



Version 3.0
English

Leica TS30/TM30

User Manual

- when it has to be **right**

Leica
Geosystems

Introduction

Purchase



Congratulations on the purchase of a TS30/TM30 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.

Product identification





The type and 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



- 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

	Description
General	This manual applies to all TS30/TM30 instruments. Where there are differences between the various models they are clearly described.
Telescope	<ul style="list-style-type: none"> • Measuring with IR mode: When measuring distances to a reflector with EDM mode "IR", the telescope uses a wide visible red laser beam, which emerges coaxially from the telescope's objective. • Measuring with RL mode and LO mode: When measuring distances with EDM modes "RL" and "LO", the telescope uses a narrow visible red laser beam, which emerges coaxially from the telescope's objective.

Available documentation

Name	Description/Format		
Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
User Manual	All instructions required in order to operate the product to a basic level are contained in this User Manual. Provides an overview of the system together with technical data and safety directions.	-	✓

Name	Description/Format		
System Field Manual	Describes the general working of the system in standard use. Intended as a quick reference field guide.	-	✓
Applications Field Manual	Describes specific onboard application programs in standard use. Intended as a quick reference field guide.	-	✓
Technical Reference Manual	Overall comprehensive guide to the system and program 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 TS30/TM30 documentation/software:

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

Table of Contents

In this manual	Chapter	Page
	1 Description of the System	11
	1.1 System Components	11
	1.2 System Concept	17
	1.2.1 Software Concept	17
	1.2.2 Data Storage and Data Conversion Concept	19
	1.2.3 Power Concept	21
	1.3 Container Contents	22
	1.4 Instrument Components	27
	2 User Interface	32
	2.1 Keyboard	32
	2.2 Screen	36
	2.3 Operating Principles	38
	2.4 Icons	44
	3 Operation	49
	3.1 Instrument Setup	49
	3.2 Autodetect Behaviour	52

3.3	Working with the RTK Device (SmartStation)	54
3.4	LED Indicators	62
3.5	Instrument Setup for Remote Control	71
3.6	Batteries	73
3.6.1	Operating Principles	73
3.6.2	Instrument Battery	74
3.6.3	Battery for SmartAntenna	76
3.7	Working with the CompactFlash Card	80
3.8	Accessing Survey Application Program	87
3.9	Guidelines for Correct Results	90
4	Check & Adjust	93
4.1	Overview	93
4.2	Preparation	97
4.3	Combined Adjustment (I, t, i, c and ATR)	99
4.4	Tilting Axis Adjustment (a)	103
4.5	Adjusting the Circular Level of the Instrument and Tribrach	107
4.6	Adjusting the Circular Level of the Prism Pole	109
4.7	Inspecting the Laser Plummet of the Instrument	110
4.8	Servicing the Tripod	112

5	Care and Transport	113
5.1	Transport	113
5.2	Storage	114
5.3	Cleaning and Drying	115
5.4	Maintenance	117
6	Safety Directions	118
6.1	General Introduction	118
6.2	Intended Use	119
6.3	Limits of Use	121
6.4	Responsibilities	122
6.5	Hazards of Use	124
6.6	Laser Classification	130
6.6.1	General	130
6.6.2	Distancer, Measurements with Reflectors	131
6.6.3	Distancer, Measurements without Reflectors	133
6.6.4	Automatic Target Aiming ATR	138
6.6.5	PowerSearch PS	140
6.6.6	Electronic Guide Light EGL	142
6.6.7	Laser Plummet	143

6.7	Electromagnetic Compatibility EMC	146
6.8	FCC Statement, Applicable in U.S.	149
7	Technical Data	155
7.1	Angle Measurement	155
7.2	Distance Measurement with Reflectors	156
7.3	Distance Measurement without Reflectors	159
7.4	Distance Measurement - Long Range (LO mode)	161
7.5	Automatic Target Aiming ATR	163
7.6	PowerSearch PS	168
7.7	SmartStation	170
7.7.1	SmartStation Accuracy	170
7.7.2	SmartStation Dimensions	172
7.7.3	SmartAntenna Technical Data	173
7.8	Conformity to National Regulations	178
7.8.1	Communication side cover with Bluetooth	178
7.8.2	GFU24, Siemens MC75	179
7.8.3	GFU19 (US), GFU25 (CAN) CDMA MultiTech MTMMC-C	181
7.8.4	GFU28, Telit UC864-G	183
7.8.5	RadioHandle	186
7.8.6	SmartAntenna with Bluetooth	188
7.9	General Technical Data of the Instrument	191

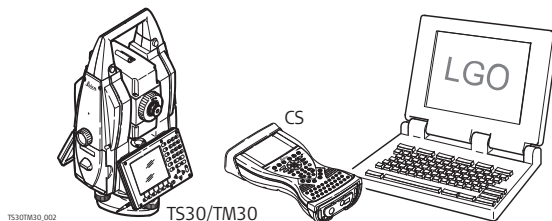
TS30/TM30, Table of Contents	10
7.10 Scale Correction	199
7.11 Reduction Formulas	205
8 International Limited Warranty, Software Licence Agreement	209
Index	211

1

Description of the System

1.1 System Components

Main components



Component	Description
TS30/TM30	<ul style="list-style-type: none">• an instrument for measuring, calculating and capturing data.• comprised of various models with a range of accuracy classes.

Component	Description
	<ul style="list-style-type: none">• integrated with an add-on GNSS system to form Smart-Station.• combined with a CS field controller to conduct remote control surveys.• connected with LGO to view, exchange and manage data.
CS field controller	A multi-purpose field controller enabling the remote control of TS30/TM30.
LGO	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
TPS	T otal S tation P ositioning S ystem
GNSS	G lobal N avigation S atellite S ystem (generic term for satellite-based navigation systems like GPS, GLONASS, Galileo, Compass, SBAS)
RCS	R emote C ontrol S urveying
LGO	L EICA G eo O ffice
EDM	E lectronic D istance M easurement EDM refers to the laser distancer incorporated into the instrument which enables distance measurement. Three 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.• LO mode. This mode refers to the visible red laser and the ability to measure extended distances to prisms.

Term	Description
PinPoint	PinPoint refers to the Reflectorless EDM technology which enables an increased measuring range with a smaller laser spot size. This is called R1000.
EGL	Electronic Guide Light 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.
Motorised	TS30/TM30 instruments are fitted with internal motors, enabling automatic horizontal and vertical turning are referred to as Motorised .
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
PowerSearch	PowerSearch refers to the instrument sensor which enables the automatic rapid finding of a prism.
SmartStation	<p>A TS30/TM30 instrument integrated with an add-on GNSS system, comprising hardware and software components, forms SmartStation.</p> <p>Components of SmartStation include SmartAntenna, SmartAntenna Adapter with attached clip-on-housing and antenna for a communication device and Communication side cover.</p> <p>SmartStation provides an additional instrument setup method for determining instrument station coordinates.</p> <p>The GNSS principles and functionality of SmartStation derive from the principles and functionality of GS15/GS12/GS09 instruments.</p>
SmartAntenna	SmartAntenna with integrated Bluetooth is a component of SmartStation. It can also be used independently on a pole, with a GNSS receiver and remote controller. Models available: GS15, GS12 and GS09. Where there are differences between the various models they are clearly described.

Term	Description
RadioHandle	A component of RCS is RadioHandle. It is both an integrated radio modem with attached antenna and instrument carry handle. Where there are differences between the various models they are clearly described.
Communication side cover	Communication side cover with integrated Bluetooth is a component of SmartStation. In combination with RadioHandle it is also a component of RCS.

Instrument models

Model	Description
TM30	Electronic tachymeter with Reflectorless EDM, Automated, Motorised. 0.5" and 1.0" accuracy.
TS30	Electronic tachymeter with Reflectorless EDM, Automated, Motorised, PowerSearch. 0.5" accuracy.

1.2

1.2.1

System Concept

Software Concept

Description

All instruments use the same software concept.

Software type

Software type	Description
System software	<p>This software comprises the central functions of the instrument. It is also referred to as firmware.</p> <p>The programs Survey and Setup are integrated into the firmware and cannot be deleted.</p> <p>The English language is integrated into the firmware and cannot be deleted.</p>
Language software	<p>Numerous languages are available for the instruments. This software is also referred to as system language.</p> <p>The system software enables a maximum of three languages which can be stored at any one time - the English language and two other languages. The English language is the default language and cannot be deleted. One language is chosen as the active language.</p>

Software type	Description
Application programs	<p>A suite of optional survey-specific application programs is available for the instrument.</p> <p>Some of the programs are activated freely and require no license key and others require purchasing and are only activated with a license key.</p>
Customised application programs	<p>Customised software specific to user requirements can be developed using the GeoC++ development kit. Information on the GeoC++ development environment is available on request from a Leica Geosystems representative.</p>

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 methods:

- Using LGO the software is transferred via the serial interface to the CompactFlash card in the instrument, which is then stored to the System RAM.
- 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 and Data Conversion Concept

Description

Data is stored within a job in a database on a memory device. This is either a CompactFlash card or an internal memory if fitted.

Memory device

CompactFlash card:

A CompactFlash card housing is standard. A CompactFlash card can be inserted and removed. Available capacity: 256 MB and 1 GB



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.

Internal memory:

An internal memory is optional. It resides inside the instrument. Available capacity: 256 MB.



Unplugging connecting cables or removing the CompactFlash card during the measurement may cause loss of data. Always return to the **Main Menu** before removing the CompactFlash card and switch off the instrument before removing cables.

Data conversion**Export**

Data can be exported from a job in a wide range of ASCII formats. The export format is defined in Format Manager which is a PC tool in LEICA Geo Office. Refer to the online help of LGO for information on creating format files.

Data can also be exported from a job in DXF or LandXML format.

Import

Data can be imported from ASCII, DXF, GSI8 or GSI16 format.

**Transfer raw data
to LGO**

Raw data can be transferred between the database on the CompactFlash card or the internal memory of the instrument and LGO in two ways:

- From the CompactFlash card or the internal memory directly via a serial interface to a project in LGO on a PC.
- From the CompactFlash card using for example an OMNI drive as supplied by Leica Geosystems to a project in LGO on a PC.



CompactFlash cards can be used directly in an OMNI drive as supported by Leica Geosystems. Other PC card drives may require an adapter.

1.2.3

Power Concept

General

Use 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 GEB241 battery fitted into the battery compartment.
External battery: One GEB171 battery connected via cable, or

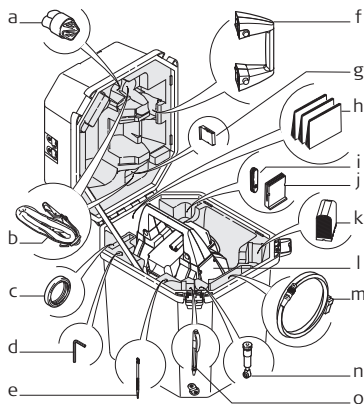
SmartAntenna

Power for the antenna is supplied internally.

Internal battery: One GEB211/GEB212 battery fitted into the antenna.

1.3

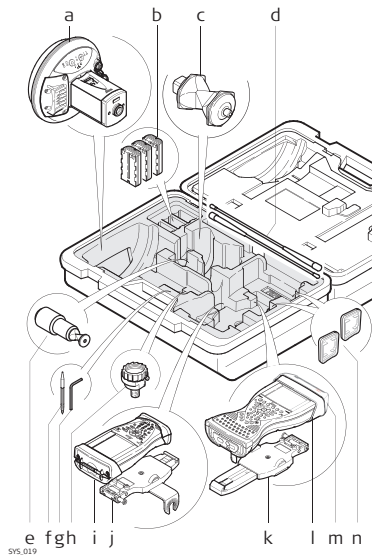
Container Contents

Container for
instrument and
accessories

TS30/TM30_003

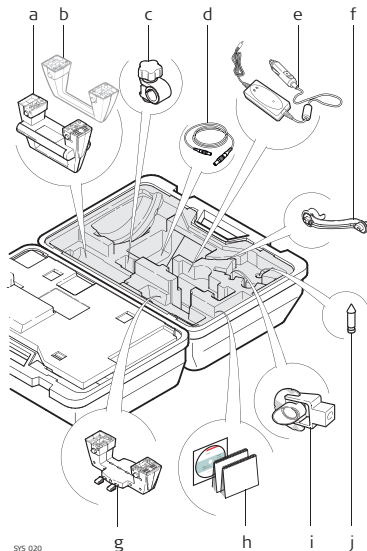
- a) Protective cover for instrument and sunshade for objective lens
- b) Container straps
- c) Counterweight for diagonal eyepiece or zenith eyepiece - optional
- d) Allen key
- e) Spare stylus
- f) Room for normal handle
- g) Compact Flash card with cover
- h) User manual
- i) Pocket knife - optional
- j) CompactFlash card adapter with cover
- k) Internal battery GEB241
- l) Instrument with supplied stylus and tribrach (with standard carry handle or RadioHandle attached)
- m) Data transfer cable GEV218
- n) Diagonal eyepiece GFZ3 or zenith eyepiece GOK6 (eyepiece for steep sighting) - optional
- o) Ball pen - optional

**Container for GS15
SmartPole/SmartStation and
accessories
part 1 of 2**



- a) GS15 instrument
- b) GEB211 / GEB212 battery
- c) GRZ4 / GRZ122 prism
- d) Radio antennas
- e) GRZ101 mini prism and GAD103 adapter
- f) Spare stylus
- g) Allen key
- h) GAD31 adapter
- i) CS10 field controller
- j) GHT62 holder
- k) GHT62 holder (extended)
- l) CS15 field controller
- m) CTR16 radio
- n) SD card / CompactFlash card and covers

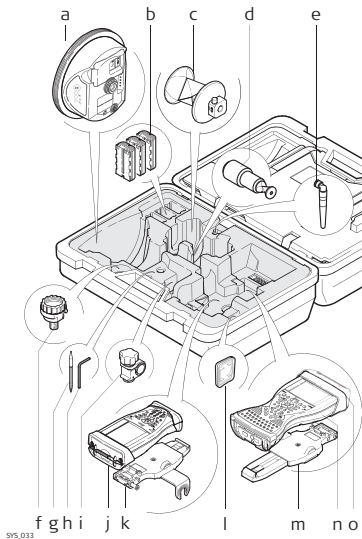
**Container for GS15
SmartPole/SmartStation and
accessories
part 2 of 2**



SYS_020

- a) RadioHandle
- b) Instrument carry handle
- c) GHT63 clamp
- d) Cables
- e) GDC221 car adapter for CS field controller
- f) GAD108 arm
- g) GAD110 adapter for GS15 instrument
- h) Manuals & DVD
- i) GMP101 mini prism
- j) Mini prism spike

**Container for GS12
SmartPole/SmartStation and
accessories
part 1 of 2**

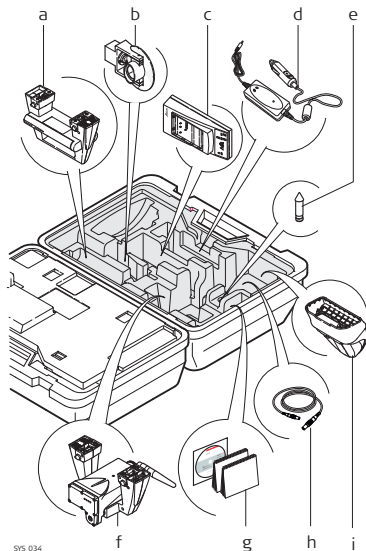


- a) GS12 instrument
- b) GEB211 / GEB212 battery
- c) GRZ4 / GRZ122 prism
- d) GRZ101 mini prism
- e) GAD103 adapter for GRZ101 mini prism
- f) GAD31 adapter
- g) Spare stylus
- h) Allen key
- i) GHT63 clamp
- j) CS10 field controller
- k) GHT62 holder
- l) SD card / CompactFlash card and covers
- m) GHT62 holder (extended)
- n) CS15 field controller
- o) CTR16 radio



The same container contents is valid for a GS09.

**Container for GS12
SmartPole/
SmartStation and
accessories
part 2 of 2**



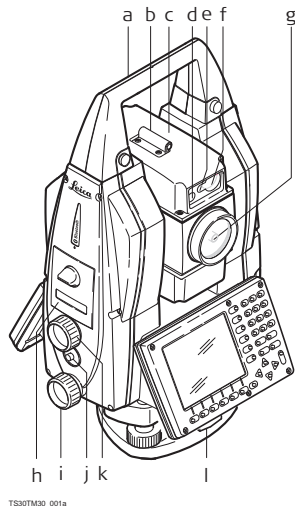
- a) RadioHandle
- b) GMP101 mini prism
- c) GKL211 battery charger
- d) GDC221 car adapter for CS field controller
- e) Mini prism spike
- f) GAD104 adapter for GS12 instrument
- g) Manuals & DVD
- h) Cables
- i) CGR10/CGR15 radio

1.4

Instrument Components

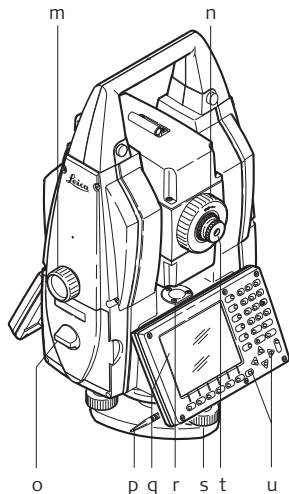
Instrument components part 1 of 2

A TS30 instrument is shown.



- a) Carry handle
- b) Optical sight
- c) Telescope, integrating EDM, ATR, for TS30 also EGL, PS
- d) EGL, for TS30
- e) PowerSearch, transmitter, for TS30
- f) PowerSearch, receiver, for TS30
- 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) User defined SmartKey
- k) Vertical drive
- l) Tribrach securing screw

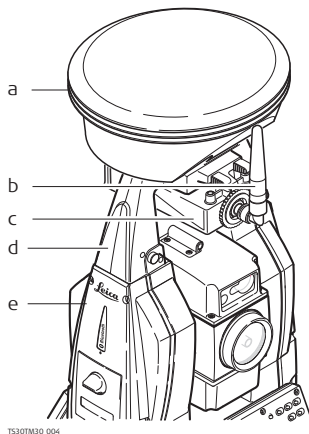
**Instrument
components
part 2 of 2**



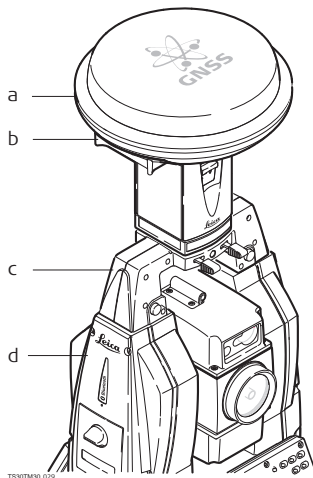
TS30/TM30_001b

- m) Vertical drive
- n) Focusing ring
- o) Battery compartment
- p) Stylus for touch screen
- q) Screen
- r) Circular level
- s) Tribrach footscrew
- t) Interchangeable eyepiece
- u) Keyboard

Instrument components for SmartStation with GS12

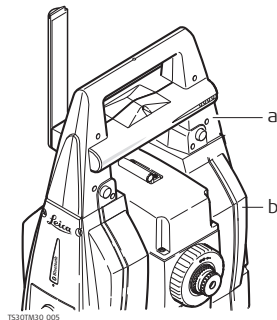


- a) SmartAntenna
- b) Antenna for communication device
- c) Clip-on-housing for communication device
- d) SmartAntenna Adapter
- e) Communication side cover

**Instrument
components for
SmartStation with
GS15**

- a) SmartAntenna
- b) RTK slot-in device
- c) SmartAntenna Adapter
- d) Communication side cover

Instrument components for RCS

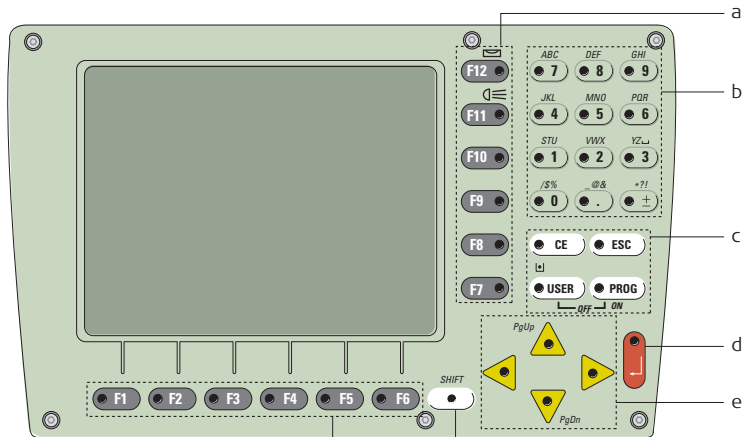


- a) RadioHandle
- b) Communication side cover

2 User Interface

2.1 Keyboard


Keyboard



- a) Hot keys **F7-F12**
- b) Alphanumeric keys
- c) CE, ESC, USER, PROG
- d) **ENTER**



- e) Arrow keys
- f) **SHIFT**
- g) Function keys **F1-F6**

Keys

Key	Description
Hot keys F7-F12 	<ul style="list-style-type: none"> User definable keys to execute commands or access chosen screens. The hot key F13, the user defined SmartKey, is located between the horizontal and vertical drive on the right hand side cover.
Alphanumeric keys	<ul style="list-style-type: none"> To type letters and numbers.
CE	<ul style="list-style-type: none"> Clears all entry at the beginning of user input. Clears the last character during user input.
ESC	<ul style="list-style-type: none"> Leaves the current menu or dialog without storing changes made.
USER	<ul style="list-style-type: none"> Calls the user-defined menu.
PROG (ON)	<ul style="list-style-type: none"> If the instrument is off: to turn instrument on. If the sensor is on: press at any time to select an application program.

Key	Description
ENTER	<ul style="list-style-type: none">• Selects the highlighted line and leads to the next logical dialog/menu.• Starts the edit mode for edit fields.• Opens a list box.
SHIFT	<ul style="list-style-type: none">• Changes between the first and the second level of function keys.
Arrow keys	<ul style="list-style-type: none">• Move the focus on the screen.
Function keys F1-F6	<ul style="list-style-type: none">• Correspond to the six softkeys that appear on the bottom of the screen when the screen is activated.

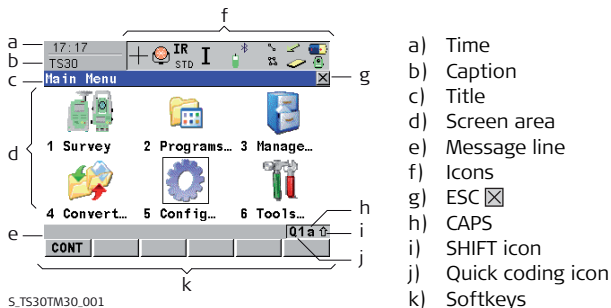
Key combinations

Keys	Description
PROG plus USER	Turns instrument off.
SHIFT F12	Calls STATUS Level & Laser Plummet .
SHIFT (F11)	Calls CONFIGURE Lights, Display, Beeps, Text, Lights page.
SHIFT USER	Calls QUICK SET Change Settings to: .
SHIFT 	Pages up.
SHIFT 	Pages down.

2.2


Screen

Screen



Elements of the screen

Element	Description
Time	The current local time is shown.
Caption	Shows location either in Main Menu , under PROG key or USER key.
Title	Name of the screen is shown.

Element	Description
Screen area	The working area of the screen.
Message line	Messages are shown for 10 s.
Icons	Shows current status information of the instrument. Refer to "2.4 Icons". Can be used with touch screen.
ESC 	Can be used with touch screen. Same functionality as the fixed key ESC . The last operation will be undone.
CAPS	The caps mode for upper case letters is active. The caps mode is activated and deactivated by pressing UPPER(F5) or LOWER(F5) in some screens.
SHIFT icon	Shows the status of the SHIFT key; either first or second level of softkeys is selected. Can be used with touch screen and has the same functionality as the fixed key SHIFT .
Quick coding icon	Shows the quick coding configuration. Can be used with touch screen to turn quick coding on and off.
Softkeys	Commands can be executed using (F1)-(F6) keys. The commands assigned to the softkeys are screen-dependent. Can be used directly with touch screen.
Scroll bar	Scrolls the screen area up and down.

2.3 Operating Principles


Keyboard and touch screen

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

Turn instrument on

Press and hold **PROG** for 2 s.

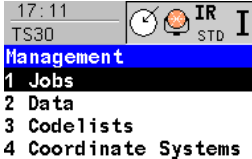
Turn instrument off step-by-step

Step	Description
	The instrument can only be turned off in the Main Menu .
1.	Press and hold both USER and PROG simultaneously. OR Press ESC for more than 2 s.
2.	Press YES (F6) to continue or NO (F4) to cancel.

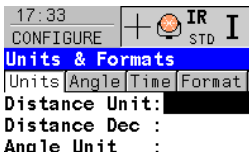
Lock/Unlock keyboard

Option	Description
Lock	To lock the keyboard press and hold SHIFT for 3 s. The message 'Keyboard locked' is momentarily displayed on the Message Line.
Unlock	To unlock the keyboard press and hold SHIFT for 3 s. The message 'Keyboard unlocked' is momentarily displayed on the Message Line.


Selecting from a menu

Appearance	Description
 A screenshot of the TS30 user interface. At the top, it shows the time '17:11' and 'TS30'. Below this is a menu with four items: 'Management' (highlighted in blue), '1 Jobs' (highlighted in black), '2 Data', '3 Codelists', and '4 Coordinate Systems'. To the right of the menu are icons for a clock, a stylus, and 'IR STD'.	<p>To select an item from a menu, do one of the following:</p> <p>Move the focus to the item. ENTER or CONT (F1).</p> <p>OR</p> <p>Type the complete selection number in front of the item. ENTER or CONT (F1) are not required.</p> <p>OR</p> <p>Tap on the item with the stylus.</p>


Selecting a page

Appearance	Description
 A screenshot of the TS30 'CONFIGURE' screen. At the top, it shows the time '17:33' and 'CONFIGURE'. Below this is a menu with four items: 'Units & Formats' (highlighted in blue), 'Units', 'Angle', and 'Time'. To the right of the menu are icons for a plus sign, a stylus, and 'IR STD'. Below the menu, there are labels for 'Distance Unit:', 'Distance Dec:', and 'Angle Unit:'.	<p>To select a page in a screen, do one of the following:</p> <p>PAGE (F6).</p> <p>OR</p> <p>Tap on the page tab with the stylus.</p>

Edit an entire value in input fields

Appearance	Description
	<ol style="list-style-type: none"> 1) Highlight the field. 2) Type numeric and/or alphanumeric characters to overwrite. 3) ENTER or tap outside of the field.

Edit an individual character in input fields

Appearance	Description
	<p>A character can be inserted or overwritten. The procedure is the same for both cases.</p> <ol style="list-style-type: none"> 1) Highlight the field. 2) For the keyboard: ENTER. The edit mode is activated where additional functions like insert and overwrite are available. 3) For the touch screen: Highlight the characters to be changed. 4) Type numeric and/or alphanumeric characters. 5) ENTER or tap outside of the field.

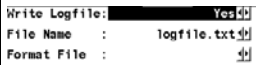


Access special alphanumeric characters for input

Step	Description
1.	Highlight the input field.
2.	For the keyboard: ENTER .
3.	Toggle to the desired special character set by using the up/down arrow keys.
4.	Press the function key assigned to the required character group.
5.	Press the function key with the required character.
6.	Repeat step 4. and 5. for entering more special characters of the same character set.
7.	ENTER .

Appearance and selection from a choicelist

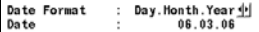

Choicelists have various appearances.

Closed choicelist

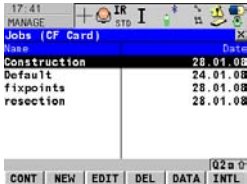

Appearance	Description	Selection
	Triangles on the right indicate further available choices.	Use the arrow keys   to change through the list or tap the triangles on the screen.

ENTER or tap on the field to access the choicelist. Opening a choicelist reveals either a simple listbox or a comprehensive listbox dialog.

Simple listbox

Appearance	Description	Selection
	<ul style="list-style-type: none"> • Choicelist shows items to select. • A search field is shown if necessary. • A scroll bar is shown if necessary. 	<ul style="list-style-type: none"> • Highlight the item and ENTER. • To exit without changes ESC, tap  or outside the simple listbox.

Listbox dialog

Appearance	Description	Selection
	<ul style="list-style-type: none"> • Choicelist fills the whole screen. • A search field is shown. • A scroll bar is shown if necessary. • The functionality comprises adding, editing and deleting of items. • Listbox dialogs are explained in detail at appropriate places in the manuals. 	<ul style="list-style-type: none"> • Highlight the item and CONT (F1). • To exit without changes press ESC or tap .

2.4

Icons

Description

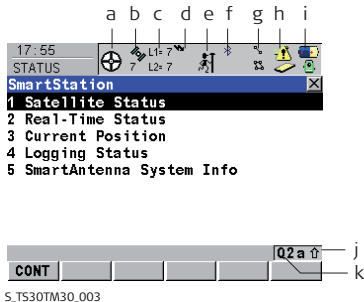
The screen icons display the status information of the instrument.

Position of the icons on the screen



S_TS30TM30_002

- a) ATR/LOCK/PS
- b) Reflector
- c) EDM
- d) Compensator/face I&II
- e) RCS
- f) Bluetooth
- g) Line/area
- h) CompactFlash card/internal memory
- i) Battery
- j) **SHIFT**
- k) Quick coding




- a) GNSS position status
- b) Number of visible satellites
- c) Contributing satellites
- d) Real-time device and real-time status, Internet online status
- e) Position mode
- f) Bluetooth
- g) Line/area
- h) CompactFlash card/internal memory
- i) Battery
- j) **SHIFT**
- k) Quick coding

TPS specific icons

Icon	Description
ATR/LOCK/PS	The currently active ATR/LOCK/PS settings or searches are displayed.
Reflector	The currently active reflector is displayed.
EDM	The currently active EDM measurement settings are displayed.
Compensator/face I&II	Compensator off, out of range or face I&II icon is displayed.
RCS	RCS settings are displayed.

GPS specific icons

Icon	Description
GNSS Position status	Displays the status of the current position. As soon as this icon becomes visible the receiver is in a stage where practical operation can commence.
Number of visible satellites	Displays the number of theoretically visible satellites above the configured cut-off angle according to the current almanac.

Icon	Description
Contributing satellites	<p data-bbox="688 148 1373 215">Displays the number of satellites that are contributing to the currently computed position solution.</p> <p data-bbox="688 220 1373 438">  The number of contributing satellites can differ from the number of visible satellites. This may be either because satellites cannot be viewed or the observations to these satellites are considered to be too noisy to be used in the position solution. </p>
Real-time device and real-time status	Displays the real-time device configured to be used and its status.
Internet online status	Receiver is online in the Internet.
Position mode	Displays the current position mode.

Common icons

Icon	Description
Bluetooth	The status of each Bluetooth port and any Bluetooth connection is displayed.
Line/area	The number of lines and areas currently open in the active job is displayed.
CompactFlash card/ internal memory	<p>The status of the CompactFlash card and internal memory if fitted are displayed.</p> <ul style="list-style-type: none">• For the CompactFlash card, the capacity of used space is shown in seven levels.• For the internal memory if fitted, the capacity of used memory is shown in nine levels.
Battery	The status and source of the battery is displayed. The percentage of remaining power capacity for all batteries is displayed numerically and graphically. For internal and external battery being attached at the same time the internal battery is used until it is empty and then the external battery is used.
SHIFT	The status of the SHIFT key is displayed.
Quick coding	Shows the quick coding configuration. Can be used with touch screen to turn quick coding on and off.

3

3.1

Operation

Instrument Setup

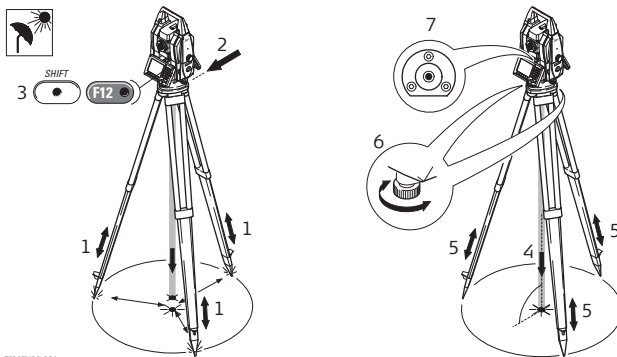
Description

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.




- Refer to "TS30/TM30 Technical Reference Manual" for additional information on using the laser plummet.
-

Setup step-by-step



TS30TM30_006

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 PROG for 2 s. Press SHIFT (F12) to access STATUS Level & Laser Plummet , activating the laser plummet.
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:
 - SmartAntenna
 - RadioHandle
 - radios/modems in clip-on-housings
 - Whenever a device is attached, the instrument responds with two short beeps.
 - Whenever a device is removed, the instrument responds with one long beep.
-

SmartAntenna Adapter

- SmartAntenna Adapter cannot be detected by the instrument but the devices that are attached to SmartAntenna Adapter are automatically detected. These devices are SmartAntenna and radios/modems in clip-on-housings.
-

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 SmartAntenna Adapter, but the device settings are not automatically set.
-

SmartAntenna

- SmartAntenna is automatically detected by the instrument when it is attached and **STATUS Interfaces** is automatically updated.
- Certain functionality can only be executed if SmartAntenna is attached.
- In addition to the autodetect behaviour, SmartAntenna can also be manually turned on/off using the ON/OFF button located on the underside. This action overrides all automatic settings but is only possible when SmartAntenna is fitted with an internal battery.
- If turned off, SmartAntenna is automatically turned on:
 - by the Setup application, when **<Station Coord: From GPS>**
 - by the GPS Survey application, in the **GPS SURVEY** screen.
 - in the **STATUS SmartStation** menu

RadioHandle

- RadioHandle is automatically detected by the instrument when it is attached.
 - When RadioHandle is attached and RCS Mode is activated via the quick settings in **SHIFT USER**, the appropriate port and device settings are set.
-

3.3

Working with the RTK Device (SmartStation)

Devices fitting into the GS15 GNSS instrument

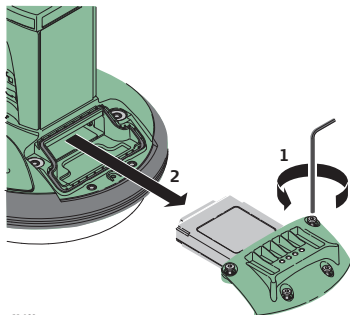
Digital cellular phones fitting into the GS15 GNSS instrument

Digital cellular phone	Device
Telit UC864-G	SLG1
CINTERION MC75i	SLG2
CDMA Telit CC864-DUAL (US)	SLC1, SLC2


Radios fitting into the GS15 GNSS instrument



Radio	Device
Pacific Crest PDL, transceive	SLR3-1
Pacific Crest PDL, transceive	SLR3-2
Satellite 3AS, transmit	SLR1
Satellite 3AS, receive	SLR2
Satellite M3-TR1, transceive	SLR5

Insert and remove a slot-in-device step-by-step

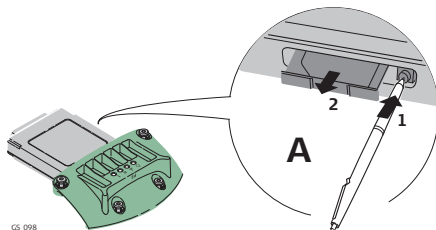




GS_089

Step	Description
	Turn over the GS15 to gain access to the slot-in-device compartment.
1.	Loosen the screws of the compartment cover with the supplied Allen key.
2.	Remove the compartment cover.
3.	Attach the slot-in-device to the compartment cover.
4.	Insert the compartment cover into the compartment (port P3).

Step	Description
5.	<p>Tighten the screws.</p>  All screws have to be tightened to ensure that the instrument is waterproof.
	<p>For the equipment setup as real-time base station with radio, it's recommended to use an external radio antenna mounted on a second tripod. This increases the height of the radio antenna and therefore maximises radio coverage. Refer to the Leica Viva GNSS Getting Started Guide for detailed information about the setup.</p>

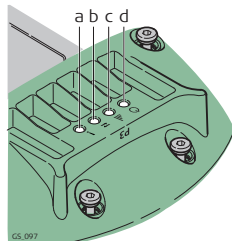
Insert and remove a SIM card step-by- step



Step	Description
	The SIM card is inserted into a slot on the side of the SLG1/SLG2.
	Take the SIM card and a pen.
1.	Using the pen, press the small button of the SIM card slot to eject the SIM card holder.
2.	Take the SIM card holder out off the SLG1/SLG2.
3.	Place the SIM card into the SIM card holder, the chip facing up.
4.	Insert the SIM card holder into the SIM card slot, the chip facing the connectors inside the slot.

LED indicators**Description**

Each slot-in-device for a radio or digital cellular phones has **L**ight **E**mitting **D**iode indicators on the bottom side. They indicate the basic device status.

Diagram

- a) Mode LED, available for
Satellite 3AS
- b) Data transfer LED
- c) Signal strength LED
- d) Power LED

Description of the LEDs

IF the	on	is	THEN
Mode LED	SLR1, SLR2 with Sateline 3AS, SLR5 with Sateline M3-TR1	red	the device is in the programming mode controlled from the PC via cable.
Data transfer LED	any device	off	data is not being transferred.
		flashing green	data is being transferred.
Signal strength LED	SLC1 (US), SLC2 (US) with CDMA Telit CC864-DUAL	red	device is on, not registered on the network.
		flashing red	device is on, registered on the network.
		off	download mode or device is off.

IF the	on	is	THEN
	SLG1 with Telit UC864-G, SLG2 with CINTERION MC75i	red	call is in progress.
		red: long flash, long break	no SIM card inserted, no PIN entered or network search, user authentication or network login in progress.
		red: short flash, long break	logged on to network, no call in progress.
		red: flashing red, long break	GPRS PDP context activated.
		red: long flash, short break	Packet switched data transfer is in progress.
		off	device is off.

IF the	on	is	THEN
	SLR3-1, SLR3-2 with Pacific Crest ADL	red	the communication link, Data Carrier Detection , is okay on the roving instrument.
		flashing red	the communication link, Data Carrier Detection , is okay on the roving instrument, but signal is weak.
		off	the DCD is not okay.
	SLR1, SLR2 with Sateline 3AS, SLR5 with Sateline M3-TR1	red	the communication link, Data Carrier Detection , is okay on the roving instrument.
		flashing red	the communication link, Data Carrier Detection , is okay on the roving instrument, but signal is weak.
		off	the DCD is not okay.
Power LED	any device	off	power is off.
		green	power is okay.

3.4

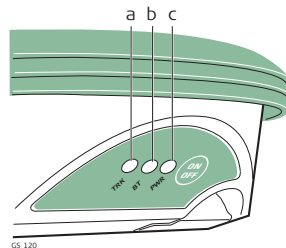
LED Indicators

LED indicators on SmartAntenna

Description

The SmartAntenna has **L**ight **E**mitting **D**iode indicators. They indicate the basic instrument status.

Diagram (GS12)

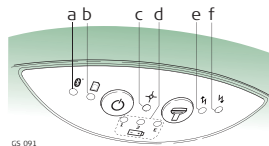


- a) TRK Tracking LED
- b) BT Bluetooth LED
- c) PWR Power LED

Description of the LEDs (GS12)

IF the	is	THEN
BT LED	green	Bluetooth is in data mode and ready for connecting.
	purple	Bluetooth is connecting.
	blue	Bluetooth has connected.
	flashing blue	data is being transferred.
PWR LED	off	power is off.
	green	power is okay.
	flashing green	power is low. The remaining time for which enough power is available depends on the type of survey, the temperature and the age of the battery.
	red	power is very low. The battery should be changed.

IF the	is	THEN
TRK LED	off	no satellites are tracked.
	flashing green	less than four satellites are tracked, a position is not yet available.
	green	enough satellites are tracked to compute a position.
	red	GS12 is initialising.

Diagram (GS15)

- a) Bluetooth LED
- b) Storage LED
- c) Position LED
- d) Power LEDs
- e) RTK Base LED
- f) RTK Rover LED

Description of the LEDs (GS15)

IF the	is	THEN
Bluetooth LED	green	Bluetooth is in data mode and ready for connecting.
	purple	Bluetooth is connecting.
	blue	Bluetooth has connected.
Storage LED	off	no SD card is inserted or GS15 is switched off.
	green	SD card is inserted but no raw data is being logged.
	flashing green	raw data is being logged.
	flashing yellow	raw data is being logged but only 10 % memory left.
	flashing red	raw data is being logged but only 5 % memory left.
	red	SD card is full, no raw data is being logged.
	fast flashing red	no SD card is inserted but GS15 is configured to log raw data.

IF the	is	THEN
Position LED	off	no satellites are tracked or GS15 is switched off.
	flashing yellow	less than four satellites are tracked, a position is not yet available.
	yellow	a navigated position is available.
	flashing green	a code-only position is available.
	green	a fixed RTK position is available.
Power LED (active battery ^{*1})	off	battery is not connected, flat or GS15 is switched off.
	green	power is 40 % - 100 %.
	yellow	power is 20 % - 40 %. The remaining time for which enough power is available depends on the type of survey, the temperature and the age of the battery.
	red	power is 5 % - 20 %.
	fast flashing red	power is low (< 5 %).

IF the	is	THEN
Power LED (passive battery ^{*2})	off	battery is not connected, flat or the GS15 is switched off.
	flashing green	power is 40 % - 100 %. LED is green for 1 s every 10 s.
	flashing yellow	power is 20 % - 40 %. LED is yellow for 1 s every 10 s.
	flashing red	power is less than 20 %. LED is red for 1 s every 10 s.
RTK Rover LED	off	GS15 is in RTK base mode or GS15 is switched off.
	green	GS15 is in rover mode. No RTK data is being received at the interface of the communication device.
	flashing green	GS15 is in rover mode. RTK data is being received at the interface of the communication device.

IF the	is	THEN
RTK Base LED	off	GS15 is in RTK rover mode or GS15 is switched off.
	green	GS15 is in RTK base mode. No RTK data is being passed to the RX/TX interface of the communication device.
	flashing green	GS15 is in RTK base mode. Data is being passed to the RX/TX interface of the communication device.

*1 The battery, which currently powers the GS15 GNSS instrument.

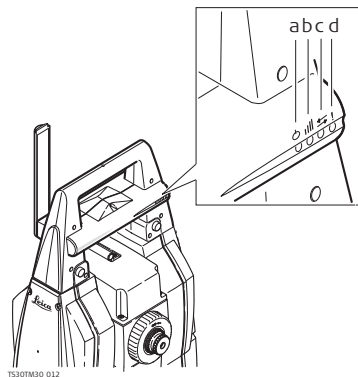
*2 Other batteries, which are inserted or connected but are not currently power the GS15 GNSS instrument.

LED Indicators

Description

The RadioHandle has **L**ight **E**mitting **D**iode indicators. They indicate the basic RadioHandle status.

Diagram of the LED Indicators



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

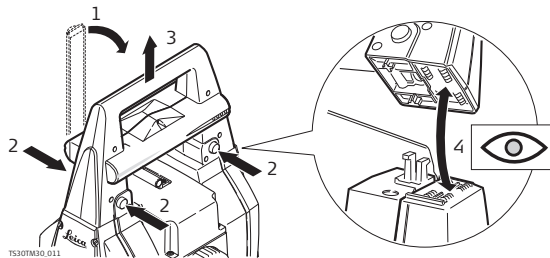
Description of the LED Indicators



IF the	is	THEN
Power LED	off	power is off.
	green	power is on.
Link LED	off	no radio 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.

3.5

Instrument Setup for Remote Control

Setup step-by-step



Step	Description
	Refer to "3.1 Instrument Setup" for the initial instrument setup onto a tripod. Remove the instrument carry handle by simultaneously pressing and holding-in the four push buttons.
1.	Place the RadioHandle onto the instrument by simultaneously pressing and holding-in the four push buttons.
	Ensure that the interface connection on the underside of the RadioHandle is on the same side as the Communication side cover.

Step	Description
2.	Swing the RadioHandle antenna into an upright position.

3.6

3.6.1

Batteries

Operating Principles

Charging / first-time use

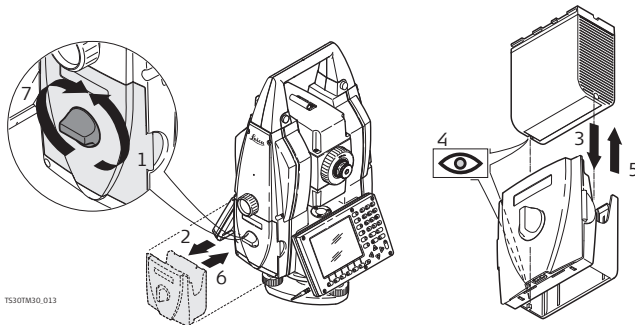
- The battery must be charged prior to using it for the first time because it is delivered with an energy content as low as possible.
 - The permissible temperature range for charging is between 0 °C to +40 °C / +32 °F to +104 °F. For optimal charging, we recommend charging the batteries at a low ambient 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.
 - 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.
-

3.6.2

Instrument Battery

Change battery
step-by-step

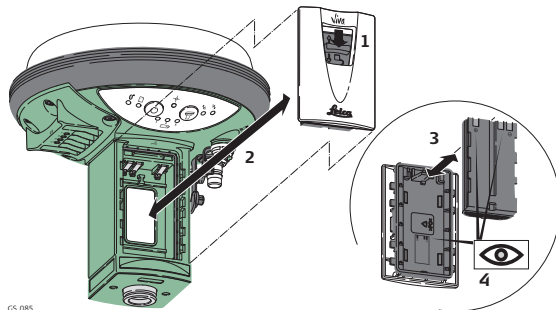
Step	Description
1.	Face the instrument on the side with the single finnedrive. The battery compartment is located just below. Turn the knob to the vertical position, opening the lid of the battery compartment.
2.	Pull out the battery housing.
3.	Pull the battery from the battery housing.

Step	Description
4.	A pictogram of the battery is displayed inside the battery housing. This is a visual aid to assist in placing the battery correctly.
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.


3.6.3

Battery for SmartAntenna

Change battery
step-by-step

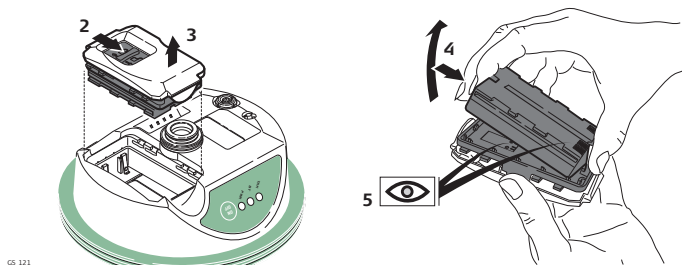


CS_085

Step	Description
	The batteries are inserted in the bottom part of the instrument.
1.	Push the slide fastener of one of the battery compartments in the direction of the arrow with the open-lock symbol.
2.	Remove the cover from the battery compartment.

Step	Description
3.	With the battery contacts facing upwards, slide the battery into the cover of the battery compartment.
4.	Push the battery upwards so that it locks into position.
5.	Insert the cover of the battery compartment into the compartment and push the slide fastener in the direction of the arrow with the close-lock symbol.
6.	Repeat steps 1. to 5. for the second battery compartment.
7.	To remove a battery, push the slide fastener of one of the battery compartments in the direction of the arrow with the open-lock symbol and remove the cover.
8.	Push the battery slightly upwards and at the same time pull out the bottom part of the battery. This releases the battery from its fixed position.
9.	Remove the battery.
10.	Insert the cover into the battery compartment and push the slide fastener in the direction of the arrow with the close-lock symbol.
11.	Repeat steps 7. to 10. for the second battery compartment.

Change battery step-by-step



Step	Description
1.	Turn GS12 over to gain access to the battery compartment.
2.	Open the battery compartment by pushing the slide fastener in the direction of the arrow with the open-lock symbol.
3.	Pull out the battery housing. The battery is attached to the housing.
4.	Hold the battery housing and pull the battery from the battery housing.
5.	A polarity of the battery is displayed inside the battery housing. This is a visual aid to assist in placing the battery correctly.

Step	Description
6.	Place the battery onto the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
7.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

3.7

Working with the CompactFlash Card

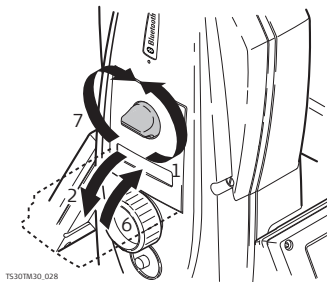


- Keep the card dry.
 - Use it only within the specified temperature range.
 - Do not bend the card.
 - Protect the card from direct impacts.
-

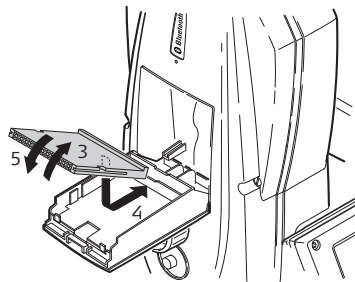


Failure to follow these instructions could result in data loss and/or permanent damage to the card.

Insert and remove a CompactFlash card step-by-step



TS30/TM30_028






Step	Description
1.	Face the instrument so that the CompactFlash card compartment is 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.

Step	Description
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.

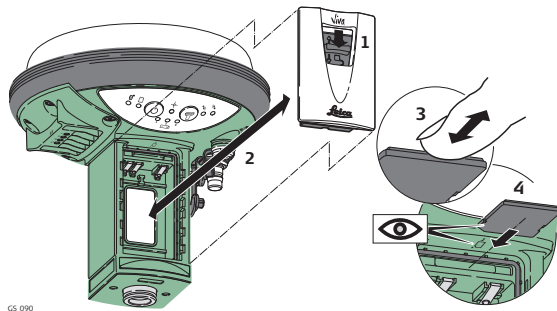
Format a CompactFlash card step-by-step


Formatting the CompactFlash card before starting to store data is required if a completely new CompactFlash card is used or if all existing data needs to be deleted.

Step	Description
1.	Main Menu: Tools...\Format Memory Device.
2.	TOOLS Format Memory Device <Memory Device: CF Card> <Format Method: Format Quick> Select the memory device to be formatted.
	By activating the format command all data will be lost. Make sure that all important data on the CompactFlash card has been backed up before formatting the card. Before formatting the internal memory make sure that all important data is first transferred to the PC.
	To exit the screen without formatting the memory device, press ESC. This returns to the previous screen without execution of any command.
3.	CONT (F1).
4.	YES (F4) to complete the formatting of the CompactFlash card.
	NO (F6) to abort the formatting of the CompactFlash card and return to TOOLS Format Memory Device.

Step	Description
5.	Once the formatting of the CompactFlash card is completed the system returns to the Main Menu .

**Insert and remove
an SD card into
GS15
step-by-step**



Step	Description
	The SD card is inserted into a slot inside the battery compartment 1 of the instrument.
1.	Push the slide fastener of battery compartment 1 in the direction of the arrow with the open-lock symbol.
2.	Remove the cover from battery compartment 1.
3.	Slide the card firmly into the slot until it clicks into position.

Step	Description
4.	Do not force the card into the slot. The card should be held with the contacts upwards and facing the slot.
5.	To remove the card, push the slide fastener of battery compartment 1 in the direction of the arrow with the open-lock symbol and remove the cover.
6.	Gently press on the top of the card to release it from the slot.
7.	Remove the SD card.
8.	Insert the cover into battery compartment 1 and push the slide fastener in the direction of the arrow with the close-lock symbol.

3.8

Accessing Survey Application Program

Access

Select **Main Menu: Survey**.

OR

Press **PROG**. Highlight **Survey**. **CONT (F1)**.

SURVEY

Survey Begin

18:11		+ IR STD I		Bluetooth		Warning		Battery	
SURVEY									
Survey Begin									
Job	:	Construction							
Coord System	:	<None>							
Code list	:	<None>							
Config Set	:	TCRP							
Reflector	:	Leica Circ Prism							
Add. Constant	:	0.0 mm							
									Q2a ↑
CONT	CONF	SETUP							CSYS

CONT (F1)

To accept changes and access the subsequent screen. The chosen settings become active.

CONF (F2)

To access **SURVEY Configuration**.

SETUP (F3)

Opens **SETUP Station Setup** to set station and orientation.

CSYS (F6)

To select a different coordinate system. Not available for **<Use Auto CrdSys: Yes>** configured in **CONFIGURE Additional Rover Settings**.

Description of fields

Field	Option	Description
<Job:>	Choicelist	The active job. All jobs from Main Menu: Manage...\Jobs can be selected.
<Coord System:>	Output	The coordinate system currently attached to the selected <Job:>. Cannot be edited for <Use AutoCrdSys: Yes> configured in CONFIGURE Additional Rover Settings .
<Codelist:>	Choicelist	No codes are stored in the selected <Job:>. All codelists from Main Menu: Manage...\Codelists can be selected.
	Output	Codes have already been stored in the selected <Job:>. If codes had been copied from a System RAM codelist, then the name of the codelist is displayed. If codes have not been copied from a System RAM codelist but typed in manually, then the name of the active job is displayed.

Field	Option	Description
<Config Set:>	Choicelist	<p>The active configuration set. All configuration sets from Main Menu: Manage...\Configuration Sets can be selected.</p> <p>The instrument has numerous user configuration parameters and functions. This allows a variety of preferences to be addressed. The configuration of the parameters and functions for an individual measuring technique are combined in a configuration set.</p>
<Reflector:>	Choicelist	<p>Displays the active reflector. All reflectors from Main Menu: Manage...\Reflectors. All listed reflectors can be selected.</p>
<Add. Constant:>	Output	<p>Displays the additive constant stored with the chosen reflector.</p>

Next step

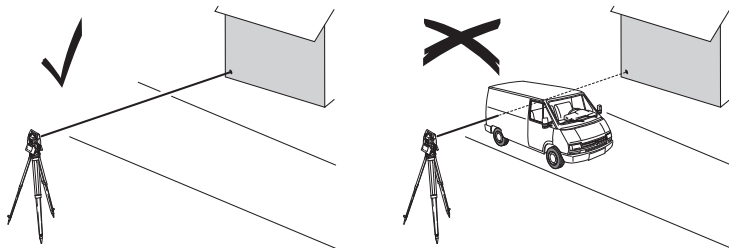
CONT (F1) to access **SURVEY Survey: Job Name**, where measurements can be performed with **ALL (F1)** or **DIST (F2)** and/or **REC (F3)**.

3.9

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

TS_095

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.

If using the long range measurement mode (> 1000 m, > 3300 ft) to prisms, and an object passes within 30 m of the EDM as the measurement is triggered, the distance measurement may be similarly effected due to the strength of the laser signal.



CAUTION

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.



Accurate measurements to prisms should be made in IR 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.



The lock mode is available for TS30.



As with all other instrument errors, the collimation error of the automatic aiming must be redetermined periodically. Refer to "4 Check & Adjust" about checking and adjusting instruments.



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.



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.

4

4.1

Check & Adjust

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:

I, 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 - option

Every angle measured in the daily work is corrected automatically if the compensator and the Hz-corrections are activated in the instrument configuration. Select **Main Menu: Config...\Instrument Settings...\Compensator** to check the settings.

**View current
adjustment errors**

The currently used adjustment errors can be viewed under **Main Menu: Tools...\Check & Adjust...\Current Values.**

**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 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 measure- ment	Automati- cally 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	✓	✓	---	✓

4.2

Preparation



Before determining the instrument errors, the instrument has to be levelled using the electronic level. **SHIFT (F12)** to access **STATUS Level & Laser Plummet, Level** page.

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



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

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



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



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. The telescope is not normally positioned exactly on the centre of the prism, to speed up the ATR measurement. 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

IF the task is to	THEN
adjust a combination of instrument errors	Refer to "4.3 Combined Adjustment (I, t, i, c and ATR)".
adjust the tilting axis	Refer to "4.4 Tilting Axis Adjustment (a)".
adjust the circular level	Refer to "4.5 Adjusting the Circular Level of the Instrument and Tribrach".
adjust the laser/optical plummet	Refer to "4.7 Inspecting the Laser Plummet of the Instrument".
adjust the tripod	Refer to "4.8 Servicing the Tripod".

4.3

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


Description

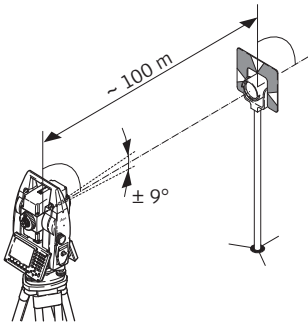
The combined adjustment procedure determines the following instrument errors in one process:


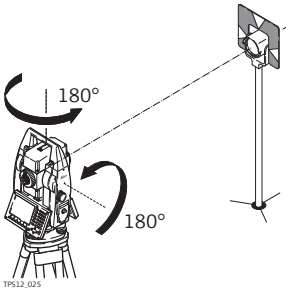

I, t	Compensator longitudinal and transversal index errors
i	Vertical index error, related to the standing axis
c	Horizontal collimation error, also called line of sight error
ATR Hz	ATR zero point error for horizontal angle option
ATR V	ATR zero point error for vertical angle option


Combined adjustment procedure step-by-step

The following table explains the most common settings.

Step	Description
1.	Main Menu: Tools...\Check & Adjust...
2.	TOOLS Check & Adjust Menu
	Select the option: Combined (I,t,i,c,ATR)
3.	TOOLS Combined I
	<ATR Adjust: On> Includes the determination of the ATR Hz and V adjustment errors if an ATR is available.
	 It is recommended to use a clean Leica circular prism as target. Do not use a 360° prism.

Step	Description
4.	<div><p>Aim the telescope accurately at a target at about 100 m distant. The target must be positioned within $\pm 9^\circ/\pm 10$ gon of the horizontal plane. The procedure can be started in any telescope face.</p></div> <p>TPS12_024</p>

Step	Description
5.	<p>MEAS (F1) to measure and to continue to the next screen.</p> <p>Motorised instruments change automatically to the other face.</p> <p>Non-motorised instruments guide to the other face.</p> <p> The fine pointing has to be performed manually in both faces.</p>  <p>TPS12_025</p>
6.	<p>TOOLS Combined II</p> <p>MEAS (F1) to measure the same target in the other face and to calculate the instrument errors.</p> <p> If one or more errors are bigger than the predefined limits, the procedure has to be repeated. All measurements of the current run are rejected and none of them is averaged with the results from previous runs.</p>

Step	Description
7.	TOOLS Adjustment Accuracy <No.of Meas:> Shows the number of runs executed. One run consists of a measurement in face I and face II. <σ I Comp:> and similar lines show the standard deviations of the determined adjustment errors. The standard deviations can be calculated from the second run onwards.
	It is recommended to measure at least two runs.
8.	MEAS (F5) if more runs have to be added. Continue with step 3. OR CONT (F1) to accept the measurements and to proceed to TOOLS Adjustment Results . No more runs can be added later.

Next step

IF the results are	THEN
to be stored	CONT (F1) overwrites the old adjustment errors with the new ones, if the Use status is set to Yes .
to be determined again	REDO (F2) rejects all new determined adjustment errors and repeats the whole procedure. Refer to step 3. of paragraph "Combined adjustment procedure step-by-step".

4.4

Tilting Axis Adjustment (a)


Description

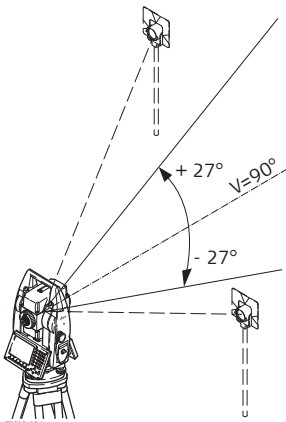
This adjustment procedure determines the following instrument error:


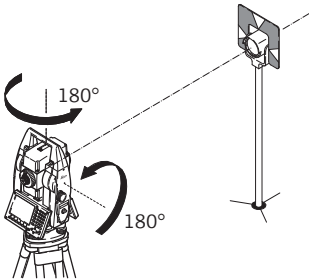

a Tilting axis error


Determination of tilting axis error step-by-step

The following table explains the most common settings.

Step	Description
	The Hz collimation error (c) has to be determined before starting this procedure.
1.	Main Menu: Tools...\Check & Adjust...
2.	TOOLS Check & Adjust Menu Select the option: Tilting Axis (a)

Step	Description
3.	<p data-bbox="474 181 895 212">TOOLS Tilting-Axis Adjustment I</p> <div data-bbox="474 212 844 761"><p data-bbox="474 761 531 771">TPS12_024a</p></div> <p data-bbox="873 212 1371 440">Aim the telescope accurately at a target at about 100 m distance or less if not possible. The target must be positioned at least 27°/30 gon above or beneath the horizontal plane. The procedure can be started in any telescope face.</p>

Step	Description
4.	<p>MEAS (F1) to measure and to continue to the next screen.</p> <p>Motorised instruments change automatically to the other face.</p> <p>Non-motorised instruments guide to the other face.</p> <p> The fine pointing has to be performed manually in both faces.</p>  <p><small>TPS12_025</small></p>
5.	<p>TOOLS Tilting-Axis Adjustment II</p> <p>MEAS (F1) to measure the same target in the other face and to calculate the tilting axis error.</p>
	<p>If the error is bigger than the predefined limit, the procedure has to be repeated. The tilting axis measurements of the current run are then rejected and not averaged with the results from previous runs.</p>

Step	Description
6.	<p>TOOLS T-Axis Adjustment Accuracy</p> <p><No.of Meas:> Shows the number of runs executed. One run consists of a measurement in face I and face II.</p> <p><σ a T-axis:> shows the standard deviation of the determined tilting axis error. The standard deviation can be calculated from the second run onwards.</p>
	It is recommended to measure at least two runs.
7.	<p>MEAS (F5) if more runs have to be added. Continue with step 3.</p> <p>OR</p> <p>CONT (F1) to accept the measurements and to proceed to TOOLS T-Axis Adjustment Result. No more runs can be added later.</p>

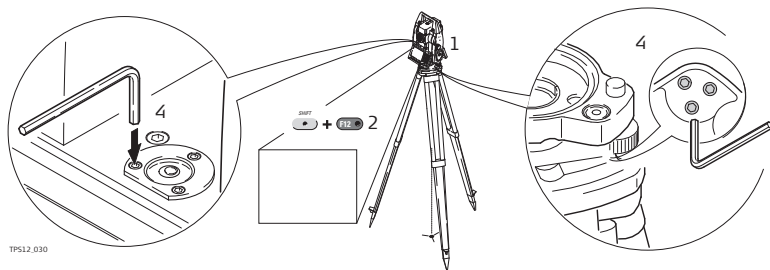
Next step

IF the results are	THEN
to be stored	CONT (F1) overwrites the old tilting axis error with the new one.
to be determined again	REDO (F2) rejects the new determined tilting axis error and repeats the whole procedure. Refer to step of paragraph "Determination of tilting axis error step-by-step".


4.5

Adjusting the Circular Level of the Instrument and Tribrach

Adjusting the circular level step-by-step



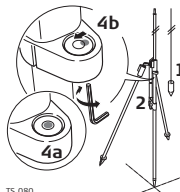

Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level. SHIFT (F12) to access STATUS Level & Laser Plummet .
3.	Check the position of the circular level on the instrument and tribrach.

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

4.6

Adjusting the Circular Level of the Prism Pole

Adjusting the circular level step-by-step

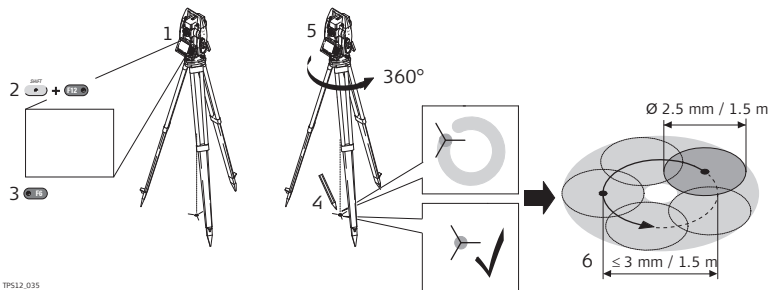
Step	Description	
1.	Suspend a plumb line.	
2.	Use a pole bipod, to align the prism pole parallel to the plumb line.	
3.	Check the position of the circular level on the prism pole.	
4.	a) If the circular level is centred, no adjustment is necessary.	
	b) If the circular level is not centred, use an allen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

4.7


Inspecting the Laser Plummet of the Instrument



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

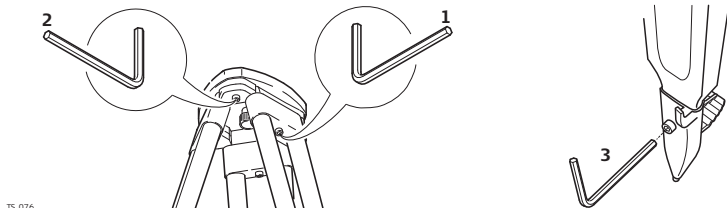
**Inspecting the
laser plummet
step-by-step**

The following table explains the most common settings.

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. SHIFT (F12) to access STATUS Level & Laser Plummet .
3.	PAGE (F6) to access the Laser Plummet page. Switch on the 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.


4.8

Servicing the Tripod

Servicing the tripod
step-by-step

TS_076

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

5

5.1

Care and Transport

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	<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>
Field adjustment	<p>After long periods of storage inspect the field adjustment parameters given in this user manual before using the product.</p>
Li-Ion batteries	<ul style="list-style-type: none">• Refer to "7 Technical Data" for information about storage temperature range.• 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.• 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.

5.3

Cleaning and Drying

Product and accessories

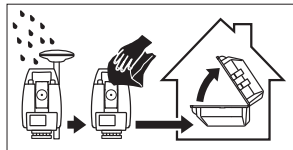
- Blow dust off lenses and prisms.
 - Never touch the glass with your fingers.
 - Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these can attack the polymer components.
-

Fogging of prisms

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

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40 °C /104 °F and clean them. 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.



An inspection of the product must be done in a Leica Geosystems authorised service workshop. Leica Geosystems recommends an inspection of the product every 24 months.

As TS30/TM30 instruments are equipped with a self-surveillance system designed for maximum motor performance and long maintenance cycles Leica Geosystems recommends inspection of the product whenever indicated in the message line of the user interface.

6 Safety Directions

6.1 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.

6.2

Intended Use

Permitted use

- Measuring horizontal and vertical angles.
 - Measuring distances.
 - Recording measurements.
 - Automatic target search, recognition and -tracking.
 - Visualising the aiming direction and vertical axis.
 - Remote control of product.
 - Data communication with external appliances.
 - Measuring raw data and computing coordinates using carrier phase and code signal from GNSS satellites.
 - Carrying out measurement tasks using various GNSS measuring techniques.
 - Recording GNSS and point related data.
 - 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 permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with recognisable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- 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.

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 close to electrical installations or similar situations by the person in charge of the product.

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 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.

6.5

Hazards of Use

**WARNING**

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can cause 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 dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

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



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.

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**

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 regarding field use 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 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

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

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

Precautions:

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

**CAUTION**

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

Precautions:

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

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

**WARNING**

High mechanical stress, high ambient temperatures or immersion into fluids can cause 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.



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.

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.



WARNING

Only Leica Geosystems authorised service workshops are entitled to repair these products.

6.6 Laser Classification

6.6.1 General

General

The following chapters provide instructions and training information for the safe use of lasers according to international standard IEC 60825-1 (2007-03) 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.

The person responsible for the product must ensure that everyone understands the instructions and adheres to them.



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

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

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



National laws and local regulations could impose more stringent instructions for the safe use of lasers than IEC 60825-1 (2007-03) and IEC TR 60825-14.

6.6.2

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

Class 1 laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with 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: TC.... Art.No.:

Power:

Leica Geosystems AG

CH-9435 Heerbrugg


Manufactured:

Made in Switzerland

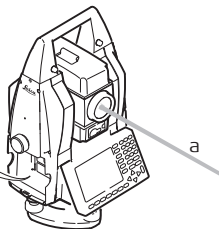
Complies with 21 CFR 1040.10 and 1040.11
except for deviations pursuant to Laser Notice
No.50, dated July 26,2001.

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

CE



Class 1 Laser Product
according to IEC 60825-1
(2007 - 03)



TS30/TM30_014

a) Laser beam

6.6.3

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

Class 3R 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
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) @ 0.25 s	80 m / 262 ft

**CAUTION**

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

Precautions:

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



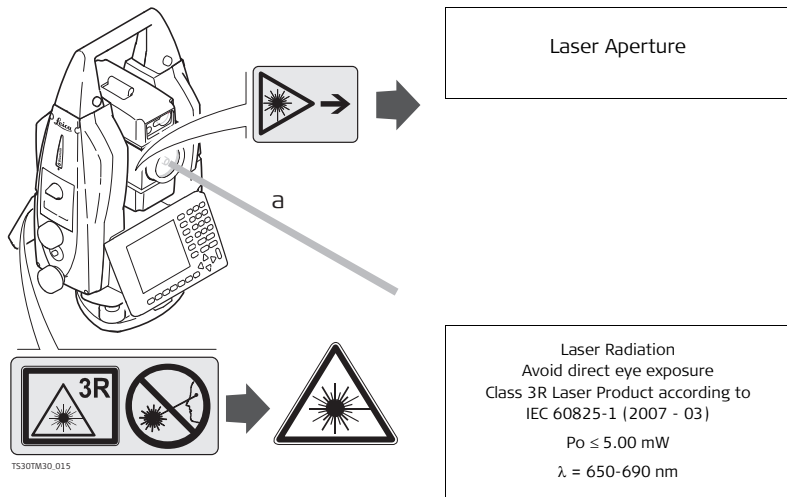
CAUTION

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, and so on.

Precautions:

- 1) Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections.
 - 2) 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



a) Laser beam

Type: TC.... Art.No.:

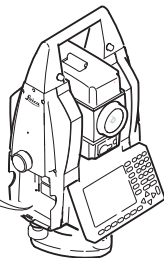
Power:

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 harm-
ful interference, and (2) this device must accept
any interference received, including inter-
ference that may cause undesired operation.



TS30TM30_016

6.6.4

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:

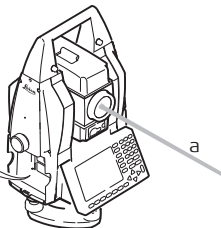
- IEC 60825-1 (2007-03): "Safety of laser products"
- EN 60825-1 (2007-10): "Safety of laser products"

Class 1 laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this User Manual.

Description	TS30	TM30
Maximum average radiant power	10 mW	6 mW
Pulse duration	11 ms	17 ms
Pulse repetition frequency	37 Hz	29 Hz
Wavelength	785 nm	785 nm

Labelling

Type: TC.... Art.No.:
Power:
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 harm-
ful interference, and (2) this device must accept
any interference received, including inter-
ference that may cause undesired operation.



TS30/TM30_014

a) Laser beam

Class 1 Laser Product
according to
IEC 60825-1 (2007 - 03)

6.6.5

PowerSearch PS



General

This is only applicable for TS30.

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

Class 1 laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this User Manual.

Description	Value
Maximum average radiant power	11 mW
Pulse duration	20 ns, 40 ns
Pulse repetition frequency	24.4 kHz
Wavelength	850 nm

Labelling

Type: TC.... Art.No.:

Power:

Leica Geosystems AG

CH-9435 Heerbrugg

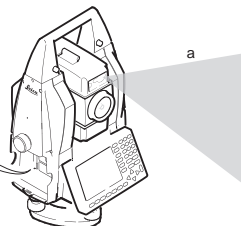
Manufactured:

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 harm-
ful interference, and (2) this device must accept
any interference received, including inter-
ference that may cause undesired operation.



Class 1 Laser Product
according to
IEC 60825-1 (2007 - 03)

TS30/TM30_027

a) Laser beam

6.6.6

Electronic Guide Light EGL



Not applicable for TM30.

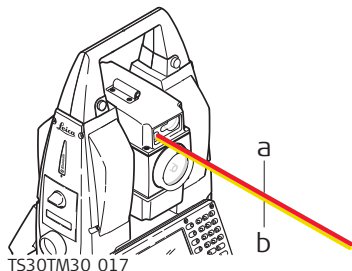
General

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 (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.

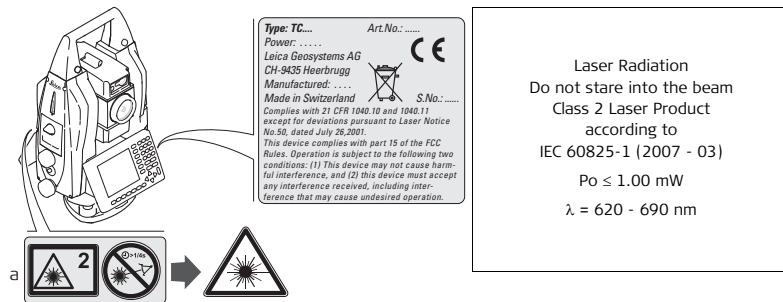
Description	Value
Maximum average radiant power	1.00 mW
Pulse duration	0 - 100 %
Pulse repetition frequency	1 kHz
Wavelength	620 nm - 690 nm

**CAUTION**

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

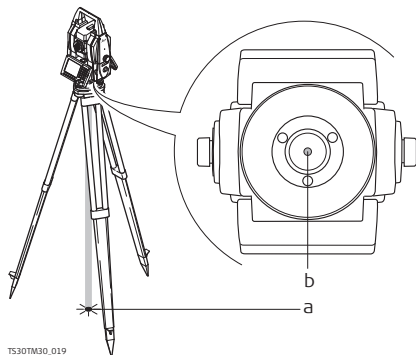
Precautions:

- 1) Avoid staring into the beam.
- 2) Avoid pointing the beam at other people.

Labelling

TS30/TM30_018

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



TS30/TM30_019

- 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 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 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, digital cellular phones or SmartAntenna with Bluetooth**WARNING**

Use of product with radio, digital cellular phone devices or SmartAntenna with Bluetooth:

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 can be disturbed or that humans or animals can be affected.

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



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.

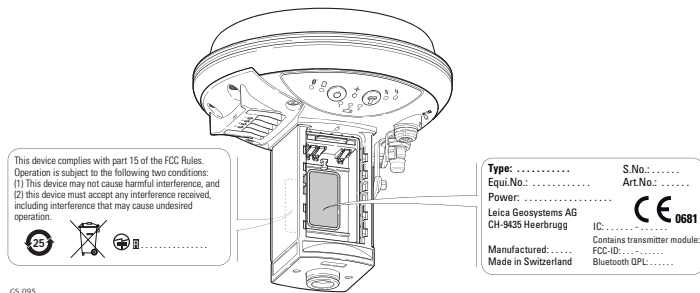
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 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.

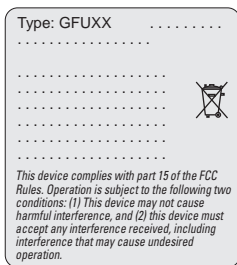
**WARNING**

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

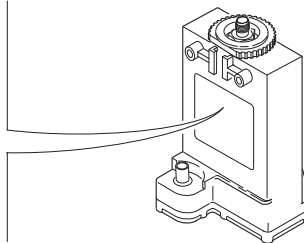
Labelling GS15



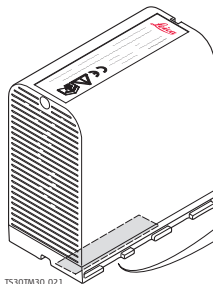
Labelling clip-on-housings GFU



TPS12_218




Labelling internal battery GEB241



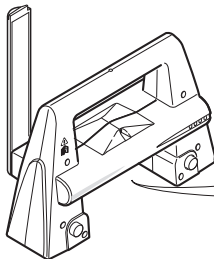
TS30TM30_021

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.

 **US**
11 WE
MH29443

Labelling RadioHandle

RH15



TS_102

Type: RH....

Air No.:

Power: 7.4/12.5V = /
0.2A max.

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured: ...

Made in Switzerland

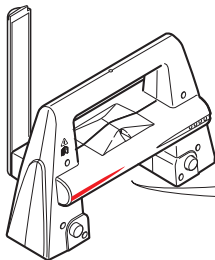
Contains
Transmitter Module:
FCC ID: H51V-2450M
IC: 44924-2450



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.

RH16



TS_136

Type: RH....

Art.No.:

Power: 7.4/12.5V = /
0.2A max.

Leica Geosystems AG

CH-9435 Heerbrugg

Manufactured:

Made in Switzerland

Contains
Transmitter ModuleFCC ID: P00030
IC: 3325A-0280

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.

7

7.1

Technical Data

Angle Measurement

Accuracy

Type	std. dev. Hz, V, ISO 17123-3		Display least count	
	["]	[mgon]	["]	[mgon]
TS30	0.5	0.15	0.01	0.01
TM30	0.5	0.15	0.01	0.01
	1	0.30	0.01	0.01


Characteristics

Absolute, continuous, quadruple

7.2

Distance Measurement with Reflectors

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1, GPH1P)	1800	6000	3000	10000	3500	12000
Three standard prisms (GPR1)	2300	7500	4500	14700	5400	17700
360° prism (GRZ4, GRZ122)	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 (GZM31) 60 mm x 60 mm	150	500	250	800	250	800
Machine Automation power prism (MPR122)  For Machine Control purposes only!	800	2600	1500	5000	2000	7000

Shortest measuring distance: 1.5 m

Atmospheric conditions

-
- Range A: Strong haze, visibility 5 km; or strong sunlight, severe heat shimmer
- Range B: Light haze, visibility about 20 km; or moderate sunlight, slight heat shimmer
- Range 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]
Precise	0.6 mm + 1 ppm*	1 mm + 1 ppm	7
Standard	1 mm + 1 ppm	1 mm + 1 ppm	2.4
Fast	3 mm + 1 ppm	5 mm + 1 ppm	0.8
Tracking	3 mm + 1 ppm	5 mm + 1 ppm	< 0.15
Averaging	1 mm + 1 ppm	1 mm + 1 ppm	-
SynchroTrack	3 mm + 1 ppm	5 mm + 1 ppm	< 0.15

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.

* Atmospheric conditions type C, range up to 1000 m, GPH1P reflector

** Distance > 10 m, target aligned to instrument

Characteristics

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

7.3

Distance Measurement without Reflectors

Range

Type	Kodak Gray Card	Range D		Range E		Range F	
		[m]	[ft]	[m]	[ft]	[m]	[ft]
R1000	White side, 90 % reflective	800	2630	1000	3280	>1000	>3280
R1000	Grey side, 18 % reflective	400	1320	500	1640	>500	>1640

Range of Measurement: 1.5 m - 1200 m

Display unambiguous: up to 1200 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 - 500 m	2 mm + 2 ppm	3 - 6	12
>500 m	4 mm + 2 ppm	3 - 6	12

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

Characteristics

Type:	Coaxial, visible red laser
Carrier wave:	658 nm
Measuring system PinPoint R1000:	System analyser basis 100 MHz - 150 MHz

Laser dot size

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

7.4

Distance Measurement - Long Range (LO mode)

Range

Reflector	Range A		Range B		Range C	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	2200	7300	7500	24600	>10000	>32800

Range of measurement:

1000 m to 12000 m

Display unambiguous:

up to 12000 m

Atmospheric conditions

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

Accuracy

Standard measuring	std. dev. ISO 17123-4	Measure time, typical [s]	Measure time, maximum [s]
Long Range	3 mm + 1 ppm	2.5	12

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:	658 nm
Measuring system:	System analyser basis 100 MHz - 150 MHz

7.5

Automatic Target Aiming ATR

Range ATR/LOCK



For TS30:

Reflector	Range ATR mode		Range Lock mode	
	[m]	[ft]	[m]	[ft]
Standard prism (GPR1)	1000	3300	800	2600
360° prism (GRZ4, GRZ122)	800	2600	600	2000
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	
Machine Automation power prism (MPR122)  For Machine Control purposes only!	600	2000	500	1600
 The maximum range can be restricted by poorer conditions, for example rain.				

Shortest measuring distance: 360° prism ATR: 1.5 m

Shortest measuring distance: 360° prism LOCK: 5 m

For TM30:

Reflector	Range ATR mode up to*	
	[m]	[ft]
Standard prism (GPR1)	3000	9900
360° prism (GRZ4, GRZ122)	2400	7800
360° Mini prism (GRZ101)	1000	3400
Mini prism (GMP101)	1500	4800
Reflector tape 60 mm x 60 mm	55	175
Machine Automation power prism (MPR122)	1800	6000
 For Machine Control purposes only!		
 The maximum range can be restricted by poorer conditions, for example rain.		

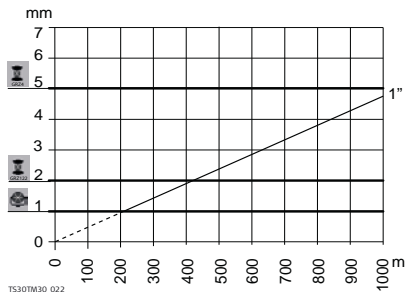
* Atmospheric conditions type C, target aligned to instrument
 Shortest measuring distance: 360° prism ATR: 1.5 m

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
Pointing precision:	± 2 mm at 1000 m
	± 7 mm at 3000 m

System accuracy with ATR

- The accuracy with which the position of a prism can be determined with Automatic Target Aiming (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 three different prism types, distances and instrument accuracies.



Leica GRZ4 prism (360°)



Leica GRZ122 prism (360°)



Leica circular prisms and Leica circular Mini prisms

mm

ATR accuracy [mm]

m

Distance measurement [m]

"

Instrument angle accuracy ["]

Maximum speed in lock mode	Maximum tangential speed: Maximum radial speed with <EDM Mode: Tracking>	9 m/s at 20 m; 45 m/s at 100 m 5 m/s
-----------------------------------	---	---


Searching	Typical search time in field of view: Field of view: Definable search windows:	1.5 s For TS30: 1°25'/1.55 gon For TM30: 0°28'/0.52 gon Yes
------------------	--	--

Characteristics	Principle: Type:	Digital image processing Infrared laser
------------------------	---------------------	--

7.6

PowerSearch PS

Range

Reflector	Range PS	
	[m]	[ft]
Standard prism (GPR1)	300	1000
360° prism (GRZ4, GRZ122)	300*	1000*
Mini prism (GMP101)	100	330
Machine Automation power prism (MPR122)  For Machine Control purposes only!	300*	1000*

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

Typical search time:	5 - 10 s
Rotating Speed:	up to 100 gon/s
Default search area:	Hz: 400 gon, V: 40 gon
Definable search windows:	Yes

Characteristics

Principle:

Digital signal processing

Type:

Infrared laser

7.7

SmartStation



Refer to the Leica GS10/GS15 User Manual for information on the GS15.

7.7.1

SmartStation Accuracy



Measurement precision and accuracy in position and accuracy in height are dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities. Figures quoted assume normal to favourable conditions.

Times required are dependent upon various factors including number of satellites, geometry, ionospheric conditions, multipath and so on. GPS and GLONASS can increase performance and accuracy by up to 30 % relative to GPS only. A full Galileo and GPS L5 constellation will further increase measurement performance and accuracy.

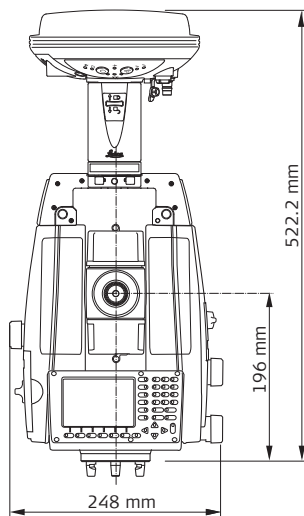
Accuracy

Position accuracy: Horizontal: 10 mm + 1 ppm
 Vertical: 20 mm + 1 ppm
When used within reference station networks the position accuracy is in accordance with the accuracy specifications provided by the reference station network.

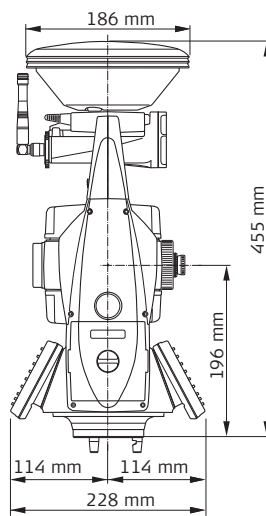
Initialisation	Method:	Real-time (RTK)
	Reliability of initialisation:	Better than 99.99 %
	Time of initialisation:	Typically 8 s, with 5 or more satellites on L1 and L2
	Range:	Up to 50 km, assuming reliable data-link is available
RTK data formats	Formats for data reception: Leica proprietary GPS and GNSS real-time data formats, CMR, CMR+, RTCM V2.1 / 2.2 / 2.3 / 3.1	

7.7.2

SmartStation Dimensions

SmartStation
Dimensions

TS30TM30_030



TS30TM30_023

7.7.3

SmartAntenna Technical Data

Description and use

The SmartAntenna is selected for use based upon the application. The table gives a description and the intended use of the SmartAntenna.

Type	Description	Use
GS12	GPS, GLONASS, Galileo, Compass SmartTrack+ antenna with built-in groundplane.	With CS field controller or TS30/TM30.
GS09	GPS, GLONASS SmartTrack+ antenna with built-in ground-plane.	With CS09 or TS30/TM30.

Dimensions

Type	Height [m]	Diameter [m]
GS09 GS12	0.089	0.186

Connector	<ul style="list-style-type: none">• 8 pin LEMO-1 socket to connect antenna cable (only applicable when SmartAntenna is used independently on a pole with CS field controller).• Special clip-on interface for connecting SmartAntenna to SmartAntenna Adapter on the instrument.	
Mounting	5/8" Whitworth	
Weight	1.1 kg including internal battery GEB211/GEB212	
Power	Power consumption: External supply voltage:	1.8 W typically, 270 mA Nominal 12 V DC (==, GEV197 SmartAntenna to PC for data transfer and to external power supply), voltage range 10.5-28 V DC
Battery internal	Type: Voltage: Capacity: Typical operating time:	Li-Ion 7.4 V GEB211: 2.2 Ah / GEB212: 2.6 Ah GEB211: 5.7 h / GEB212: 6.5 h

Electrical data

Type	GS12	GS09
Voltage	-	-
Current	-	-
Frequency	GPS L1 1575.42 MHz GPS L2 1227.60 MHz GLONASS L1 1602.5625-1611.5 MHz GLONASS L2 1246.4375-1254.3 MHz Galileo E1 1575.42 MHz Galileo E5a 1176.45 MHz Galileo E5b 1207.14 MHz Galileo Alt-BOC 1191.795 MHz	GPS L1 1575.42 MHz GPS L2 1227.60 MHz GLONASS L1 1602.5625-1611.5 MHz GLONASS L2 1246.4375-1254.3 MHz - - - -
Gain	Typically 27 dBi	Typically 27 dBi
Noise Figure	Typically < 2 dBi	Typically < 2 dBi
BW, -3 dBiW	-	-
BW, -30 dBi	-	-

**Environmental specifications**

Galileo Alt-BOC covers bandwidth of Galileo E5a and E5b.

Temperature

Operating temperature [°C]	Storage temperature [°C]
-40 to +65 Bluetooth: -30 to +65	-40 to +80

Protection against water, dust and sand

Protection
IP67 (IEC 60529) Dusttight Protected against water jets Waterproof to 1 m temporary immersion

Humidity

Protection
Up to 100 % The effects of condensation are to be effectively counteracted by periodically drying out the antenna.

7.8

Conformity to National Regulations

7.8.1

Communication side cover with Bluetooth

Conformity to national regulations

- FCC Part 15 (applicable in US).
- Hereby, Leica Geosystems AG, declares that the instrument with Communication side cover 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

Antenna

Type: Internal Microstrip antenna
Gain: 1.5 dBi

7.8.2

GFU24, Siemens MC75

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the GFU24 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, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.

Frequency band

Quad-Band EGSM850 MHz/ EGSM900 MHz/ GSM1800 MHz/ GSM1900 MHz

Output power

EGSM850/900:	2 W
GSM1800/1900:	1 W

Antenna

Type	GAT3	GAT5	GAT18
Frequency band [MHz]	890 - 960 / 1710 - 1880 / 1920 - 2170	824 - 894 / 1850 - 1990	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170
Type	Detachable $\lambda/2$ antenna	Detachable $\lambda/2$ antenna	Detachable $\lambda/2$ antenna
Connector	TNC	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guidelines 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.

7.8.3

GFU19 (US), GFU25 (CAN) CDMA MultiTech MTMMC-C

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 has to be approved prior to use and operation.

Frequency band

Dual-Band CDMA850 MHz/CDMA1900 MHz

Output power

CDMA850: 2 W
CDMA1900: 0.4 W

Antenna

Type	GAT5	GAT18
Frequency band [MHz]	824 - 894 / 1850 - 1990	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170
Type	Detachable $\lambda/2$ antenna	Detachable $\lambda/2$ antenna
Connector	TNC	TNC

Specific Absorption Rate (SAR)	The product meets the limits for the maximum permissible exposure of the guidelines 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.
---------------------------------------	--

7.8.4

Conformity to national regulations

GFU28, Telit UC864-G

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the GFU28 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, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
-

Frequency band UMTS/HSDPA (WCDMA/FDD) 850 MHz/ 1900 MHz/ 2100 MHz
 Quad-Band EGSM 850 MHz/ 900 MHz/ 1800 MHz/ 1900 MHz
 GPRS multi-slot class 12
 EDGE multi-slot class 12

Output power EGSM850/900: 2 W
 GSM1800/1900: 1 W
 UMTS2100: 0.25 W
 EDGE850/900: 0.5 W
 EDGE1800/1900: 0.4 W

Antenna

Type	Internal	GAT3	GAT5	GAT18
Frequency band [MHz]	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170	890 - 960 / 1710 - 1880 / 1920 - 2170	824 - 894 / 1850 - 1990	824 - 894 / 890 - 960 / 1710 - 1880 / 1850 - 1990 / 1920 - 2170
Type	Internal	Detachable $\lambda/2$ antenna	Detachable $\lambda/2$ antenna	Detachable $\lambda/2$ antenna
Connector	-	TNC	TNC	TNC

**Specific Absorption
Rate (SAR)**

The product meets the limits for the maximum permissible exposure of the guidelines 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.

7.8.5

RadioHandle

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the RadioHandle 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 authorisation 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	RH1200:	Limited to 2409 - 2435 MHz
	RH15:	Limited to 2402 - 2452 MHz
	RH16:	Limited to 2402 - 2480 MHz

Output power	< 100 mW (e. i. r. p.)
---------------------	------------------------

Antenna	Type:	$\lambda/2$ dipole antenna
	Gain:	2 dBi
	Connector:	Special customized SMB

7.8.6

SmartAntenna with Bluetooth

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the SmartAntenna with Bluetooth is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity can 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 EU 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

Type	Frequency band [MHz]
GS12	1176.45 1191.795 1207.14 1227.60 1246.4375 - 1254.3 1575.42 1602.4375 - 1611.5
GS09	1227.60 1246.4375 - 1254.3 1575.42 1602.4375 - 1611.5
Bluetooth	2402 - 2480

Output power

Type	Output power [mW]
GNSS	Receive only
Bluetooth	5 (Class 1)

Antenna

GNSS	Internal GNSS antenna element (receive only)
Bluetooth	Type: Internal Microstrip antenna
	Gain: 1.5 dBi

7.9

General Technical Data of the Instrument

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]
TS30	0.5	0.15	4	0.07
TM30	0.5	0.15	4	0.07

Level

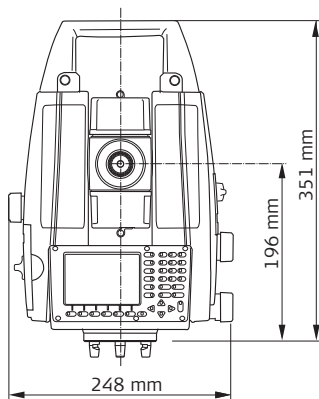
Compensation:	Centralised quadruple axis compensation
Circular level sensitivity:	6'/2 mm
Electronic level resolution:	2"

Control unit	Display:	1/4 VGA (320 x 240 pixels), colour, graphics capable LCD, illumination, touch screen
	Keyboard:	34 keys including 12 function keys, 12 alphanumeric keys and a user defined SmartKey, illumination
	Angle Display:	360°", 360° decimal, 400 gon, 6400 mil, V %
	Distance Display:	m, ft int, ft us, ft int inch, ft us inch
	Position:	TM30 face I only, TS30 both faces
	Touch screen:	Toughened film on glass

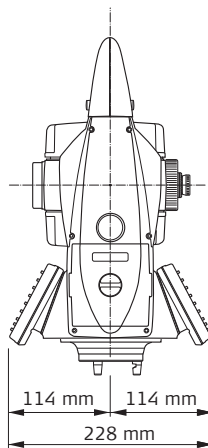
Instrument Ports

Port	Name	Description
Port 1	Port 1	<ul style="list-style-type: none"> 8 pin LEMO-1 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 RadioHandle with RCS and SmartAntenna Adapter with SmartStation. 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



TS30/TM30, 024



Weight

Instrument:	7.25 kg
Tribrach:	0.8 kg
Internal battery GEB241:	0.43 kg

Recording

Data can be recorded onto a CompactFlash card or into internal memory if fitted.

Type	Capacity [MB]	Number of measurements per MB
CompactFlash card	• 256, 1024	1750
Internal memory - optional	• 256	1750

Laser plummet

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

Operation

Three endless drives: For one and two hand manual operation
 User defined Smartkey: Fast precision triggerkey for manual high precision measurements

Motorisation

Maximum acceleration: 400 gon/s²
 Maximum rotating speed: 200 gon/s
 Time for change face: Typically 2.9 s

Power	External supply voltage:	Nominal voltage 12.8 V DC Range 11.5 V-13.5 V
	Standby power consumption:	Typically 5.9 W
Internal battery	Type:	Li-Ion
	Voltage:	14.8 V
	Capacity:	GEB241: 4.8 Ah
	Typical operating time:	9 h
External battery	Type:	NiMH
	Voltage:	12 V
	Capacity:	GEB171: 9.0 Ah
	Typical operating time:	12 - 18 h

Environmental specifications**Temperature**

Type	Operating temperature [°C]	Storage temperature [°C]
TS30/TM30	-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
TS30/TM30	IP54 (IEC 60529)

Humidity

Type	Protection
TS30/TM30	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 / 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
Machine Automation power prism, MPR122  For Machine Control purposes only!	+28.1	yes	yes

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

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
-

7.10

Scale Correction

Use of scale correction

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

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

Atmospheric correction $\Delta D1$

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

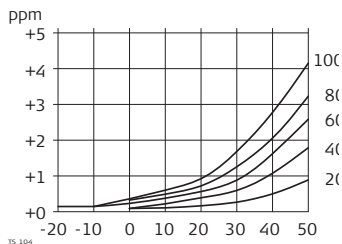
For highest precision distance measurements, the atmospheric correction should be determined with an accuracy of 1 ppm. The following parameters must be redetermined:

- 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

TS_104

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 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

$$\Delta D_1 = 286.34 - \left[\frac{0.29525 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^x \right]$$

TS_105

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:

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

TS_106

ΔD_2 Reduction to mean sea level [ppm]

H Height of EDM above sea level [m]

R 6.378 * 10⁶ m

**Projection
distortion ΔD_3**

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

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

TS_107

ΔD_3 Projection distortion [ppm]

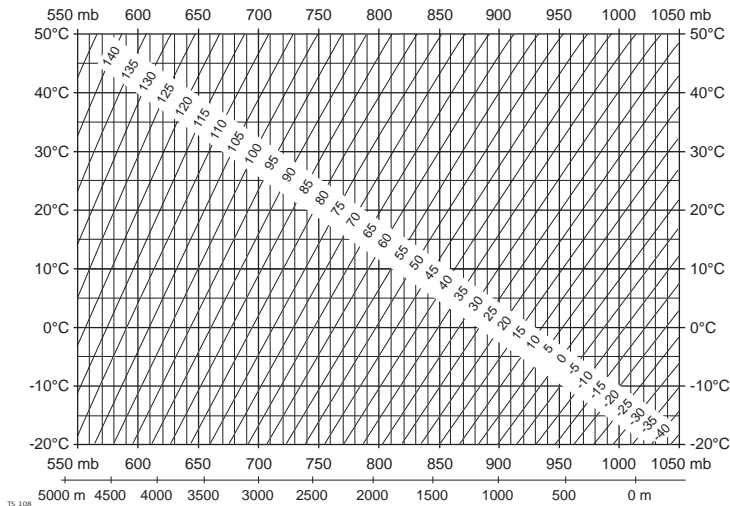
X Easting, distance from projection zero line with the scale factor 1 [km]

R $6.378 \cdot 10^6$ m

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

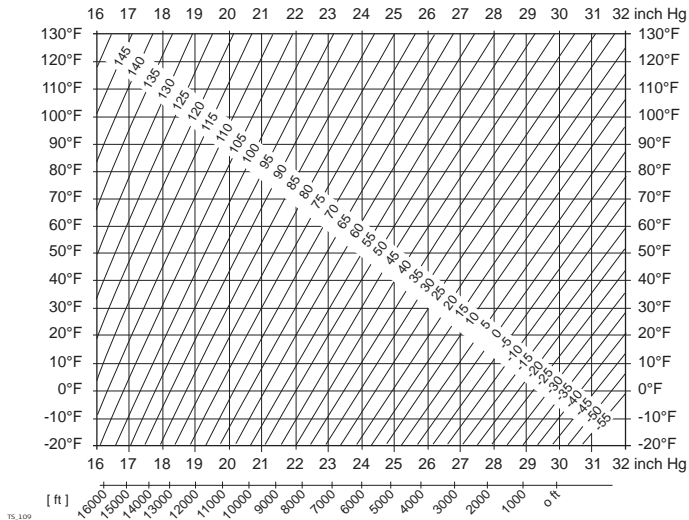
Atmospheric corrections °C

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



**Atmospheric
correction °F**

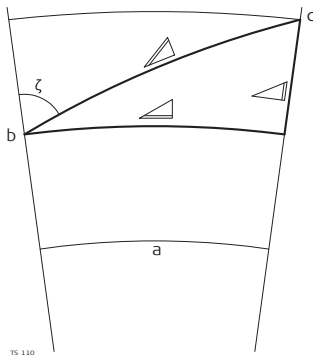
Atmospheric corrections in ppm with temperature [°F], air pressure [inch Hg] and height [ft] at 60 % relative humidity.






7.11

Reduction Formulas

Measurements



- 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, to reflector tape and reflectorless measurements.

Formulas

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

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

TS_111

\triangle Displayed slope distance [m]

D_0 Uncorrected distance [m]

ppm Atmospheric scale correction [mm/km]

mm Additive constant of the reflector [mm]

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

TS_112

\triangle Horizontal distance [m]

\triangle Height difference [m]

Y $\triangle * |\sin \zeta|$

X $\triangle * \cos \zeta$

ζ Vertical circle reading

A $(1 - k/2)/R = 1.47 * 10^{-7} \text{ [m}^{-1}\text{]}$

B $(1 - k)/2R = 6.83 * 10^{-8} \text{ [m}^{-1}\text{]}$

k 0.13 (mean refraction coefficient)

R $6.378 * 10^6 \text{ m}$ (radius of the earth)

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

TS_113

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:

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

TS_114

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

TS_115

- \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:

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

TS_116

$S_{\bar{D}}$ Standard deviation of the arithmetic mean of the distance

s Standard deviation of a single measurement

n Number of measurements

International Limited Warranty, Software Licence Agreement

International Limited Warranty

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Index

A

Accuracy

Angle measurement	155
IR mode	158
LO mode	161
RL mode	160
SmartStation	170

Adjustment

Combined (I, t, i, c and ATR)	99
Electronic	93
Inspecting laser plummet	110
Inspecting the laser plummet	110
Mechanical	94
Of circular level on instrument	107
Of circular level on prism pole	109
Of circular level on tribrach	107
Preparation	97
Titling axis (a)	103

Adjustment Errors

View current	94
--------------------	----

Angle measurement	155
-------------------------	-----

Antenna	178
---------------	-----

RadioHandle	187
-------------------	-----

Antennas

GS12	190
Type	173

Autodetect behaviour

RadioHandle	53
Radios/Modems	52
SmartAntenna	53
SmartAntenna Adapter	52

Automatic Corrections

Automatic Target Aiming ATR

Accuracy with the GPR1 prism	165
Description	138
Positioning of crosshairs	98
System accuracy	165

B

Batteries

Charging, first-time use	73
Operation, Discharging	73

Battery		Connector	
Change in SmartAntenna	76	SmartAntenna	174
For instrument	74	Container Contents	
Icon	48	For instrument	22
Internal, SmartAntenna	174	Control unit	192
Technical data GEB171	195	Conversion, data conversion	20
Technical data GEB241	195	Corrections	
Bluetooth		Automatic	198
LED on SmartAntenna	64	Scale	199
Bluetooth, icon	48	D	
C		Data Conversion	19
CE	33	Data Storage	19
Check & Adjust	93	Description of the system	11
Communication side cover		Device	
Graphical overview with RadioHandle	31	Status	58
Graphical overview with SmartStation	29	Dimensions	
Technical data	178	Of instrument	193
CompactFlash Card	19	Of SmartAntenna	173
Format card	83	Of SmartStation	172
Icon	48	Distance Measurement	
Remove card	81	Any surface mode	159
Compensator	191	LO mode	161
		Prism mode	156

Documentation	4
Drive	
OMNI	20
Drives	194
E	
Edit	
Value in input field	40
Electrical data, SmartAntenna	175
Electronic Adjustment	93
Electronic Distance Measurement EDM	
Description	13
PinPoint R1000	14
Screen icons	44, 46
Electronic Guide Light EGL	
Description	14
Safety directions	142
Technical data	197
ENTER	34
Environmental Specifications	196
SmartAntenna	176
ESC	33

F

FCC Statement	149
Flashing LED on slot-in device	60, 60
Frequency band	
GFU19, MultiTech MTMMC-C	181
GFU24, Siemens MC75	179
GFU25, MultiTech MTMMC-C	181
GFU28, Telit UC864-G	184
Frequency Band	178
RadioHandle	187
SmartAntenna	189

G

GAT 3, antenna	180, 184
GAT 5, antenna	180, 181, 184
GAT18, antenna	180, 181, 184
GeoC++ Software Development Kit	18
GFU19	181
GFU24	179
GFU25	181
GFU28	183
GNSS = Global Navigation Satellite System	13

GS15		Instrument Setup	
Insert SD card	85	For remote control	71
Remove SD card	85	Intended Use	119
Guidelines for Correct Results	90	Internal Memory	19
I		Internal memory, icon	48
Icons		International Limited Warranty	209
Specific for GPS	46	K	
Specific for TPS	46	Keyboard	32
Indicators, LED		Locking and unlocking	38
SmartAntenna	62	Operating principles	38
Indicators, LED for slot-in-device	58	Keys	33
Insert		Keys, Alphanumeric	33
SIM card	57	Keys, Arrow	34
Slot-in-device	55	Keys, Combinations	35
Instrument		Keys, Function	34
Dimensions	193	Keys, Hot	33
Ports	192	L	
Setup	49	Labelling	
Technical Data	191	GEB241	152
Turn on and turn off	38	GS12	150
Weight	193	GS15	151
Instrument Models	16	Laser	
		Classification	130

Laser Classification	
Automatic Target Aiming	138
Integrated Distancer, Invisible Laser	131
Integrated Distancer, Visible Laser	133
PowerSearch PS	140
Laser plummet	
Inspect	110
Safety directions	143
Technical data	194
LED	
Slot-in-device	58
Slot-in-device, description	59
LED Indicators	
For RadioHandle	69
LEICA Geo Office LGO, description	12
Level	35, 191
Light Emitting Diode	
SmartAntenna	62
Light Emitting Diode, slot-in-device	58
Lights	35
Li-Ion battery	174
Storage	114
Lock, keyboard	38

M

Mechanical Adjustment	94
Menu, selecting from a	39
Mount, SmartAntenna	174
MultiTech MTMMC-C	
GFU19/GFU25, technical data	181

O

OMNI drive	20
ON	33
Operating Temperature	
SmartAntenna	176
Operation	194
Output power	
GFU19, MultiTech MTMMC-C	181
GFU24, Siemens MC75	179
GFU25, MultiTech MTMMC-C	181
GFU28, Telit UC864-G	184
GS12	189
Output Power	178
RadioHandle	187

P

Page	
Selecting from a	39
Pages down	35
Pages up	35
Ports	192
Position	
LED on SmartAntenna	64
Power	
SmartAntenna	174
Power LED	
SmartAntenna	64
Power supply	21
PowerSearch PS	168
Precise Measurements	94
PROG	33

Q

Quick coding, icon	48
Quick settings	35

R

R1000	14
RadioHandle	
Description	16
LED indicators	69
Setup for remote control	71
Technical data	186
Raw data transfer to LGO	20
Recording	194
Reduction Formulas	205
Reflectors	197
Remove	
SIM card	57
Slot-in-device	55
Responsibilities	122
RTK Base	
LED on SmartAntenna	64
RTK Rover	
LED on SmartAntenna	64

S

Safety Directions	118
Screen	36
Scroll bar, description	37

SD card		SmartStation	
Insert	85	Components	15
Remove	85	Communication side cover	16
Setup		Description	16
For remote control	71	Graphical overview	29
Instrument	49	SmartAntenna	15
SHIFT	34, 48	Technical Data	
Siemens MC75		Accuracy	170
GFU24, technical data	179	Dimensions	172
SIM card		SmartAntenna	188
Insert	57	Software	
Remove	57	Application programs	18
Slot-in-device		Customised application programs	18
Insert	55	Language software	17
Remove	55	Software type	17
SmartAntenna		Software upload	18
Description	15	System software	17
Dimensions	172	Software Licence Agreement	209
Power supply	21	Specifications, environmental	
Technical data	188	SmartAntenna	176
		Status	
		RadioHandle	69
		Status, device	58

Storage		Terminology	11
LED on SmartAntenna	64	Touch Screen, operating principles	38
Storage Temperature		Transfer data	20
SmartAntenna	176	Transfer raw data to LGO	20
Survey Application	87		
T		U	
Telescope	191	Unlock, keyboard	38
Telit UC864-G		USER	33
GFU28, technical data	183	User Interface	32
Temperature		User Manual	
Battery Internal		Validity of	4
Operating	196		
Storage	196	V	
Bluetooth		Value	
Operating	196	Edit in input field	40
Storage	196	View Current Adjustment Errors	94
CompactFlash Card			
Operating	196	W	
Storage	196	Weight	
Instrument		Of instrument	193
Operating	196	SmartAntenna	174
Storage	196		
Temperature, charging internal battery	73		

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