

Leica iCON robot 50 User Manual



Version 1.0
English

- when it has to be **right**

Leica
Geosystems

Introduction

Purchase

Congratulations on the purchase of a iCON robot 50 series instrument.



This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "6 Safety Directions" for further information.



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

To ensure safety when using the system, please also observe the directions and instructions contained in the User Manual and Safety Handbook issued by the:

- Machine manufacturer,
 - Controller manufacturer and
 - Sensor manufacturer.
-

Product identification

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

Type: _____

Serial No.: _____

Symbols

The symbols used in this manual have the following meanings:

Type	Description
 Danger	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 Warning	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
 Caution	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage.
	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

Trademarks

- Windows and Windows CE are a registered trademark of Microsoft Corporation
 - CompactFlash and CF are trademarks of SanDisk Corporation
 - Bluetooth is a registered trademark of Bluetooth SIG, Inc
- All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to all iCON robot 50 Series instruments. Where there are differences between the various models they are clearly described.

Available
documentation

Name	Description and Format		
User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	✓	✓

Name	Description and Format		
System Software Manual	Overall comprehensive guide to the product and program functions. Included are detailed descriptions of special software/hardware settings and software/hardware functions.	✓	✓

Refer to the following resources for all iCON robot 50 documentation and software

- the Leica iCon DVD
- <http://myworld.leica-geosystems.com/>



It is recommended to set-up the product while reading through this manual.

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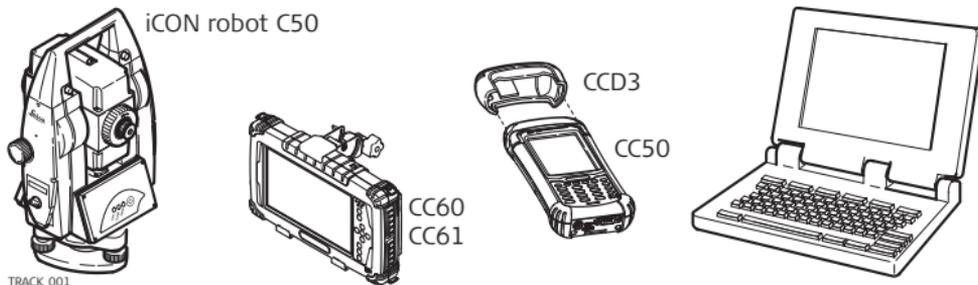
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1 Description of the System

1.1 System Components

Main components



Component	Description
iCON robot 50	<ul style="list-style-type: none"> an instrument for measuring, calculating and capturing data. comprised of various models with a range of accuracy classes. combined with a multi-purpose controller to conduct remote control surveys.
CC50 or CC60	Multi-purpose controller enabling the remote control of iCON robot 50 via short range Bluetooth and WiFi.

Component	Description
CC61 or CCD3 with CC50	Multi-purpose controller enabling the remote control of iCON robot 50 via long range Bluetooth and WiFi.
LM office	An office software consisting of a suite of standard and extended programs for the viewing, exchange and management of data.

Terminology

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

Term	Description
ATR	Automatic Target Recognition ATR refers to the instrument sensor which enables the automatic fine pointing to a prism.
Automated	Instruments fitted with ATR are referred to as Automated. Three automation modes are available with ATR: <ul style="list-style-type: none"> • None: no ATR - no automation and no tracking. • ATR: automatic fine pointing to a prism. • LOCK: automatic tracking of an already targeted prism.

Term	Description
Communication-Handle	CommunicationHandle is a component of the Remote Control System (RCS) . It is both, an integrated communication module with attached antenna and a handle to carry the instrument. Available models are: WiFi, long range Bluetooth and radio handle.
Communication side cover	Communication side cover has integrated short range Bluetooth. In combination with CommunicationHandle it is a component of RCS.
EDM	Electronic Distance Measurement 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">• IR mode. This mode refers to the ability to measure distances to prisms.• RL mode. This mode refers to the ability to measure distances without prisms.

Term	Description
EGL	<p>Electronic Guide Light</p> <p>An EGL fitted to an instrument assists with prism targeting. It consists of two differently coloured flashing lights located in the instrument telescope housing. The person holding the prism can align him/herself into the instrument's line of sight.</p>
Motorised	<p>Instruments fitted with internal motors, enabling automatic horizontal and vertical turning are referred to as <i>Motorised</i>.</p>
PinPoint	<p>PinPoint refers to the Reflectorless EDM technology which enables measuring to any surface with a visible red laser spot.</p>
PowerSearch	<p>PowerSearch refers to the instrument sensor which enables the automatic rapid finding of a prism.</p>

1.2 System Concept

1.2.1 Software Concept

Software type

Software type	Description
System software	This software comprises the central functions of the instrument. It is also referred to as firmware.
Application program	It is recommended to control the instrument with Leica Geosystems field software. Other 3rd party software products may also be available. Refer to the respective software manual for more information.

Software upload

All instrument software is stored in the System RAM of the instrument. The software can be uploaded onto the instrument using the following method:

- By connecting the CompactFlash card directly to the computer either via an internal card slot housing or an external OMNI drive, the software is transferred to the card, which is then stored to the System RAM.

1.2.2

Data Storage

Memory device

CompactFlash card:

A CompactFlash card housing is standard. A CompactFlash card can be inserted and removed. Various storing capacities are available.



Whilst other CompactFlash cards may be used, Leica recommends Leica CompactFlash cards and cannot be held responsible for data loss or any other error that may occur when using a non-Leica card.



Unplugging connecting cables or removing the CompactFlash card during the measurement may cause loss of data. Always ensure the instrument is OFF before removing the CompactFlash card or removing cables.

1.2.3

Power Concept

General

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

Power options

Instrument

Power for the instrument can be supplied either internally or externally. An external battery is connected to the instrument using a LEMO cable.

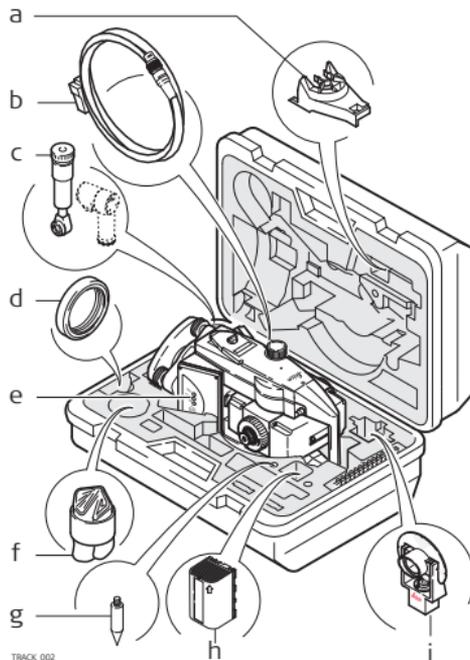
Internal battery: One GEB221 battery fitted into the battery compartment.

External battery: One GEB171 battery connected via cable.

1.3

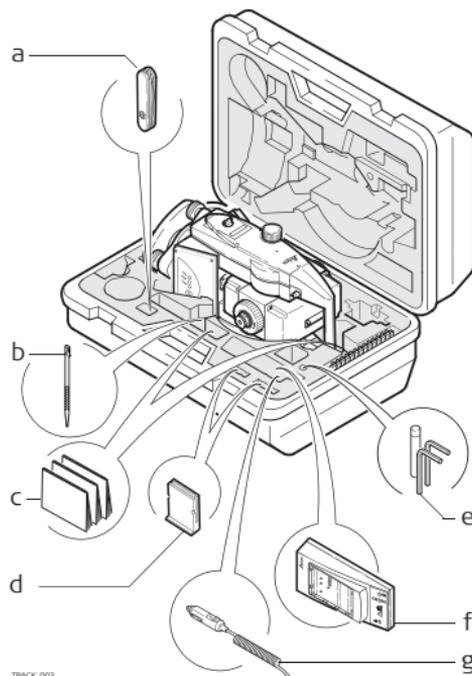
Container for instrument and delivered accessories part 1 of 2

Container Contents



- a) Tribrach bracket for height meter
- b) Data transfer cable GEV102
- c) Diagonal eyepiece GFZ3 or zenith eyepiece GOK6 (eyepiece for steep sighting) - optional
- d) Counterweight for diagonal eyepiece or zenith eyepiece - optional
- e) Instrument with supplied stylus and tribrach (with standard carry handle or CommunicationHandle attached)
- f) Protective cover for instrument and sunshade for objective lens
- g) Tip for mini prism
- h) Internal battery GEB221
- i) Mini prism and holder

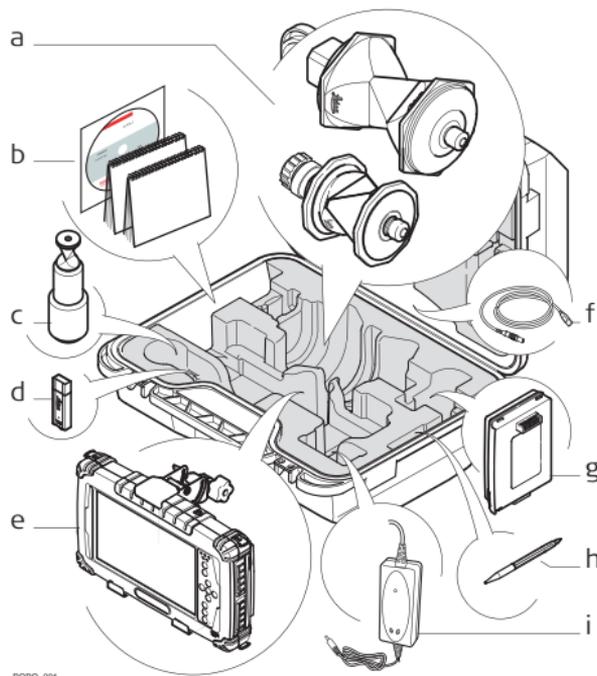
**Container for
instrument and
delivered
accessories
part 2 of 2**



TRACK_003

- a) Pocket knife - optional
- b) Spare stylus
- c) User manual
- d) 2 x CompactFlash cards and covers
- e) Tool set for circular level and EDM adjustments - comprising two adjusting pins, two allen keys and one screwdriver
- f) Battery charger
- g) Car adapter power plug for battery charger (stored under battery charger)

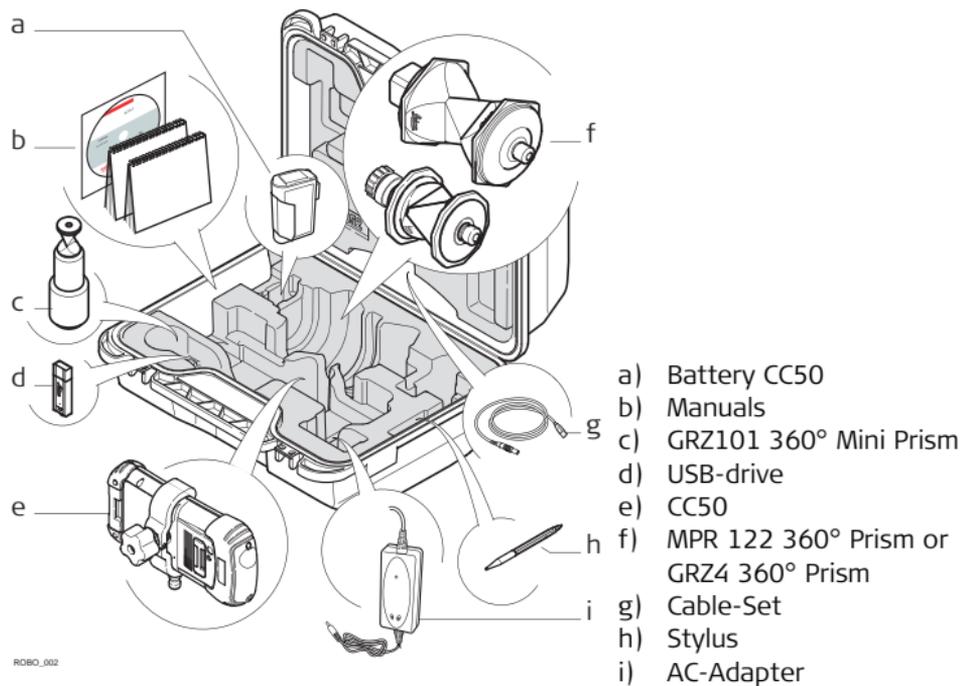
Container for CC60/CC61



- a) MPR 122 360° Prism or GRZ4 360° Prism
- b) Manuals
- c) GRZ101 360° Mini Prism
- d) USB-drive
- e) CC60/CC61
- f) Cable-Set
- g) Battery for CC60/CC61
- h) Stylus
- i) AC-Adapter

ROBO_001

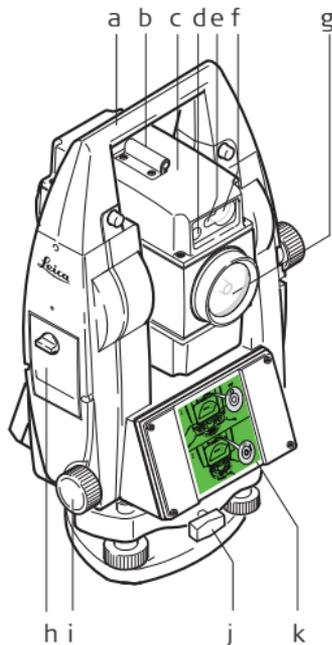
Container for CC50



1.4

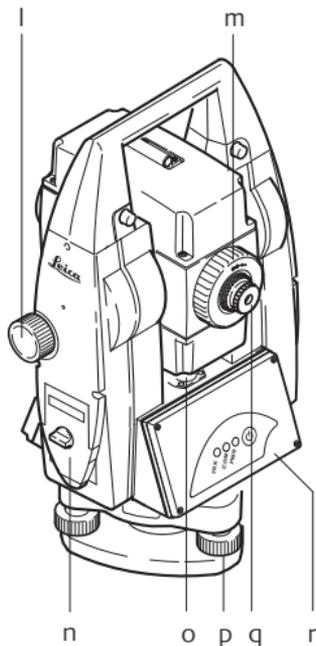
Instrument Components

Instrument components part 1 of 2



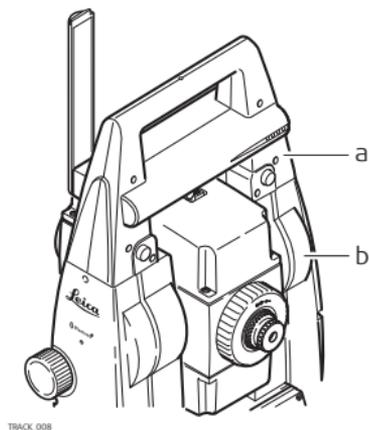
TRACK_006

- a) Carry handle
- b) Optical sight
- c) Telescope, integrating EDM, ATR, EGL, PS
- d) EGL flashing diode - yellow
- e) EGL flashing diode - red
- f) PowerSearch
- g) Coaxial optics for angle and distance measurement, and exit port of visible laser beam for distance measurements
- h) CompactFlash card compartment
- i) Horizontal drive
- j) Tribrach securing screw
- k) Label "leveling hint"

**Instrument
components
part 2 of 2**

- l) Vertical drive
- m) Focusing ring
- n) Battery compartment
- o) Circular level
- p) Tribrach footscrew
- q) Interchangeable eyepiece
- r) Control Panel

Instrument components for RCS



- a) CommunicationHandle
 - b) Communication side cover
-

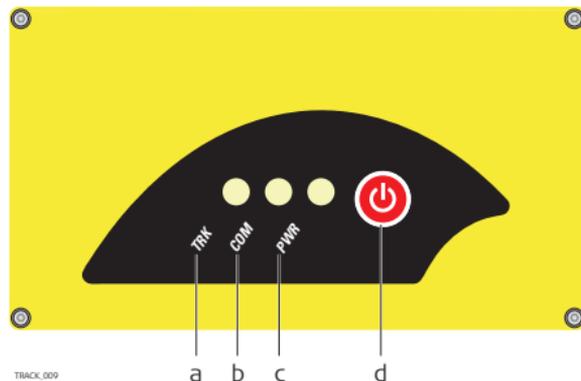
2

User Interface

2.1

Control Panel

Control Panel



- a) **TRK** Tracking LED
- b) **COM** Communication LED
- c) **PWR** Power LED
- d) **ON/OFF** button

Description of LED indicators

IF the	is	THEN
PWR	off	power is off.
	green	power is okay, battery status is okay.
	flashing green	power is low. The remaining time for which enough power is available depends on the temperature and the age of the battery.
	red	power is very low. The battery should be changed.
COM	green	Bluetooth is in data mode and ready for connection.
	blue	Bluetooth has connected.
	red	Internal Bluetooth is off, communication on Port 2 is active to communicate with field software over a handle.
	off	Internal Bluetooth is off, Port 1 serial is active for communication with field software.
	flashing red	Firmware upload failed.

IF the	is	THEN
TRK	off	no prism found.
	red	instrument is in startup mode and not ready.
	flashing green	prism locked but not tracking.
	green	prism locked and tracking.
	flashing red	uploading firmware.

2.2

Operating Principles

Turn instrument on

1. Press and hold ON/OFF for 2 s.
 2. Release when PWR LED turns green. When the red TRK LED switches off the instrument is ready.
-

Turn instrument off

1. Press and hold ON/OFF for 2 s. PWR LED turns red.
 2. Release and instrument shuts down.
-

Using the instrument with internal Bluetooth

1. Press and hold ON/OFF for 5 s.
 2. Release when the COM LED turns green. All LEDs turn to their current status.
 3. Internal Bluetooth is now enabled for use with a controller.
-

Using the instrument with cable

1. Press and hold ON/OFF for 10 s. BT LED switches off and Bluetooth is disabled.
 2. Release and all LEDs turn to their current status.
 3. RS232 mode (Port1) is now enabled for use with a controller.
-

Using the instrument with Communication-Handle and field software (geocom)

1. Press and hold ON/OFF for 15 s.
 2. Release when the COM LED turns red. All LEDs turn to their current status.
 3. CommunicationHandle (Port2) is now enabled for use with a controller (geocom).
-

Reset instrument

1. Press and hold ON/OFF for 20 s.
2. Release when PWR and TRK LEDs turn red and COM LED turns green.
3. Instrument shuts down. All LEDs turn red.
4. Instrument turns on again.
5. LEDs turn to their current status.



When resetting the instrument following tasks will be performed:

- The current job will be deleted.
 - System RAM will be formatted.
 - Factory default settings will be activated.
 - Cable mode will be activated (Baudrate 115200).
-

2.3

Ports

Available ports

Port	Location
Port 1	This port is located at the base of the instrument and is always available.
Port 2 (Handle)	This port is located on top of Communication side cover.
Port 3 (BT)	This port is housed within Communication side cover.

3

Operation

3.1

Instrument Setup

Description

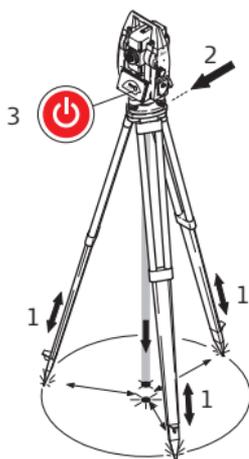
This topic describes an instrument setup over a marked ground point using the laser plummet. It is always possible to set up the instrument without the need for a marked ground point.



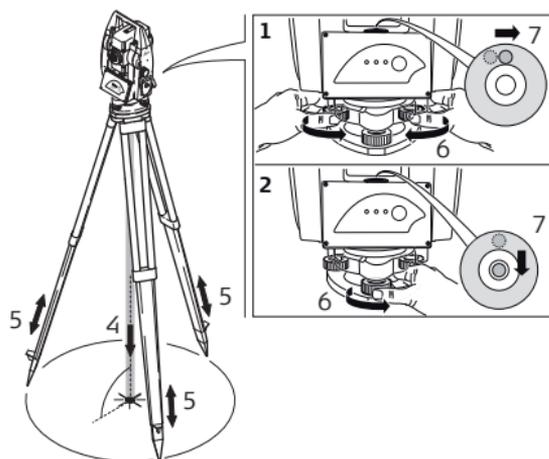
Important features:

- It is always recommended to shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
 - The laser plummet described in this topic is built into the vertical axis of the instrument. It projects a red spot onto the ground, making it appreciably easier to centre the instrument.
 - The laser plummet cannot be used in conjunction with a tribrach equipped with an optical plummet.
-

Setup step-by-step



TRACK_010



Step	Description
	Shield the instrument from direct sunlight and avoid uneven temperatures around the instrument.
1.	Extend the tripod legs to allow for a comfortable working posture. Position the tripod over the marked ground point, centring it as well as possible.
2.	Fasten the tribrach and instrument onto the tripod.

Step	Description
3.	Turn on the instrument by pressing ON/OFF for 2 s. Activate the laser plummet. Refer to GeoPad/Site Foreman manual to access level & laser plummet dialog.
4.	Move the tripod legs (1) and use the tribrach footscrews (6) to centre the plummet (4) over the ground point.
5.	Adjust the tripod legs to level the circular level (7).
6.	By using the electronic level turn the tribrach footscrews (6) to precisely level the instrument.
7.	Centre the instrument precisely over the ground point (4) by shifting the tribrach on the tripod plate (2).
8.	Repeat steps 6. and 7. until the required accuracy is achieved.

3.2

Autodetect Behaviour

Description

- The instrument incorporates an autodetect behaviour and automatically detects the following devices:
 - CommunicationHandle
 - radios/modems
 - Whenever a device is attached, the instrument responds with two short beeps.
 - Whenever a device is removed, the instrument responds with one long beep.
-

Radio/Modem in clip-on housing

- All radios and modems that are built into a clip-on housing are automatically detected by the instrument when attached to clip-on housing, but the device settings are not automatically set.
-

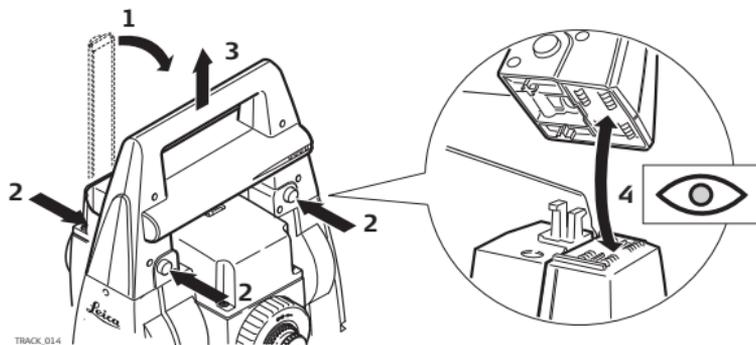
Communication- Handle

- CommunicationHandle is automatically detected by the instrument when it is attached.
 - WiFi and long range Bluetooth Handles appear as "C1" or "C2" identification while they are searched for pairing. Example reading: "iCR52 280536 **C1**"
 - CCD1 = WiFi shown as "C1"
 - CCD2 = Bluetooth shown as "C2"
-

3.3 Instrument Setup for Remote Control

3.3.1 Remote Control Setup

Setup step-by-step



Step	Description
	Refer to "3.1 Instrument Setup" for the initial instrument setup onto a tripod. To remove the instrument carry handle: Press and hold the four unlock push buttons and lift off the handle.

Step	Description
1.	To install the CommunicationHandle, first make sure that the interface connection on the underside 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.
	<ul style="list-style-type: none">• 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.
2.	Swing the CommunicationHandle antenna into an upright position.
	Refer to field software manual for more information.

3.3.2

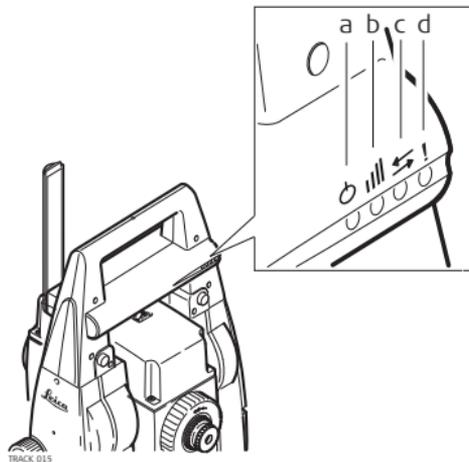
LED Indicators on CommunicationHandle

LED Indicators

Description

The CommunicationHandle has Light Emitting Diode 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

IF the	is	THEN
Power LED	off	power is off.
	green	power is on.
Link LED	off	no connection link to remote controller.
	red	radio link to remote controller.
Data Transfer LED	off	no data transfer to/from remote controller.
	green or green flashing	data transfer to/from remote controller.
Mode LED	off	data mode.
	red	configuration mode.

3.4

Battery

3.4.1

Operating Principles

Charging/ first-time use



For charging and first-time use, the following must be obtained:

- The battery must be charged prior to using for the first time because it is delivered with an energy content as low as possible.
 - For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make 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.
 - The permissible temperature range for charging is between 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 if the temperature is too high.
-

Operation/ Discharging

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

Warning

If charged or discharged, batteries not recommended by Leica Geosystems may be damaged. They may burn and explode.

Precautions:

Only charge and discharge batteries recommended by Leica Geosystems.

Operation of indoor-use products (Charger and AC-Adapter)

Danger

The product is not designed for use under wet and severe conditions. If unit becomes wet it may cause you to receive an electric shock.

Precautions:

Use the product only in dry environments, for example in buildings or vehicles. Protect the product against humidity. If the product becomes humid, it must not be used!



Operation of products with grounding connector

The following refers to the operation of products, which are equipped with a ground connector:

If unit is not connected to ground, death or serious injury can occur.

Precautions:

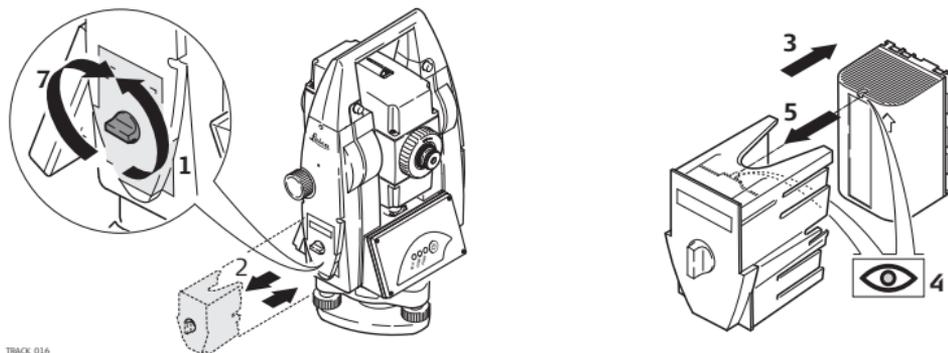
To avoid electric shock power cable and power outlet must be grounded.



3.4.2

Instrument Battery

Inserting and removing the Battery step-by-step



Step	Description
1.	Face the instrument so that the vertical drive screw is on the left. The battery compartment is now on the left side of the instrument. Turn the knob to the vertical position, opening the lid of the battery compartment.
2.	Pull out the battery housing.
3.	Pull the battery from the battery housing.
4.	A pictogram of the battery is displayed inside the battery housing. This is a visual aid to assist in placing the battery correctly.

Step	Description
5.	Place the battery into the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
6.	Place the battery housing into the battery compartment. Push the battery housing in until it fits completely into the battery compartment.
7.	Turn the knob to lock the battery compartment. Ensure that the knob is returned to its original horizontal position.

3.5

Working with the CompactFlash Card

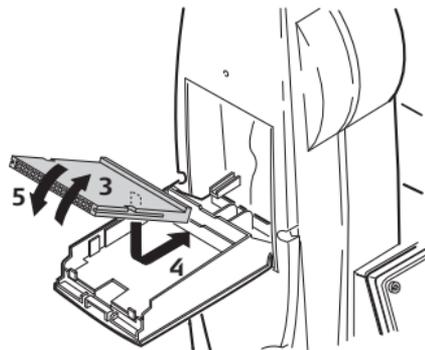


- Keep the card dry.
- Use it only within the specified temperature range.
- Do not bend the card.
- Protect the card from direct impacts.



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

Insert and remove a CompactFlash card step-by-step



Step	Description
1.	Face the instrument so that the vertical drive screw is on the left. The CompactFlash card compartment is now on the right side of the instrument. Turn the knob to the vertical position, opening the lid of the CompactFlash card compartment.
2.	Open the lid of the CompactFlash card compartment.
3.	Pull the front of the CompactFlash card up and take the card out of the lid.
4.	Place the lower end of the CompactFlash card at the lower end of the CompactFlash card compartment. The extended edge of the card has to be on the upper side as shown on the pictogram in the CompactFlash card compartment.
5.	Press the card down on the lid.
6.	Close the lid.
7.	Turn the knob to lock the CompactFlash card compartment. The lid is closed correctly when the knob is turned to a horizontal position.

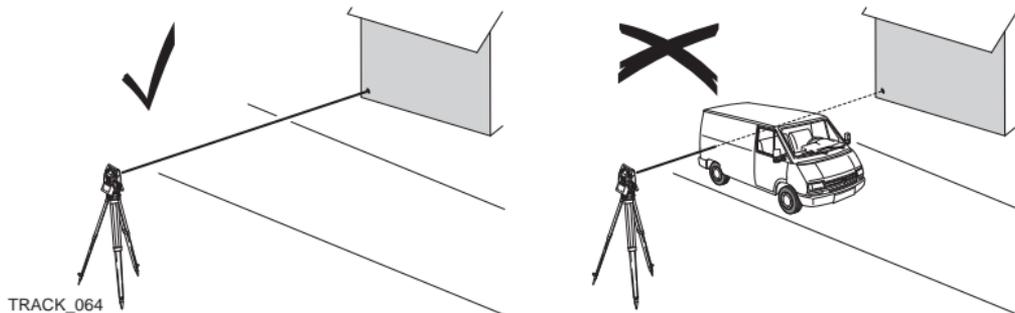
3.6

Guidelines for Correct Results



Very short distances may be measured reflectorless in IR mode to well reflecting targets. Note that the distances are corrected with the additive constant defined for the active reflector.

Distance measurement



When measurements are being made using the red laser EDM, the results may 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 road, but a vehicle passes between the EDM and the target surface as a 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 road surface.



Accurate measurements to prisms should not be made in reflectorless 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.



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

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.



As with all other instrument errors, the collimation error of the automatic target recognition must be redetermined periodically. Refer to the GeoPad/Site Foreman manual about checking and adjusting instruments.



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.



Warning

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

4 Check & Adjust

4.1 Overview

Description

Leica 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 can be done in the field by running through specific measurement procedures. The procedures are guided and have to 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:

l, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Hz collimation error, also called line of sight error
a	Tilting axis error
ATR	ATR zero point error for Hz and V - option

Every angle measured in the daily work is corrected automatically if the compensator and the Hz-corrections are activated in the instrument configuration.

Mechanical adjustment

The following instrument parts can be adjusted mechanically:

- Circular level on instrument and tribrach
 - Laser plummet
 - 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.
 - Refer to "4.2 Preparation" to find more important points.
-



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 transportations
 - 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 adjust- ment
c - Line of sight error	✓	---	✓	✓
a - Tilting axis error	✓	---	✓	✓
l - Compensator index error	---	✓	✓	✓
t - Compensator index error	✓	---	✓	✓
i - V-Index error	---	✓	✓	✓
ATR Collimation error	✓	✓	---	✓

4.2

Preparation



Before determining the instrument errors, the instrument has to be levelled-up using the electronic level. Please refer to the Controller manual in order to use the electronic level.

The tribrach, the tripod and the underground should be very stable and secure from vibrations or other disturbances.



The instrument should be protected from direct sunlight in order to avoid thermal warming.

It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are usually early in the morning or with overcast sky.



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



Note, that even after good adjustment of the ATR, the crosshairs might not be positioned exactly on the centre of the prism after an ATR measurement has been executed. This is a normal effect. To speed up the ATR measurement, the telescope is normally not positioned exactly on the centre of the prism. The small rest deviations, the ATR offsets are measured individually for each measurement and corrected electronically. This means that the Hz- and V- angles are corrected twice: first by the determined ATR errors for Hz and V and then by the individual small deviations of the current pointing.

4.3

Combined Adjustment (I, t, i, c and ATR)

Description

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

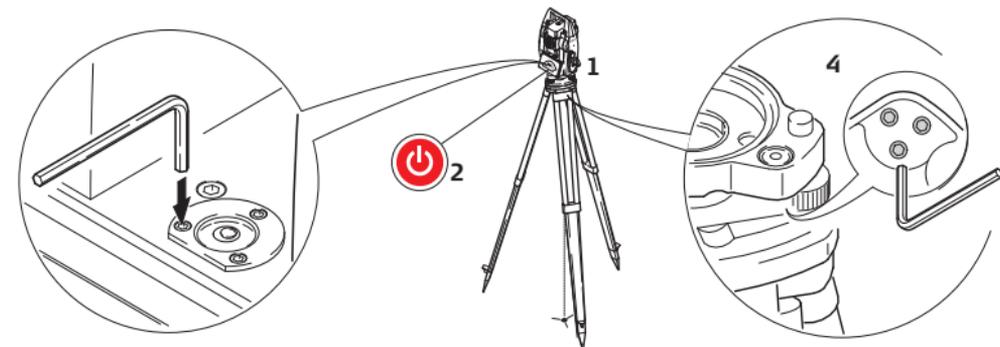
I, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Hz collimation error, also called line of sight error
ATR Hz	ATR zero point error for Hz angle - option
ATR V	ATR zero point error for V angle - option



Refer to GeoPad/Site Foreman manual to gain further informations regarding all adjustment procedure.

4.4 Adjusting the Circular Level of the Instrument and Tribrach

Adjusting the circular level step-by-step



TRACK_018

Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level.
3.	Check the position of the circular level on the instrument and tribrach.

Step	Description
4.	a) If both circular levels are centered, no adjustments are necessary
	b) If one or both circular levels are not centered, 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 centered. Tribach: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws.
	After the adjustments, all adjusting screws should have the same tightening tension and no adjusting screw shall be loose.

4.5

Adjusting the Circular Level of the Prism Pole

Adjusting the circular level step-by-step

Step	Description	
1.	Suspend a plumb line.	
2.	Using a pole bipod, align the prism pole parallel to the plumb line.	
3.	Check the position of the circular level on the prism pole.	
4.	a) If the circular level is centered, no adjustment is necessary. b) If the circular level is not centered, use an allen key to centre it with the adjustment screws.	
	After the adjustments, all adjusting screws should have the same tightening tension and no adjusting screw shall be loose.	

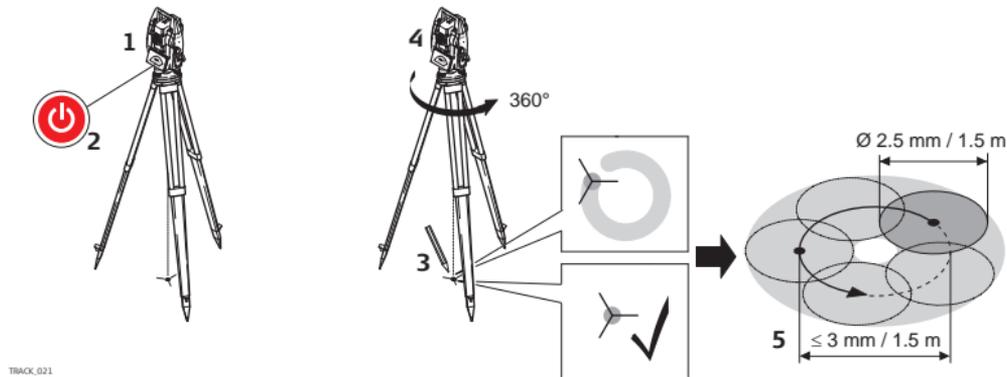
4.6

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, the instrument has to be returned to any Leica Geosystems authorised service workshop.

Inspecting the laser plummet step-by-step



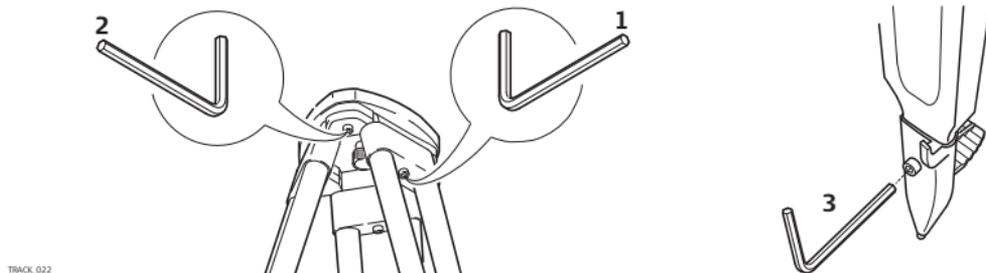
The following table explains the most common settings.

Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level. Refer to GeoPad/Site Foreman manual to access electronic level.
3.	Switch on the laser plummet. Refer to GeoPad/Site Foreman manual to access laser plummet. Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, like a sheet of paper.
4.	Mark the centre of the red dot on the ground.
5.	Turn the instrument through 360° slowly, carefully observing the movement of the red laser dot.
	The maximum diameter of the circular movement described by the centre of the laser point should not exceed 3 mm at a distance of 1.5 m.
6.	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 workshop. Depending on brightness and surface, the diameter of the laser dot can vary. At 1.5 m it is about 2.5 mm.

4.7

Servicing the Tripod

Servicing the tripod step-by-step



TRACX_022

The following table explains the most common settings.

Step	Description
	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 just enough to keep the tripod legs open when lifting the tripod off the ground.
3.	Tighten the allen screws of the tripod legs.

5 Care and Transport

5.1 Transport

Transport in the field

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

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

Transport in a road vehicle

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

Shipping

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

Shipping, transport of batteries

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.

Field adjustment

After transport inspect the field adjustment parameters given in this user manual before using the product.

5.2

Storage

Product

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

Field adjustment

After long periods of storage inspect the field adjustment parameters given in this user manual before using the product.

Li-Ion batteries

- Refer to "7.7 General Technical Data" for information about storage temperature range.
 - A storage temperature range of -20°C to +30°C/-4°F to +86°F in a dry environment is recommended to minimise self-discharging of the battery.
 - At the recommended storage temperature range, batteries containing a 10% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.
 - Remove batteries from the product and the charger before storing.
 - After storage recharge batteries before using.
 - Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
-

5.3 Cleaning and Drying

Objective, eyepiece and prisms

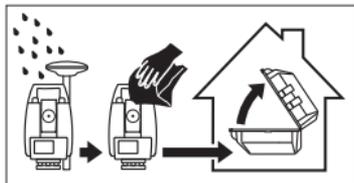
- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Fogging of prisms

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

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. Do not repack until everything is completely dry. Always close the transport container when using in the field.



**Charger and
AC-adapter**

Use only dry, clean, soft and lint-free cloths for cleaning.

Cables and plugs

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

5.4

Maintenance

Motorisation

Maintenance of the motorisation in motorised products must be done in a Leica Geosystems authorised service workshop.

Following conditions:

- After about 4000 hours operation.
 - Twice a year in case of permanent use of the product.
-

6 Safety Directions

6.1 General Introduction

Description

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

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

6.2

Intended Use

Permitted use

- Measuring horizontal and vertical angles.
 - Measuring distances.
 - Recording measurements.
 - Automatic target search, recognition and -tracking.
 - Visualizing the aiming direction and vertical axis.
 - Remote control of product.
 - Data communication with external appliances.
 - Computing with software.
-

Adverse use

- Use of the product without instruction.
- Use outside of the intended limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is specifically permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obviously recognizable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.

- Aiming directly into the sun.
- Inadequate safeguards at the working site, for example when measuring on roads.
- Deliberate dazzling of third parties.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.

 **Warning**

Adverse use can lead to injury, malfunction and damage.

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

 **Warning**

Unauthorised modification of building and constructions machines by mounting or installing the product may alter the function and safety of the machine.

Precautions:

Follow the instructions of the machine manufacturer. If no appropriate instruction is available, ask machine manufacturer for instructions before mounting or installing the product.

6.3

Limits of Use

Environment

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



Danger

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

For Charger and AC-adapters

Suitable for use in dry environments only and not under adverse conditions.



6.4

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 completely safe condition.

Manufacturers of non Leica Geosystems accessories

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

Person in charge of the product

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

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of radio transmitters are respected.



Warning

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

 **Warning**

This product may be installed on building and construction machinery only by an appropriately trained and qualified specialist.

6.5

Hazards of Use

6.5.1

Safety hazards related to the product



Warning

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.



Caution

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

Precautions:

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

 **Danger**

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



 **Caution**

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**

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.

-
-  **Caution** Be careful when pointing the product towards the sun, because the telescope functions as a magnifying glass and can injure your eyes and/or cause damage inside the product.
- Precautions:**
Do not point the product directly at the sun.
-
-  **Warning** During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.
- Precautions:**
The person responsible for the product must make all users fully aware of the existing dangers.
-
-  **Warning** Inadequate securing of the working site 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 and accident prevention and road traffic.
-
-  **Warning** Only Leica Geosystems authorised service workshops are entitled to repair these products.
-

 **Warning**

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

Precautions:

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

 **Caution**

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

Precautions:

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

Avoid subjecting the product to mechanical stress.

 **Caution**

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

Precautions:

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

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

-
-  **Warning** If charged or discharged, batteries not recommended by Leica Geosystems may be damaged. They may burn and explode.
Precautions:
Only charge and discharge batteries recommended by Leica Geosystems.
-
-  **Warning** Using a battery charger not recommended by Leica Geosystems can destroy the batteries. This can cause fire or explosions.
Precautions:
Only use chargers recommended by Leica Geosystems to charge the batteries.
-
-  **Warning** High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.
Precautions:
Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.
-
-  **Warning** If battery terminals come in contact with jewellery, keys, metallised paper or other metals, short circuited battery terminals 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.
-

 **Caution**

During the operation of the product there is a hazard of squeezing extremities or entanglement of hairs and/or clothes by moving parts.

Precautions:

Keep a safe distance of the moving parts.

 **Caution**

Installing near mechanically moving machine components may damage the product.

Precautions:

Deflect the mechanically moving machine components as far as possible and define a safe installation zone.

 **Caution**

Beware of inadequate steering if machine is defective like after a crash or other damaging events or alterations to the machine.

Precautions:

Periodically perform control measurements and field adjustments on the machine as specified in the User Manual. While working, construction and grading should be checked by appropriate means, for example spirit level, tachymeter, before and after important measuring tasks.

 **Warning**

While steering or navigating the machine accidents can occur due:

- the operator not paying attention to the surroundings (persons, ditches, traffic, etc.), or
- malfunctions of a system component, interference etc.

Precautions:

The operator assures that the machine is operated, guided and monitored by a qualified user (e.g. driver). The user has to be able to take emergency measures, for example an emergency stop.

**For the
AC-Adapters** **Warning**

The following must be obtained for handling of AC-Adapters:

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

- touching live components, or
- using the product after incorrect attempts were made to carry out repairs.

Precautions:

Do not open the product. Only Leica Geosystems authorised service workshops are entitled to repair these products.

Units equipped with a ground connector



The following refers to units, which are equipped with a ground connector:

If unit is not connected to ground, death or serious injury can occur.

Precautions:

To avoid electric shock power cable and power outlet must be grounded.



For the AC-Adapters and Chargers



The following must be obtained for handling with AC-Adapters and Chargers:

The product is not designed for use under wet and severe conditions. If unit becomes wet it may cause you to receive an electric shock.

Precautions:

Use the product only in dry environments, for example in buildings or vehicles. Protect the product against humidity. If the product becomes humid, it must not be used!



 **Warning**

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

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

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 downloaded from the Leica Geosystems home page at <http://www.leica-geosystems.com/treatment> or received from your Leica Geosystems dealer.

6.6

6.6.1

Laser Classification

General

General

The following directions (in accordance with the state of the art - international standard IEC 60825-1 (2007-03) and IEC TR 60825-14 (2004-02)) provide instruction and training information to 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.



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.



Products classified as laser class 2 or class 3R may cause dazzle, flash-blindness and afterimages, particularly under low ambient light conditions.

6.6.2

Distancer, Measurements with Reflectors (IR mode)

General

The EDM module built into this 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 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "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
Maximum average radiant power	0.33 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm

Labelling

Type: iCR.... **Art.No.:**

Equipo.No.:

Power: 12V / 7,4V \approx , 1A max

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured:

Made in Switzerland

S.No.:

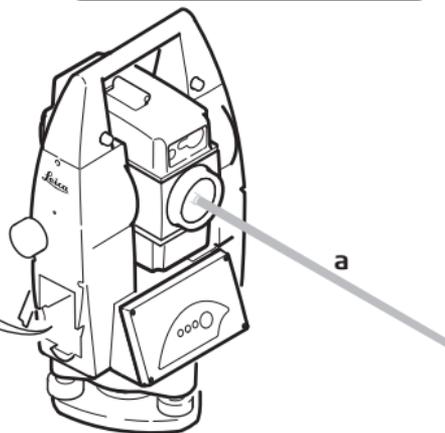
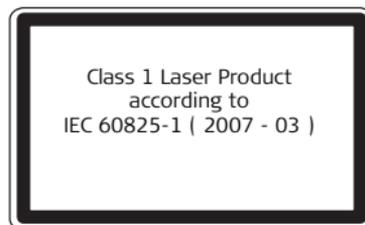




Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.

This device complies with part 15 of the FCC Rules.

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



TRACK_023

a) Laser beam

6.6.3

Distancer, Measurements without Reflectors (RL mode)

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 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

Direct intrabeam viewing may be hazardous (low-level eye hazard), in particular for deliberate ocular exposure. 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
Maximum average radiant power	5.00 mW
Pulse duration	800 ps
Pulse repetition frequency	100 MHz - 150 MHz
Wavelength	650 nm - 690 nm
Beam divergence	0.2 mrad x 0.3 mrad
NOHD (Nominal Ocular Hazard Distance) @ 0.25s	80 m / 262 ft

 **Warning**

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.

 **Warning**

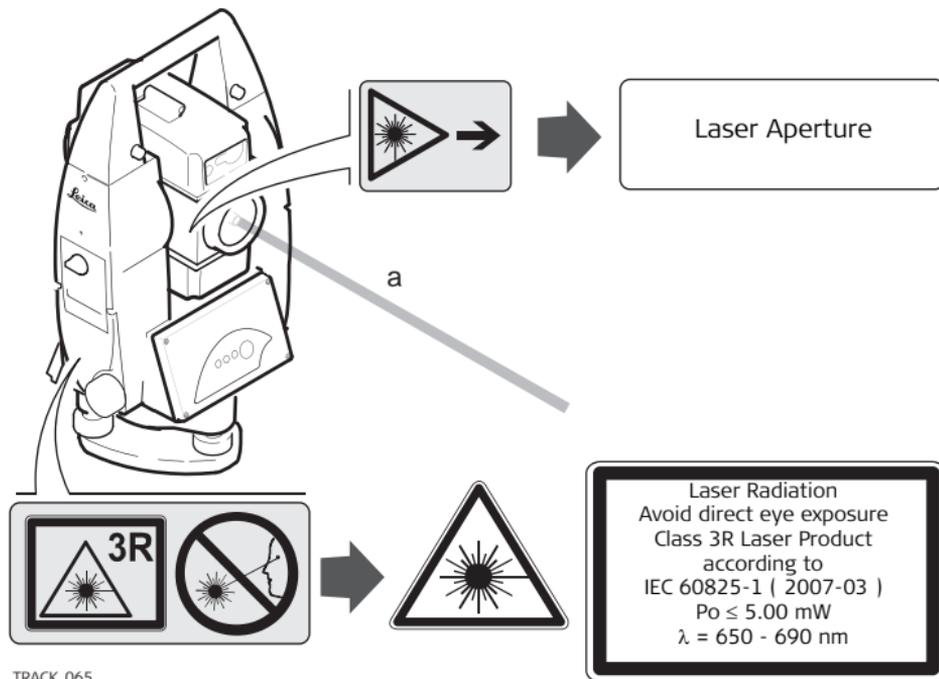
Potential hazards are not only related to direct beams but also to reflected beams aimed at reflecting surfaces such as prisms, windows, mirrors, metallic surfaces etc.

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



Type: iCR.... Art.No.:

Equipo.No.:

Power: 12V / 7,4V \approx , 1A max

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured:

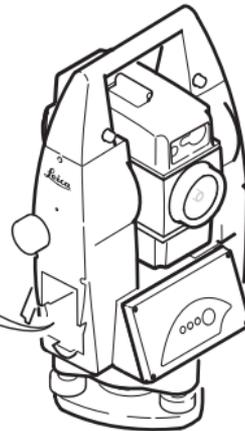
Made in Switzerland

 S.No.:



Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.

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



TRACK_066

6.6.4

Automatic Target Recognition ATR

General

The Automatic Target Recognition built into this 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 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "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
Maximum peak radiant power	10 mW
Pulse duration	11 ms
Pulse repetition frequency	37 Hz
Wavelength	785 nm

Labelling

Type: iCR.... **Art.No.:**

Equipo.No.:

Power: 12V / 7,4V $\overline{\text{---}}$, 1A max

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured:

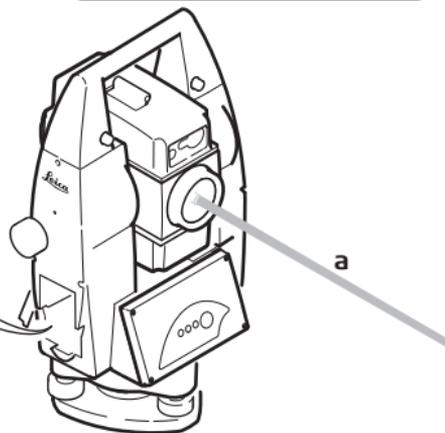
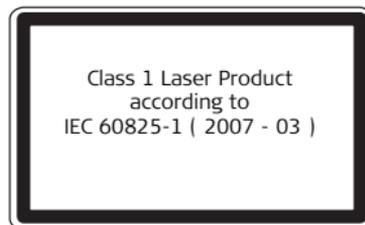
Made in Switzerland

 **S.No.:**

CE

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.

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



TRACK_024

a) Laser beam

6.6.5

PowerSearch PS

General

The PowerSearch built into this 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 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "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
Maximum peak radiant power	11 mW
Pulse duration	20 ns, 40 ns
Pulse repetition frequency	24.4 kHz
Wavelength	850 nm

Labelling

Type: iCR.... Art.No.:

Equipo.No.:

Power: 12V / 7,4V $\overline{\text{---}}$, 1A max

Leica Geosystems AG

CH-9435 Heerbrugg

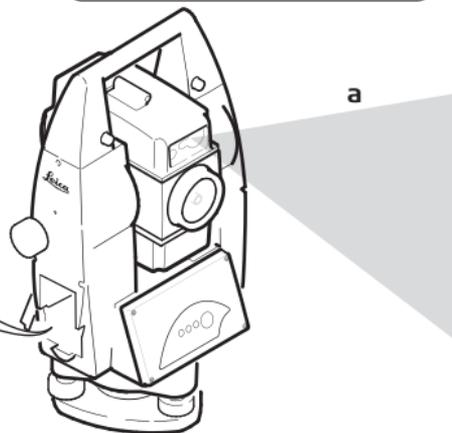
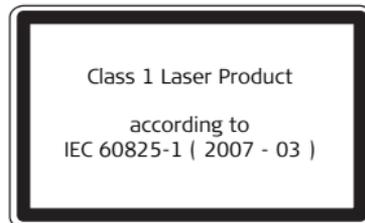
Manufactured:

Made in Switzerland

S.No.:

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.

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



TRACK_025

a) Laser beam

6.6.6

Electronic Guide Light EGL

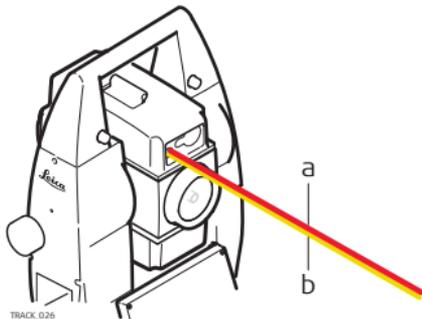
General

The integrated Electronic Guide Light produces a visible LED beam from the front side of the telescope. Depending on the type of telescope the EGL may be designed differently.



The product described in this section, is excluded from the scope of IEC 60825-1 (2007-03): "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.



- a) LED beam red
- b) LED beam yellow

6.6.7

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 (2007-03): "Safety of laser products".
- EN 60825-1 (2007-10): "Safety of laser products"

Class 2 laser products:

These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam.

Description	Value
Maximum average radiant power	1.00 mW
Pulse duration	0-100%
Pulse repetition frequency	1 kHz
Wavelength	620 nm - 690 nm

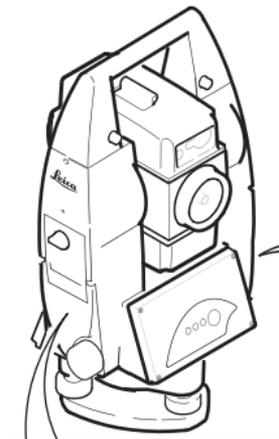
 **Warning**

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

Precautions:

Avoid staring into the beam or pointing the beam at other people.

Labelling



Type: iCR.... **Art.No.:**

Equipo.No.:

Power: 12V / 7,4V ~~, 1A max

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured:

Made in Switzerland

S.No.:



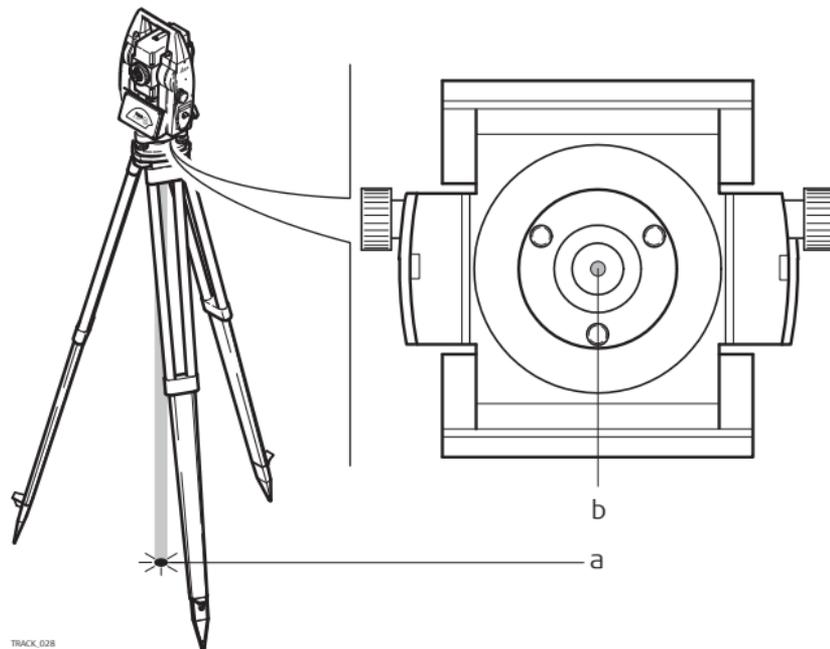


Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.

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



Laser Radiation
 Do not stare into the beam
 Class 2 Laser Product
 according to
 IEC 60825-1 (2007 - 03)
 $P_o \leq 1.00 \text{ mW}$
 $\lambda = 620 - 690 \text{ nm}$



TRACK_028

- a) Laser beam
- b) Exit for laser beam

6.7 Electromagnetic Compatibility EMC

Description

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



Warning

Electromagnetic radiation can cause disturbances in other equipment.

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



Caution

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

Precautions:

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

 **Caution**

Disturbances caused by electromagnetic radiation can result in erroneous measurements.

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

Precautions:

Check the plausibility of results obtained under these conditions.

 **Warning**

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

Precautions:

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

Radios, Bluetooth

Use of product with radio devices and Bluetooth:

**Warning**

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

Precautions:

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

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
 - Do not operate the product with radio or digital cellular phone devices near to medical equipment.
 - Do not operate the product with radio or digital cellular phone devices in aircraft.
-

6.8

FCC Statement, Applicable in U.S.

Applicability

The greyed paragraph below is only applicable for products of the iCON robot 50 System without radio, digital cellular phone devices or Bluetooth.

Warning

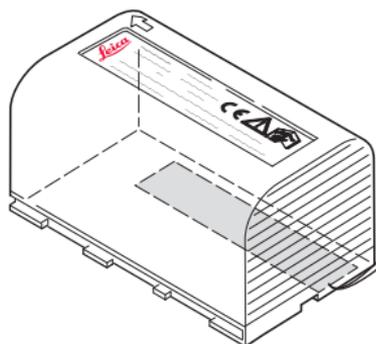
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

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.

**Labelling
internal battery
GEB211, GEB221**

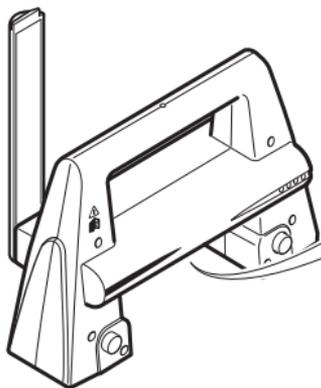


This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



TRACK_032

Labelling Communication- Handle



TRACK_003

Type: CCD... **Art.No.:**

Power: 7.4/12V⁼⁼, nominal 0.2A max.
100mW EIRP

Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: 2004
Made in Switzerland

This device contains
a transmitter:
FCC ID: HSW-2410M S.No.: XXXXXX

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



Available Communication- Handle types

The following CommunicationHandle types are available:

- RH 1200 radio handle
- CCD1 with WiFi
- CCD2 with long range Bluetooth

Exposure to Radio Frequency (RF) Signals

The wireless device is a radio transmitter and receiver. It is designed and manufactured not to exceed the emission limit for exposure to radio frequency (RF) energy set by the OET Bulletin 65 Supplement C / Ministry of Health (Canada), Safety Code 6. These limits are part of comprehensive guidelines and established permitted levels of RF energy for the general population. These guidelines are based on the safety standards previously set by international standard bodies. These standards include a substantial safety margin designed to assure the safety of all persons, regardless of age and health.

This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general public exposure limits specific in ANSI/IEEE C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.

6.9

ICES-003 Statement, Applicable in Canada



This Class (B) digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe (B) est conforme à la norme NMB-003 du Canada.

7 Technical Data

7.1 Angle Measurement

Accuracy

Type	std. dev. Hz, V, ISO 17123-3		Display least count	
	["]	[mgon]	["]	[mgon]
iCON robot 50	2	0.6	0.1	0.5
iCON robot 50	5	1.5	0.1	0.5

Characteristics

Absolute, continuous, diametric.

7.2

Distance Measurement with Reflectors (IR mode)

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1800	6000	3000	10000	3500	12000
3 standard prisms (GPR1)	2300	7500	4500	14700	5400	17700
360° prism (GRZ4, GRZ121, GRZ122, MPR122)	800	2600	1500	5000	2000	7000
360° Mini prism (GRZ101)	450	1500	800	2600	1000	3300
Mini prism (GMP101)	800	2600	1200	4000	2000	7000
Reflector tape 60 mm x 60 mm	150	500	250	800	250	800

Shortest measuring distance: 1.5 m

Atmospheric conditions

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



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

Accuracy

Accuracy refers to measurements to standard prisms.

EDM measuring mode	std. dev. ISO 17123-4, standard prism	std. dev. ISO 17123-4, tape	Measurement time, typical [s]
Standard	1 mm + 1.5 ppm	5 mm + 2 ppm	2.4
Fast	3 mm + 1.5 ppm	5 mm + 2 ppm	0.8
Tracking	3 mm + 1.5 ppm	5 mm + 2 ppm	< 0.15
Averaging	1 mm + 1.5 ppm	5 mm + 2 ppm	-

Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.
The display resolution is 0.1 mm.

Characteristics

Principle: Phase measurement
 Type: Coaxial, visible red laser
 Carrier wave: 660 nm
 Measuring system: System analyzer basis 100 MHz - 150 MHz

7.3

Distance Measurement without Reflectors (RL mode)

Range

Kodak Gray Card	Range D		Range E		Range F	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
White side, 90 % reflective	200	660	250	825	250	825
Grey side, 18 % reflective	150	490	200	660	>200	>660

Range of Measurement: 1.5 m - 250 m

Atmospheric conditions

D: Object in strong sunlight, severe heat shimmer
E: Object in shade, sky overcast
F: Underground, night and twilight

Accuracy

Standard measuring	std. dev. ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
0 m - 250 m	2 mm + 2 ppm	3 - 6	12

Object in shade, sky overcast.

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

Characteristics

Type:	Coaxial, visible red laser
Carrier wave:	658 nm
Measuring system PinPoint:	System analyzer basis 100 MHz - 150 MHz

Laser dot size

Distance [m]	Laser dot size, approximately [mm]
at 20	7 x 14
at 100	12 x 40
at 200	25 x 80

7.4

Automatic Target Recognition ATR

Range ATR/LOCK

Reflector	Range ATR mode		Range Lock mode	
	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1000	3300	800	2600
360° prism (GRZ4, GRZ121, GRZ122, MPR122)	600	2000	500	1600
360° Mini prism (GRZ101)	350	1150	300	1000
Mini prism (GMP101)	500	1600	400	1300
Reflector tape 60 mm x 60 mm	55	175	not qualified	

Shortest measuring distance: 360° prism ATR:

1.5 m

Shortest measuring distance: 360° prism LOCK:

5 m

ATR accuracy with the GPR1 prism

ATR angle accuracy Hz, V (std. dev. ISO 17123-3):

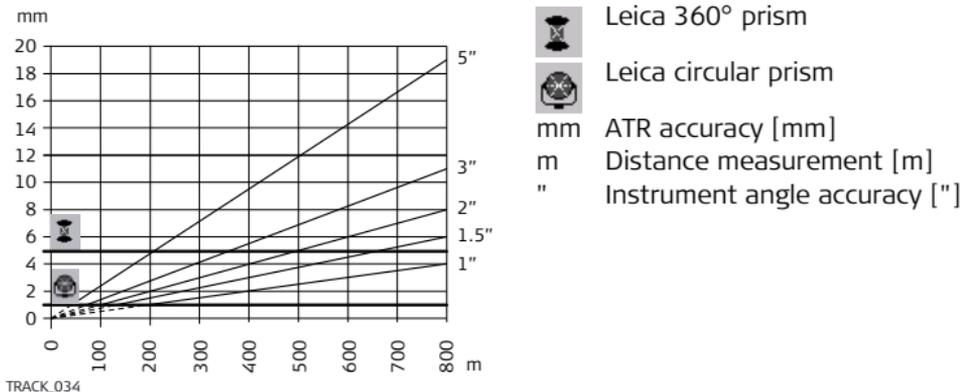
1 " (0.3 mgon)

Base Positioning accuracy (std.dev.):

± 1 mm

System accuracy with ATR

- The accuracy with which the position of a prism can be determined with Automatic Target Recognition (ATR) depends on several factors such as internal ATR accuracy, instrument angle accuracy, prism type, selected EDM measuring program and the external measuring conditions. The ATR has a basic standard deviation level of ± 1 mm. Above a certain distance, the instrument angle accuracy predominates and takes over the standard deviation of the ATR.
- The following graph shows the ATR standard deviation based on two different prism types, distances and instrument accuracies.



Maximum speed in lock mode	Maximum tangential speed:	5 m/s at 20 m; 25 m/s at 100 m
	Maximum radial speed with <EDM Mode: Tracking>:	5 m/s
Searching	Typical search time in field of view:	1.5 s
	Field of view:	1°25'/1.55 gon
	Definable search windows:	Yes
Characteristics	Principle:	Digital image processing
	Type:	Infrared laser

7.5

PowerSearch PS

Range

Reflector	Range PS	
	[m]	[ft]
Standard prism (GPR1)	300	1000
360° prism (GRZ4, GRZ121, GRZ122, MPR122)	300*	1000*
Mini prism (GMP101)	100	330

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

Shortest measuring distance: 1.5 m

Searching

Typical search time: < 10 s
 Default search area: Hz: 400 gon, V: 40 gon
 Definable search windows: Yes

Characteristics

Principle: Digital signal processing
 Type: Infrared laser

7.6

7.6.1

Conformity to national regulations

Conformity to National Regulations ConstructionRobot



Hereby, Leica Geosystems AG, declares that the iCON robot 50 is in compliance with the essential requirements and other relevant provisions of the applicable European Directives. The declaration of conformity may be consulted at <http://www.leica-geosystems.com/ce>.

7.6.2

Communication side cover with Bluetooth

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the Communication side cover with Bluetooth is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at <http://www.leica-geosystems.com/ce>.



Class 1 equipment according European Directive 1999/5/EC (R&TTE) 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 1999/5/EC has to be approved prior to use and operation.
-

Frequency band

2402 - 2480 MHz

Output power

Bluetooth: 5 mW (Class 1)

Antenna

Type Internal Microstrip antenna
Gain 1.5 dBi

7.6.3

CommunicationHandle

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the CommunicationHandle is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at <http://www.leica-geosystems.com/ce>.



Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorization for use:

- France
 - Italy
 - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Frequency band

Limited to 2409 - 2435 MHz

Output power

< 100mW (e.i.r.p.) (for CCD2 with long range Bluetooth : Class 1)

Antenna

Type:	Patch antenna (omnidirectional)
Gain:	2 dBi
Connector:	SMB

**Exposure to Radio
Frequency (RF)
Signals**

The wireless device is a radio transmitter and receiver. It is designed and manufactured not to exceed the emission limit for exposure to radio frequency (RF) energy set by the OET Bulletin 65 Supplement C / Ministry of Health (Canada), Safety Code 6. These limits are part of comprehensive guidelines and established permitted levels of RF energy for the general population. These guidelines are based on the safety standards previously set by international standard bodies. These standards include a substantial safety margin designed to assure the safety of all persons, regardless of age and health.

This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general public exposure limits specific in ANSI/IEEE C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.

7.7

General Technical Data

7.7.1

iCON robot 50 Technical Data

Telescope

Magnification:	30 x
Clear objective diameter:	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

Type	Setting accuracy		Setting range	
	["]	[mgon]	[']	[gon]
iCON robot 50	1	0.3	4	0.07
iCON robot 50	1.5	0.5	4	0.07

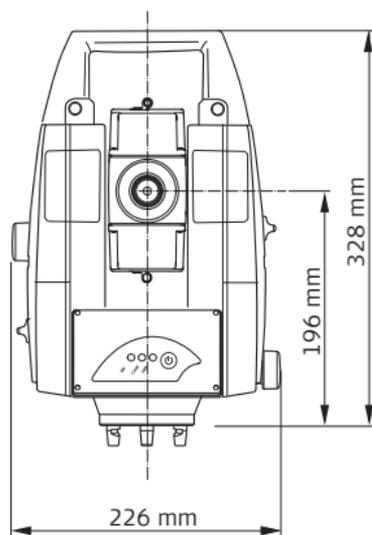
Level

Circular level sensitivity:	6'/2 mm
Electronic level resolution:	2"

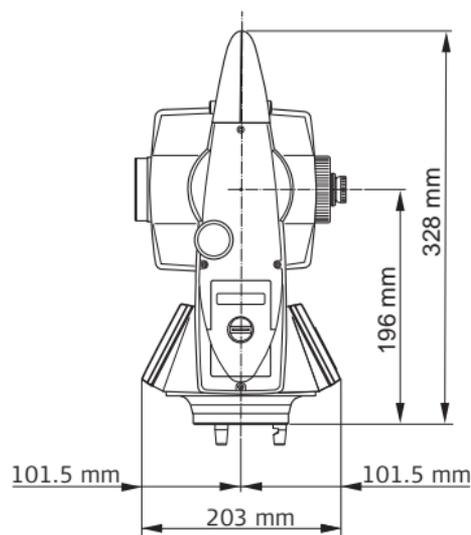
Instrument Ports

Port	Name	Description
Port 1	Port 1	<ul style="list-style-type: none">• 5 pin LEMO-0 for power, communication, data transfer.• This port is located at the base of the instrument.
Port 2	Handle	<ul style="list-style-type: none">• Hotshoe connection for CommunicationHandle with RCS.• This port is located on top of Communication side cover.
Port 3	BT	<ul style="list-style-type: none">• Bluetooth module for communication.• This port is housed within Communication side cover.

Instrument Dimensions



TRACK_035



TRACK_036

Weight

Instrument:	4.8 - 5.5 kg
Tribrach:	0.8 kg
Internal battery GEB221:	0.2 kg

Laser plummet

Type:	Visible red laser class 2
Location:	In standing axis of instrument
Accuracy:	Deviation from plumbline: 1.5 mm at 1.5 m instrument height
Diameter of laser point:	2.5 mm at 1.5 m instrument height

Drives

Type:	Endless horizontal and vertical drives
-------	--

Motorisation

Maximum rotating speed:	50 gon/s
-------------------------	----------

Power

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

Internal battery

Type:	Li-Ion
Voltage:	7.4 V
Capacity:	GEB221: 4.4 Ah
Typical operating time:	5 - 8 h

External battery

Type:	NiMH
Voltage:	12 V
Capacity:	GEB171: 8.0 Ah
Typical operating time:	18 - 24 h

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
iCON robot 50	-20 to +50	-40 to +70
Leica CompactFlash cards, all sizes	-40 to +80	-40 to +80
Battery internal	-20 to +55	-40 to +70
Bluetooth	-30 to +60	-40 to +80

Protection against water, dust and sand

Type	Protection
iCON robot 50	IP54 (IEC 60529)

Humidity

Type	Protection
iCON robot 50	Max 95 % non condensing The effects of condensation are to be effectively counter-acted by periodically drying out the instrument.

Reflectors

Type	Additive Constant [mm]	ATR	PS
Standard prism, GPR1	0.0	yes	yes
Mini prism, GMP101	+17.5	yes	yes
360° prism, GRZ4, GRZ121, GRZ122	+23.1	yes	yes
360° MA prism MPR122	+28.1	yes	yes
360° Mini prism	+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 PS.

**Electronic Guide
Light EGL**

Working range: 5 - 150 m
Positioning accuracy: 5 cm at 100 m

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
-

7.8

Scale Correction

Use

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 ΔD_1

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:

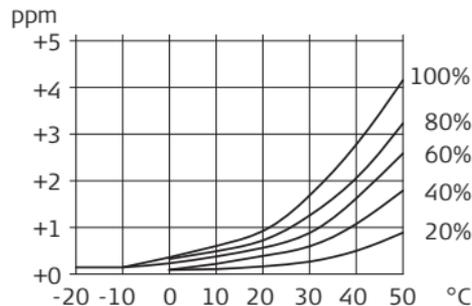
- Air temperature to 1°C
 - Air pressure to 3 mbar
 - Relative humidity to 20 %
-

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



TRACK_037

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

Index n

Type	Index n	carrier wave [nm]
combined EDM	1.0002863	660

The index n is calculated from the formula of Barrel and Sears, 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

$$\Delta D_1 = 286.269 \cdot \left[\frac{0.29528 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^x \right]$$

TRACK_052

ΔD_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 ΔD_2

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

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

TRACK_053

ΔD_2 Reduction to mean sea level [ppm]

H Height of EDM above sea level [m]

R $6.378 \cdot 10^6$ m

Projection distortion ΔD_3

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

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

TRACK_054

ΔD_3 Projection distortion [ppm]

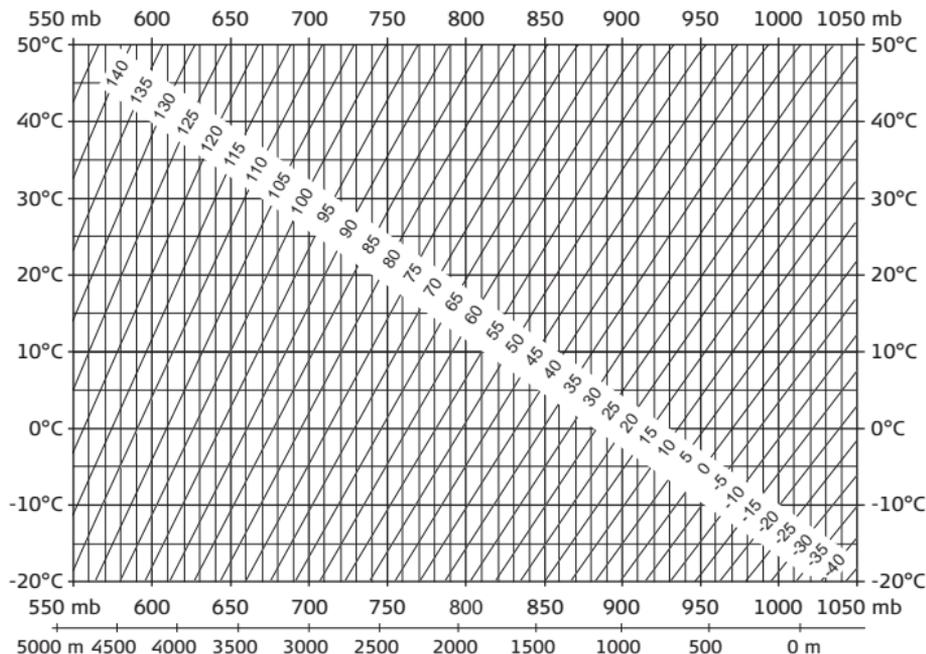
X Northing, distance from projection zero line with the scale factor 1 [km]

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

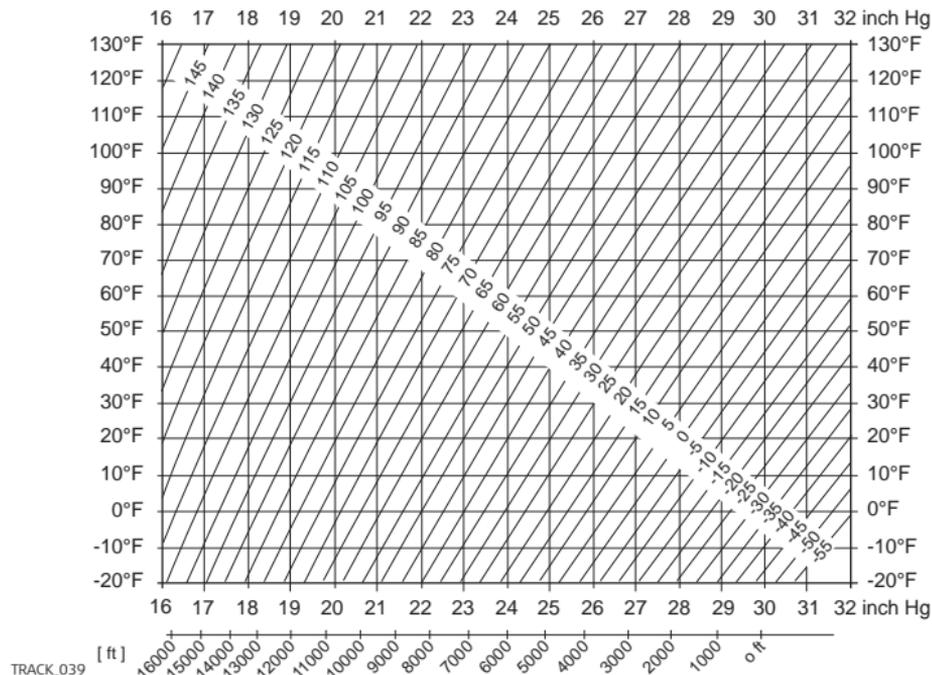
Atmospheric corrections in ppm with temperature [°C], air pressure [mb] and height [m] at 60 % relative humidity.



TRACK_038

Atmospheric correction F

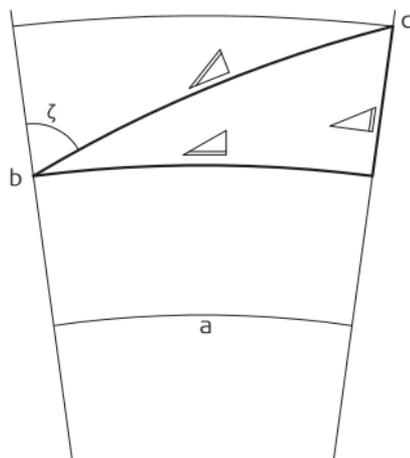
Atmospheric correction in ppm with temperature [F], air pressure [inch Hg] and height [ft] at 60 % relative humidity.



7.9

Reduction Formulas

Measurements



TRACK_040

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

Reflector types

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

- measurements to prisms and reflector tape.

Formulas

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

$\triangle = D_0 \cdot (1 + \text{ppm} \cdot 10^{-6}) + \text{mm}$	\triangle Displayed slope distance [m]
<small>TRACK_055</small>	D_0 Uncorrected distance [m]
	ppm Atmospheric scale correction [mm/km]
	mm Additive constant of the reflector [mm]
$\triangle = Y - A \cdot X \cdot Y$	\triangle Horizontal distance [m]
<small>TRACK_056</small>	\triangle Height difference [m]
	Y $\triangle \cdot \sin\zeta $
	X $\triangle \cdot \cos\zeta$
	ζ Vertical circle reading
$\triangle = X + B \cdot Y^2$	A $(1 - k/2)/R = 1.47 \cdot 10^{-7} [\text{m}^{-1}]$
<small>TRACK_057</small>	B $(1 - k)/2R = 6.83 \cdot 10^{-8} [\text{m}^{-1}]$
	k 0.13 (mean refraction coefficient)
	R $6.378 \cdot 10^6$ m (radius of the earth)

Earth curvature (1/R) and mean refraction coefficient (k) (if enabled on the Refraction page in Main Menu: Config...\Instrument Settings...\TPS Corrections) are automatically taken into account when calculating the horizontal distance and height difference. The calculated horizontal distance relates to the station height and not to the reflector height.

Distance measuring program Averaging

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

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

These values are calculated as follows:

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

TRACK_058

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

TRACK_059

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

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

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

TRACK_060

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

8 International Limited Warranty, Software License Agreement

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