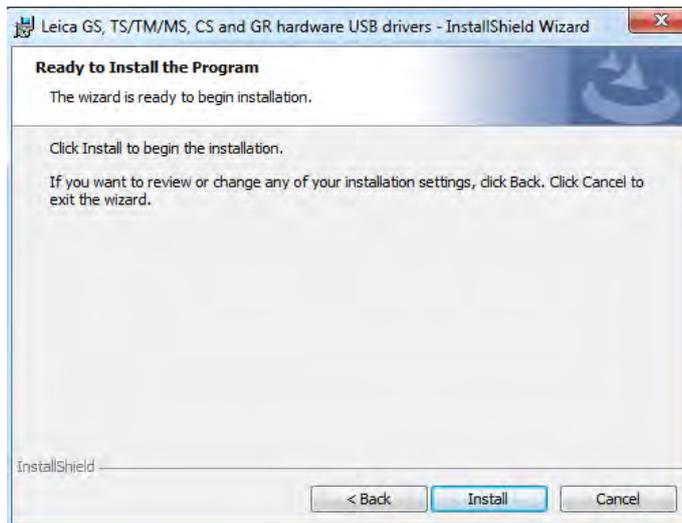
☞ The setup has to be run only once for all Leica devices.

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!

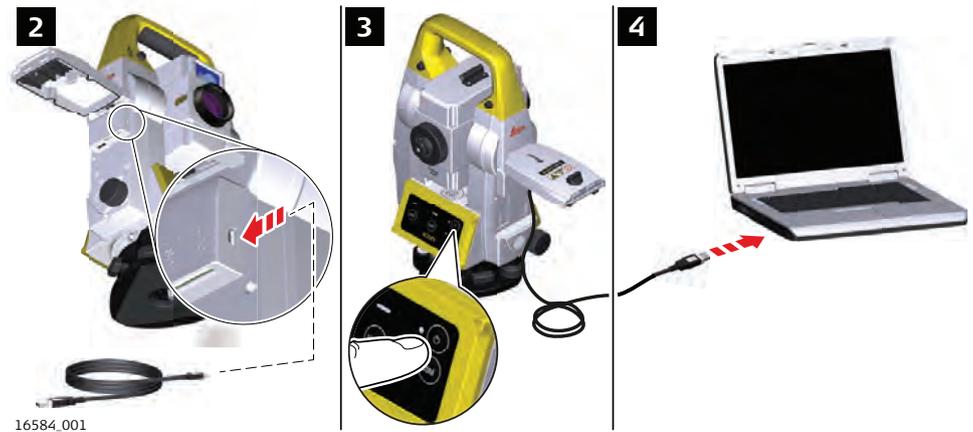


- 
4. Click **Next>**.
  5. The **Ready to Install the Program** window appears.
- 



- 
6. Click **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

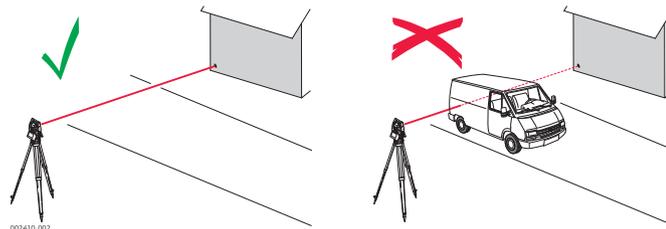


1. Start the PC.
2. Plug the cable into the instrument.
3. Turn on the instrument.
4. Plug the cable into the USB port of the PC.
5. Press the Windows Start button at the bottom left corner of the screen.
6. Type the IP address of the device into the search field.  
\\192.168.254.3\
7. Press **Enter**.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

## 4.8

### Guidelines for Correct Results

#### Distance measurement



When measurements are being made using the red laser EDM, the results can be influenced by objects passing between the EDM and the intended target surface. This occurs because reflectorless measurements are made to the first surface returning sufficient energy to allow the measurement to take place. For example, if the intended target surface is the surface of a building, but a vehicle passes between the EDM and the target surface as the measurement is triggered, the measurement may be made to the side of the vehicle. The result is the distance to the vehicle, not to the surface of the building.



Very short distances can also be measured reflectorless in Prism mode to well reflecting natural targets. The distances are corrected with the additive constant defined for the active reflector.



Accurate measurements to prisms should be made in prism mode.



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.

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Do not measure with two instruments to the same target simultaneously to avoid getting mixed return signals.

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### **ATR/Lock**

Instruments equipped with an ATR sensor permit automatic angle and distance measurements to prisms. The prism is sighted with the optical sight. After initiating a distance measurement, the instrument sights the prism centre automatically. Vertical and horizontal angles and the distance are measured to the centre of the prism. The lock mode enables the instrument to follow a moving prism.

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As with all other instrument errors, the collimation error of the automatic aiming must be redetermined periodically. Refer to "5 Check & Adjust" about checking and adjusting instruments.

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When a measurement is triggered while the prism is still moving, distance and angle measurements may not be made for the same position and coordinates may vary.

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If the prism location is changed too quickly, the target may be lost. Make sure that the speed does not exceed the figure given in the technical data.

---

# 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
ATR	ATR zero point error for Hz and V

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.

#### Mechanical adjustment

The following instrument parts can be adjusted mechanically:

- Circular level on instrument and tribrach
- Optical plummet - option on tribrach
- Allen screws on 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 above, these errors can change and it is highly recommended to redetermine them in the following situations:

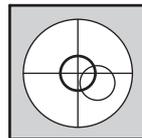
- Before the first use
- Before every high precision survey
- After rough or long transportation
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20 °C

### 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	-	✓	✓	✓
ATR Collimation 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. Take at least 15 minutes into account or approximately 2 minutes per °C of temperature difference from storage to working environment.



Even after adjustment of the ATR, the crosshairs may not be positioned exactly on the centre of the prism after an ATR measurement has been completed. This outcome is a normal effect. To speed up the ATR measurement, the telescope is normally not positioned exactly on the centre of the prism.

These small deviations ATR offsets, are calculated individually for each measurement and corrected electronically. This means that the horizontal and vertical angles are corrected twice: first by the determined ATR errors for Hz and V, and then by the individual small deviations of the current aiming.

**Next step**

- **Adjusting a combination of instrument errors**  
Refer to "5.3 Combined Adjustment (l, t, i, c and ATR)".
- **Adjusting the circular level**  
Refer to "5.4 Adjusting the Circular Level of the Instrument and Tribach".
- **Adjusting the laser/optical plummet**  
Refer to "5.6 Inspecting the Laser Plummet of the Instrument".
- **Adjusting the tripod**  
Refer to "5.7 Servicing the Tripod".

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

**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
ATR Hz	ATR zero point error for horizontal angle option
ATR V	ATR zero point error for vertical angle option

**Combined adjustment procedure step-by-step**

The following description explains the most common settings:

1. Connect the device with the Instrument.
2. Select **Devices** from the Home Menu.

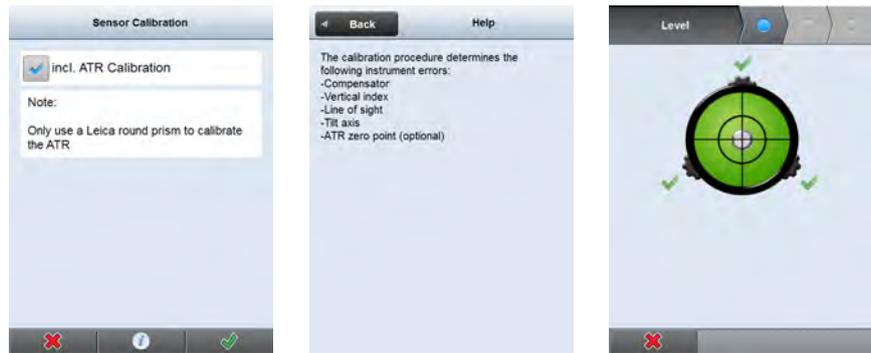


3.
  - Select your instrument and tap the arrow.
  - Select **Sensor Calibration**.

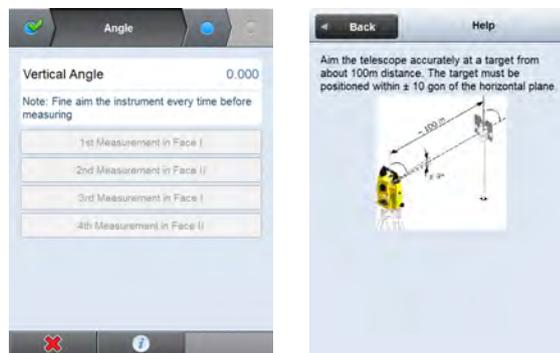


It is recommended to use a clean Leica circular prism as target. Do not use a 360° prism.

4.
  - Select the **incl. ATR Calibration** option if you like to calibrate the ATR.
  - Tap  to see which instrument errors are determined.
  - Follow the wizard which guides through the calibration.



5.
  - Aim the telescope accurately at a target at about 50 m distant. The target must be positioned within  $\pm 9^\circ/\pm 10$  gon of the horizontal plane. Start the procedure in telescope face one.
  - Press the measurement keys to measure and to continue to the next step.
  - Motorised instruments change automatically to face one.



 The fine pointing has to be performed manually in both faces.

6.
  - Tap  in the wizard to get to the next page.
  - Aim the telescope accurately at a target at about 50 m distant or less if not possible. The target must be positioned at least  $27^\circ/30$  gon above or beneath the horizontal plane.
  - Press the measurement keys to measure and to continue to the next step.  
Motorised instruments change automatically to the other face.



☞ The fine pointing has to be performed manually in both faces.

### 7. Adjustment Accuracy

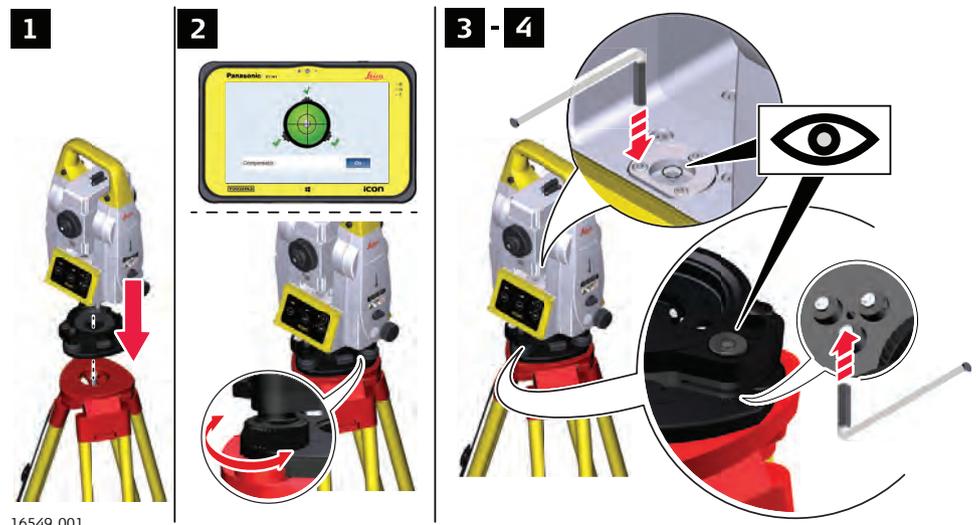
After pressing the last  in the wizard the results are shown and stored to the instrument.



8. Tap  to get back to the **Devices** page.

## 5.4 Adjusting the Circular Level of the Instrument and Tribrach

### Adjusting the circular level step-by-step



16549\_001

☞ A field controller is necessary for this procedure.

1. Place and secure the instrument into the tribrach and onto a tripod.

- Turn on the instrument. Connect the instrument to the field controller. Using the tribrach footscrews, level the instrument with the electronic level.



Electronic level:

- Select **Devices** from the Home Menu.
- Tap the arrow button to the right of the device name.
- To display the electronic level, tap **Compensator**.

- Check the position of the circular level on the instrument and tribrach.



If both circular levels are centred, no adjustments are necessary.

- 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.



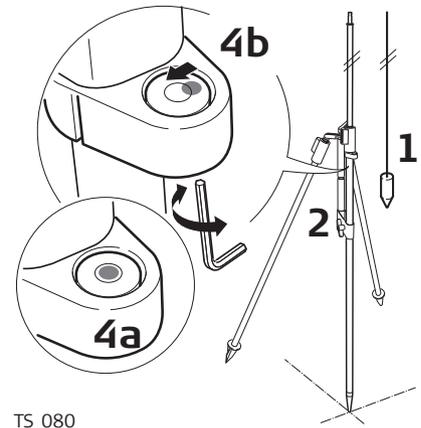
After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

## 5.5

### Adjusting the Circular Level of the Prism Pole

#### Adjusting the circular level step-by-step

- Suspend a plumb line.
- Use a pole bipod, to align the prism pole parallel to the plumb line.
- Check the position of the circular level on the prism pole.
- If the circular level is centred, no adjustment is necessary.
  - If the circular level is not centred, use an 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.

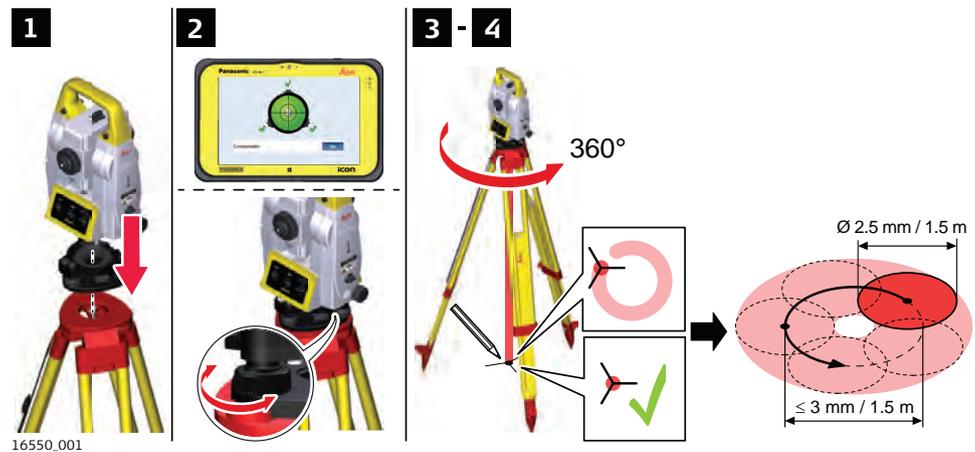
## 5.6

### 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. Place and secure the instrument into the tribrach and onto a tripod.
2. Turn on the instrument. Connect the instrument to the field controller. Using the tribrach footscrews, level the instrument with the electronic level.



Electronic level:

- Select **Devices** from the Home Menu.
- Tap the arrow button to the right of the device name.
- To display the electronic level, tap **Compensator**.

3. *The laser plummet is switched on when the Compensator screen is displayed.*



Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, such as a sheet of paper.

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.



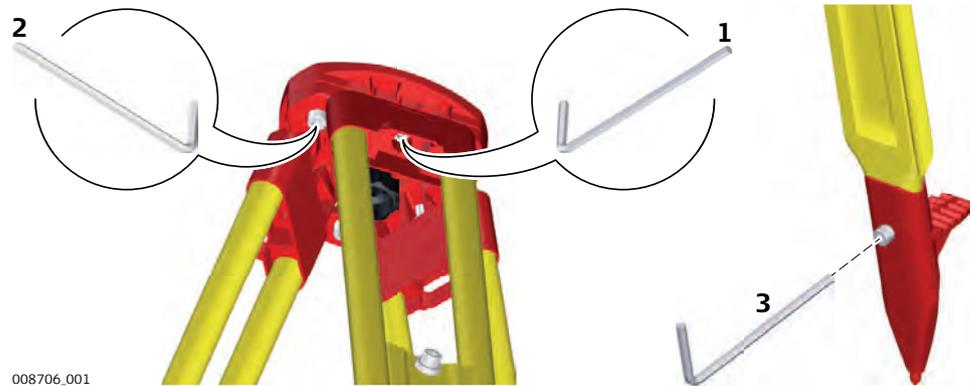
The maximum diameter of the circular movement described by the centre of the laser dot should not exceed 3mm at a height of 1.5m.

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.

## 5.7

## 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

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### 6.1 Transport

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<b>Transport in the field</b>	<p>When transporting the equipment in the field, always make sure that you</p> <ul style="list-style-type: none"><li>• either carry the product in its original container,</li><li>• or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.</li></ul>
<b>Transport in a road vehicle</b>	<p>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.</p> <p>For products for which no container is available use the original packaging or its equivalent.</p>
<b>Shipping</b>	<p>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.</p>
<b>Shipping, transport of batteries</b>	<p>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.</p>
<b>Field adjustment</b>	<p>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.</p>

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### 6.2 Storage

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<b>Product</b>	<p>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.</p>
<b>Li-Ion batteries</b>	<ul style="list-style-type: none"><li>• Refer to "7 Technical Data" for information about storage temperature range.</li><li>• Remove batteries from the product and the charger before storing.</li><li>• After storage recharge batteries before using.</li><li>• Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.</li><li>• 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.</li><li>• 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.</li></ul>

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## 6.3

## Cleaning and Drying

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### 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.
- 

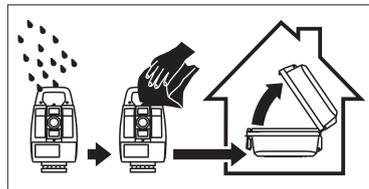
### Fogging of prisms

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.

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### 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.

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## 6.4

## Maintenance

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An inspection of the motorisation in motorised instruments must be done in a Leica Geosystems authorised service centre. Leica Geosystems recommends an inspection of the product every 12 months.

For instruments which are in intensive or permanent use, for example tunneling or monitoring, the recommended inspection cycle may be reduced.

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## 7 Technical Data

### 7.1 Angle Measurement

Accuracy	Available angular accuracies	Standard deviation Hz, V ISO 17123-3
	["]	[mgon]
	9	2.8

**Characteristics** Absolute, continuous, diametric.

### 7.2 Distance Measurement with Reflectors

Range	Shortest measuring distance:	1.5 m
	Maximum measuring distance:	80 m



Measurements can be made to reflector tapes over the entire range without external ancillary optics.

**Accuracy** Accuracy refers to measurements to standard prisms.

Distance measuring mode	Standard deviation ISO 17123-4, standard prism	Standard deviation ISO 17123-4, tape	Measurement time, typical [s]
Single Auto	1 mm	3 mm	2.4
Continuous with lock	3 mm	3 mm	< 0.15

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	658 nm
Measuring system	System Analyzer Basis 100–150 MHz

### 7.3 Distance Measurement without Reflectors

Range	<b>R80</b>	
	<b>Kodak Gray Card</b>	<b>Range</b>
		[m] [ft]
	White side, 90 % reflective	80 260
	Grey side, 18 % reflective	80 260
	Range of Measurement:	1.5 m to 80 m

**Accuracy**

Standard deviation ISO 17123-4	Measure time, typ- ical [s]	Measure time, maximum [s]
2 mm	3	12

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

**Characteristics**

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

**Laser dot size**

Distance [m]	Laser dot size, approximately [mm]
at 30	7 × 10
at 50	8 × 20

**7.4****Automatic Target Aiming (ATR)****Range of target aiming/  
target locking**

Reflector	Range (Target Aiming)		Range (Target Locking)	
	[m]	[ft]	[m]	[ft]
All prisms (GPR1, GRZ4, GRZ122, GRZ101, GMP101)	80	260	80	260
Reflector tape 60 mm × 60 mm	45	150	not qualified	

 The maximum range can be restricted by poorer conditions, for example rain.

Shortest measuring distance: 360° prism (Target aiming): 1.5 m

Shortest measuring distance: 360° prism (Target locking): 5 m

**ATR accuracy with the  
GPR1 prism**

Type	Accuracy
ATR angle accuracy Hz, V (std. dev. ISO 17123-3)	1" (0.3 mgon)

**Maximum prism speed**

	Direction of prism movement	
	Tangential	Radial
Prism Lock only	14 m/s at 20 m	25 m/s
Prism Lock with Measure Mode <b>Con- tinuous with lock</b>	6 m/s at 20 m	6 m/s

 A tangential movement means the prism is passing by the instrument at the specified distance.  
A radial movement means the prism is moving away from or towards the instrument in the line of sight direction.

**Searching**

Type	Value
Typical search time in field of view	1.5 s
Field of view	1°25'/1.55 gon
Definable search windows	Yes

**Characteristics**

Type	Description
Principle	Digital image processing
Type	Infrared laser

**7.5****AutoSearch****Range**

Reflector	Range	
	[m]	[ft]
Standard prism (GPR1)	80	260
360° prism (GRZ4, GRZ122)	80	260
360° mini prism (GRZ101)	Not recommended	
Mini prism (GMP101)	80	260

Measurements at the vertical limits of the fan or under unfavourable atmospheric conditions may reduce the maximum range. (\*optimally aligned to the instrument)

Shortest measuring distance: 1.5 m

**Searching**

Type	Value
Typical search time	20 s
Default search area	Hz: 400 gon, V: 40 gon
Definable search windows	Yes

**Characteristics**

Type	Description
Principle	Digital signal processing
Type	Infrared laser

**7.6****LOC8 Theft Deterrence and Location Device (optional)****Internal battery**

Battery	Voltage	Capacity
Li-Ion	800 mAh Recharged by the total station battery when instrument is switched on	Up to 3 days Depending on mode of operation and cellular network conditions

**Tracking period**

Update rate up to 1 minute

**Interfaces**

Wi-Fi: 802.11 b/g/n

**Environmental specifications****Temperature****Operating temperature**  
[°C]

-20 to +60

**Storage temperature**  
[°C]

-20 to +60

## 7.7

## Conformity to National Regulations

### 7.7.1

### iCT30

#### Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG declares that the radio equipment type iCT30 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>.



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]
Bluetooth	2402 - 2480

#### Output power

Type	Output Power [mW]
Bluetooth	< 10

#### Antenna

Type	Bluetooth
Antenna	Integrated antenna
Gain [dBi]	0
Connector	-
Frequency band [MHz]	2400 - 2500

### 7.7.2

### CommunicationHandle

#### Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG declares that the radio equipment type CCD6/RH16/RH17 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>.



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]
CCD6	Limited to 2402–2480
RH16	Limited to 2402–2480
RH17	Limited to 2402–2480

#### Output power

Value
< 100 mW (e. i. r. p.)

#### Antenna

Type	$\lambda/2$ dipole antenna
Gain [dBi]	2
Connector	Special customized SMB

### 7.7.3

#### LOC8 Theft Deterrence and Location Device (optional)

#### Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG declares that the radio equipment type LOC8 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>.



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, 22 and 24 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).

#### Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

## Frequency band

Type	Value
GSM	GSM 900: 880 - 960 MHz GSM 1800: 1710 - 1880 MHz
WCDMA	WCDMA 900: 880 - 960 MHz WCDMA 2100: 1920 - 2170 MHz
WLAN	2.4G Wi-Fi 802.11 b/g/n (20 MHz): 2412 - 2472 MHz 802.11 n (40 MHz): 2422 ~ 2462 MHz
GPS	1.57542 GHz

## Output power

Type	Value
GSM	GPRS: Maximal power: 29,13 dBm
WCDMA	Maximal power: 23,58 dBm

## Antenna

Type	Antenna	Gain
GSM	Internal PIFA antenna	GSM 900: 0.23 dBi GSM 1800: 0.23 dBi
WCDMA	Internal antenna	WCDMA 900: 1.34 dB WCDMA 1200: 1.34 dBi
GPS	Internal antenna	0 dBi
WLAN	Internal PIFA antenna	-0.66 dBi

### 7.7.4

### 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.

**System Accuracy**

Several factors can influence the system's accuracy for determining the location of a prism:

- Internal ATR accuracy
- Angular accuracy of the instrument
- Type and centring accuracy of the prism
- Selected EDM measuring program
- External measuring conditions

Therefore, the overall pointing accuracy of the determined point location can be lower than the given angular accuracy and the ATR accuracy.

The following paragraphs provide a short overview of these influencing factors and their possible intensities.

**Angular accuracy**

The accuracy of angular measurements depends on the instrument type. The angular accuracy for total stations is typically in the range from 0.5" to 5". The resulting error depends on the measurement distance.

Angular accuracy	Possible deviation* at 60 m distance
9"	~3.0 mm

\* Orthogonal to the line of sight.



Refer to the data sheet of the respective instrument model for information about the angular accuracy.

**EDM accuracy**

The distance measurement accuracy usually consists of two parts: a fixed value and a distance-dependent value (ppm-value).

Example: "Single measurements: 1 mm + 1.5 ppm"



Because of the maximum measurement distance for iCT30, only the fixed value is specified. Refer to "7.2 Distance Measurement with Reflectors".

**ATR accuracy**

Automatic target aiming accuracies, like those of the ATR, are in general the same as the stated angular accuracy. Therefore these accuracies are also distance-dependent parameters.

External impacts, like heat shimmer, rain (prism surface covered by rain drops), fog, dust, strong background lights, dirty targets, alignment of the targets etc. can have a significant influence on the automated target. In addition the selected EDM mode affects the ATR performance. Under good environmental conditions and with a clean, properly aligned target the accuracy of the automated target aiming is equivalent to the manual target aiming (presumed valid calibration values).

**Type and centring accuracy of the prism**

The prism centring accuracy depends mainly on the used prism type, for example:

Prism type		Centring accuracy
Leica GPR1	Circular prism	1.0 mm
Leica GPH1P	Precision circular prism	0.3 mm

Prism type		Centring accuracy
Leica GRZ122	360° prism	2.0 mm
Leica GRZ4	360° prism	5.0 mm



Refer to the white paper "Leica Surveying Reflectors" for information about the different centring accuracies.

### Additional influencing factors

When determining absolute coordinates, the following parameters can also affect the resulting accuracy:

- Environmental conditions: temperature, air pressure and humidity
- Typical instrument errors, such as horizontal collimation error or index error.
- Proper functioning of laser plummet or optical plummet
- Correct horizontal levelling
- Setup of the target
- Quality of additional equipment, such as tribrach or tripod.

### Telescope

Type	Value
Magnification	30 ×
Free Objective aperture	40 mm
Focusing	1.7 m/5.6 ft to infinity
Field of view	1°30'/1.66 gon 2.7 m at 100 m

### Compensator

Angular accuracy instrument ["]	Setting accuracy		Setting range	
	["]	[mgon]	[']	[gon]
9	1.5	0.5	4	0.07

### Level

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

### Four button keyboard unit

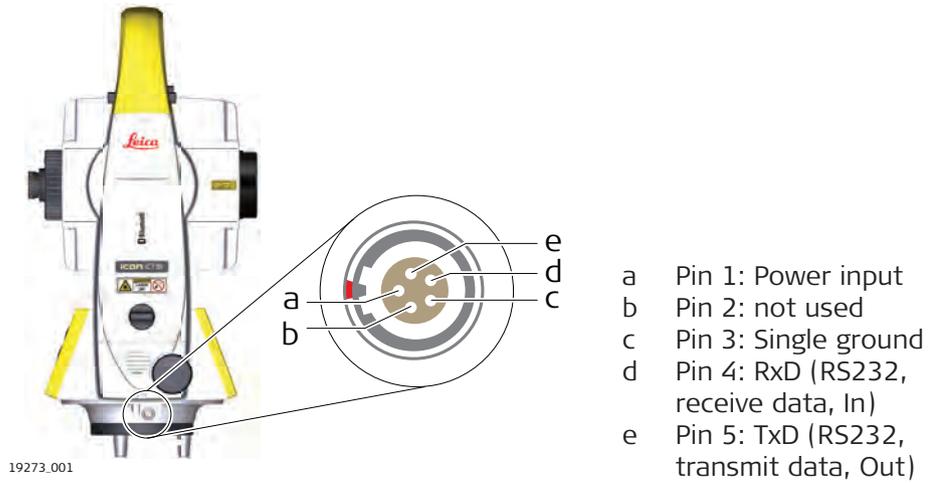
Type	Description
Keyboard	4 keys, 4 LEDs
Position	Face I only

### Instrument ports

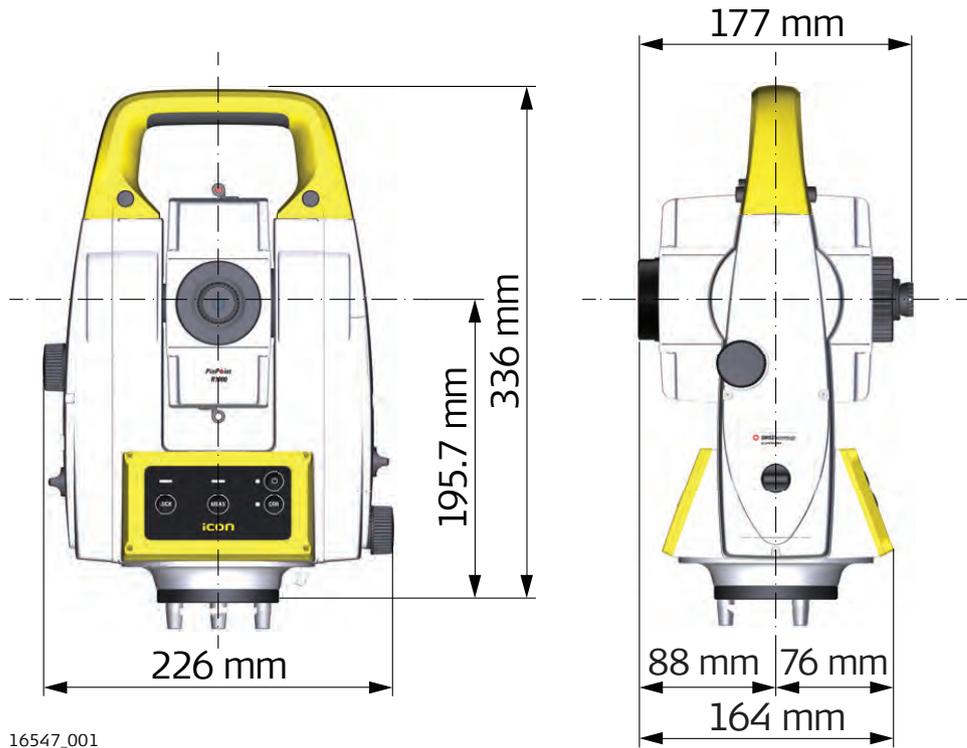
Name	Description
Cable	<ul style="list-style-type: none"> <li>• 5 pin LEMO-0 for power, communication, data transfer.</li> <li>• This port is located at the base of the instrument.</li> </ul>
CommunicationHandle	<ul style="list-style-type: none"> <li>• Hotshoe connection for Communication-Handle.</li> <li>• This port is located on top of Communication side cover.</li> </ul>

Name	Description
Bluetooth	<ul style="list-style-type: none"> <li>Bluetooth module for communication.</li> <li>This port is housed within Communication side cover.</li> </ul>
USB host port	<ul style="list-style-type: none"> <li>USB memory stick port for data transfer.</li> </ul>
USB device port	<ul style="list-style-type: none"> <li>Cable connections from USB devices for communication and data transfer.</li> </ul>

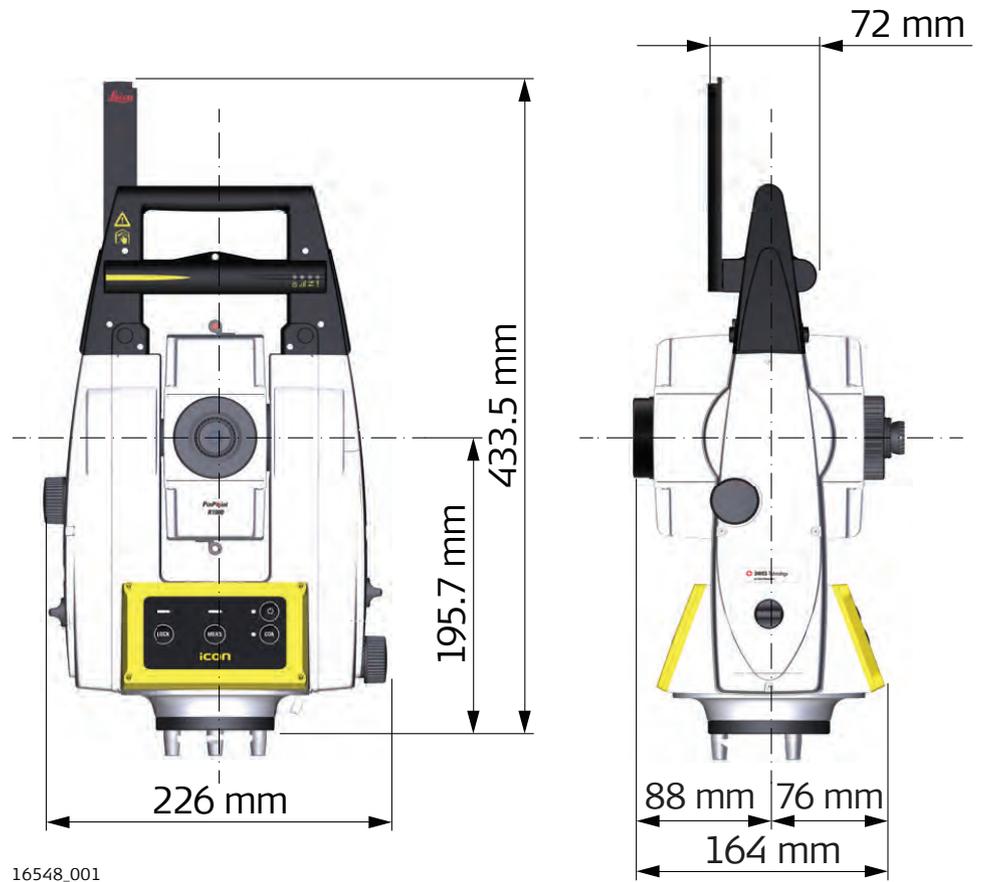
### Pin Assignments of the 5 Pin LEMO-0 Port



### Instrument Dimensions



With CCD6



16548\_001

**Weight**

Instrument (including battery):	5.0 kg
Tribrach:	0.8 kg

**Laser plummet**

Type	Value
Type	Visible red laser class 2
Location	In standing axis of instrument
Accuracy	Deviation from plumb line: 1.5 mm (2 sigma) at 1.5 m instrument height
Diameter of laser point	2.5 mm at 1.5 m instrument height

**Drives**

Description
Endless horizontal and vertical drives

**Motorisation**

Type	Description
Maximum rotating speed	50 gon/s

**Power**

Type	Description
External supply voltage	Nominal voltage 12.8 V DC, Range 11.5 V-13.5 V

**Internal battery**

Type	Battery	Nominal Voltage	Capacity
GEB222	Li-Ion	7.4 V ==	6.0 Ah

**External battery**

Type	Battery	Voltage	Capacity
GEB371	Li-Ion	13 V	16.8 Ah

**Environmental specifications****Temperature**

Type	Operating temperature [°C]	Storage temperature [°C]
All instruments	-20 to +50	-40 to +70
Leica SD cards	-40 to +80	-40 to +80
Battery internal	-20 to +55	-40 to +70

**Protection against water, dust and sand**

Type	Protection
All instruments	IP55 (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.

**Reflectors**

Type	Additive Constant [mm]	ATR	AutoSearch
Standard prism, GPR1	0.0	yes	yes
Mini prism, GMP101	+17.5	yes	yes
360° prism, GRZ4 / GRZ122	+23.1	yes	yes
360° mini prism, GRZ101	+30.0	yes	not recommended
Reflector tape S, M, L	+34.4	yes	no
Reflectorless	+34.4	no	no

There are no special prisms required for ATR or for AutoSearch.

**Electronic Guide Light (EGL)**

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
  - Circle eccentricity
  - Compensator index error
  - Vertical index error
  - Standing axis tilt
  - Refraction
  - ATR zero point error
- 

**7.9**

**Scale Correction**

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**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  $\Delta D1$**

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%
- 

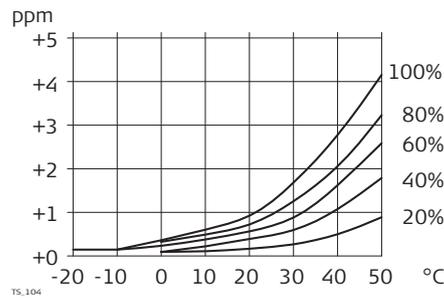
**Air humidity**

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



ppm Air humidity correction [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

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

002419.002

$\Delta D_1$  Atmospheric correction [ppm]  
 p Air pressure [mbar]  
 t Air temperature [°C]  
 h Relative humidity [%]  
 $\alpha = \frac{1}{273.15}$   
 $x = (7.5 \cdot t / (237.3 + t)) + 0.7857$

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 $\Delta D_2$

The values for  $\Delta D_2$  are always negative and are derived from the following formula:

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

TS\_106

$\Delta D_2$  Reduction to mean sea level [ppm]  
 H Height of EDM above sea level [m]  
 R  $6.378 \cdot 10^6$  m

## Projection distortion $\Delta D_3$

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:

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

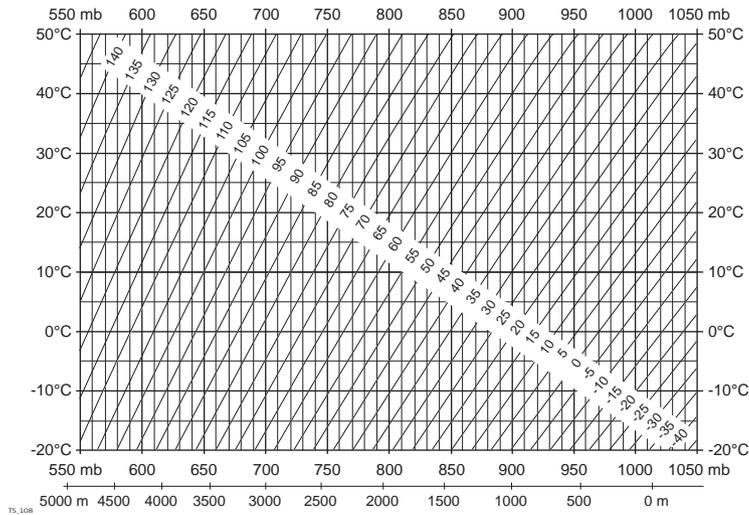
TS.107

- $\Delta D_3$  Projection distortion [ppm]
- X Easting, distance from projection zero line with the scale factor 1 [km]
- R  $6.378 \cdot 10^6$  m

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

### Atmospheric corrections °C

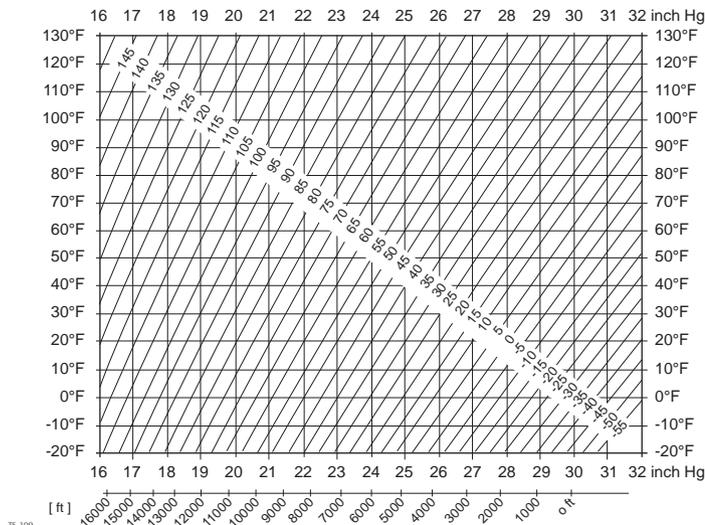
Atmospheric corrections in ppm with temperature [°C], air pressure [mb] and height [m] at 60% relative humidity.



TS.108

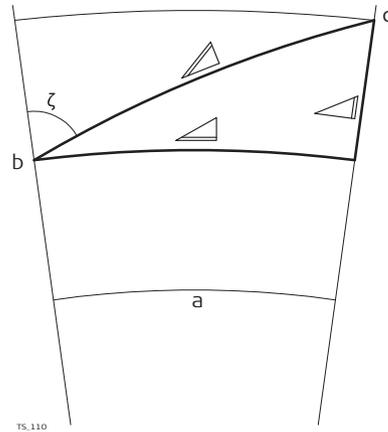
### Atmospheric corrections °F

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



TS.109

## Formulas



- a Mean Sea Level
- b Instrument
- c Reflector
- $\triangle$  Slope distance
- $\triangle$  Horizontal distance
- $\triangle$  Height difference

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

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

002425.002

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

$$\triangle = Y - A \cdot X \cdot Y$$

TS.112

$$\triangle = X + B \cdot Y^2$$

TS.113

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

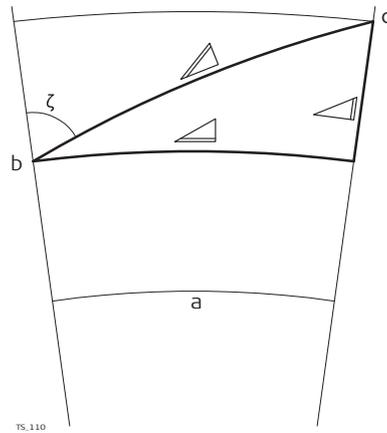
Earth curvature ( $1/R$ ) and mean refraction coefficient ( $k$ ) are automatically taken into account when calculating the horizontal distance and height difference. The calculated horizontal distance relates to the station height and not to the reflector height.

## Reflector types

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

- To prisms
- To reflector tape
- Reflectorless measurements

## 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:

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002425\_002

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- $D_0$  Uncorrected distance [m]
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TS.112

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TS.113

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- X ▴ \* cosζ
- ζ Vertical circle reading
- A  $(1 - k / 2) / R = 1.47 * 10^{-7} \text{ [m}^{-1}\text{]}$
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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.

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