Leica GS05

Certified Models:
LG1001 (UHF)
LG1002 (LTE Cat M1)
LG1003 (LTE Cat 1 Bis)

User Manual
Version 1.2
English

- when it has to be **right**

Leica Geosystems

PART OF HEXAGON

Introduction

Purchase

Congratulations on the purchase of the Leica GS05.

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

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

☞

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

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

https://myworld-portal.leica-geosystems.com/ > myDownloads

Product identification

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

Always refer to this information when contacting your agency or Leica Geosystems authorised service centre.

Trademarks

- *Bluetooth*® is a registered trademark of Bluetooth SIG, Inc.

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to all models of the Leica GS05 GNSS instrument.
Where there are differences between the various instruments they are clearly described.

Available documentation

Name	Description/Format		
GS05 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
GS05 User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions. Also included in the internal memory of the product.	-	✓
Name	**Description/Format**		
Captivate Technical Reference Manual	Overall comprehensive guide to the product and apps. Included are detailed descriptions of special software/hardware settings and software/hardware functions intended for technical specialists.	-	✓

Refer to the following resources for documentation/software:

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

myWorld

https://myworld-portal.leica-geosystems.com/ offers a wide range of services, information and training material.

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

The availability of services depends on the instrument model.

Service	Description
My Products	Register all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
My Service	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
My Support	Create new support requests for your products that will be answered by your local Leica Geosystems support team. View your complete support history and view detailed information on all your support requests.
Knowledge	Enter key words and start searching in our knowledge base. You can find FAQs (Frequently asked questions) as well as Knowledge articles for Leica Geosystems products.
Downloads	Downloads of software, manuals, tools, training material and news for Leica Geosystems products. Download the latest documentation and software to keep yourself and your products up-to-date. You can access downloads of software, manuals, tools, and training material.
Online Learning	Welcome to the home of Leica Geosystems online learning! There are numerous online courses – available to all customers with products that have valid CCPs (Customer Care Packages).
My SmartNet	Add and view your HxGN SmartNet subscriptions and user information. HxGN SmartNet delivers high-precision and high-availability GNSS network correction services in real-time and around the globe. The HxGN SmartNet Global family offers Network RTK with RTK bridging and Precise Point Positioning (PPP) services. These services work exclusively with Leica Geosystems GS smart antennas and receivers, providing the highest accuracy. Combined, they ensure HxGN SmartNet coverage everywhere.

Service	Description
My Trusted Services	Leica Geosystems Trusted Services offer you increased productivity while at the same time providing maximum security. New software services and state-of-the-art IT infrastructure offer a vast potential to optimise your workflow and increase your efficiency and productivity, both now and in the future.
My Security	Leica Geosystems Security delivers you total peace-of-mind in knowing that if your instrument is ever stolen, a locking mechanism is available to ensure that the instrument is disabled and can no longer be used.

Table of Contents

1 Safety Directions

1.1 General Introduction

Description

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

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

About warning messages

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

Warning messages...

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

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

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

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

1.2 Definition of Use

Intended use

- Computing with software
- Recording measurements
- Carrying out measurement tasks using various GNSS measuring techniques
- Recording GNSS and point related data
- Remote control of product
- Data communication with external appliances
- Measuring raw data and computing coordinates using carrier phase and code signal from GNSS satellites (GNSS systems)

Reasonably foreseeable misuse

- Use of the product without instructions
- Use outside of the intended use and limits
- Disabling of safety systems
- Removal of hazard notices
- Opening the product using tools, for example a screwdriver, unless this is permitted for certain functions
- Modification or conversion of the product
- Use after misappropriation
- Use of products with recognisable damage or defects
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems
- Inadequate safeguards at the working site
- Controlling of machines, moving objects or similar monitoring applications without additional control and safety installations

1.3 Limits of Use

Environment

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

⚠WARNING

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

Life Risk.

Precautions:

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

1.4 Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the User Manual
- To ensure that the product is used in accordance with the instructions
- To be familiar with local regulations relating to safety and accident prevention
- To stop operating the system and inform Leica Geosystems immediately if the product and the application become unsafe
- To ensure that the national laws, regulations and conditions for the operation of the product are respected

1.5 Hazards of Use

⚠DANGER

Risk of electrocution

Because of the risk of electrocution, it is dangerous to use poles, levelling staffs and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

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

⚠WARNING

Distraction/loss of attention

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

Precautions:

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

⚠WARNING

Inadequate securing of the working site

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

Precautions:

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

⚠CAUTION

Not properly secured accessories

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

Precautions:

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

⚠WARNING

Lightning strike

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

Precautions:

- Do not use the product in a thunderstorm.

⚠CAUTION

Dropping the product

When being dropped, the product can cause personal injury and/or mechanical damage.

Precautions:

- Secure the product when operating it.

⚠CAUTION

Dropping the product

When being dropped, the product can cause personal injury and/or mechanical damage.

Precautions:

- Ensure to have a firm grip on the product before operating it.

For the AC/DC power supply:

⚠WARNING

Electric shock due to use under wet and severe conditions

If unit becomes wet it may cause you to receive an electric shock.

Precautions:

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

- Protect the product against humidity.

For the AC/DC power supply:

⚠WARNING

Unauthorised opening of the product

Either of the following actions may cause you to receive an electric shock:

- Touching live components
- Using the product after incorrect attempts were made to carry out repairs.

Precautions:

- ▸ Do not open the product!
- ▸ Only Leica Geosystems authorised service centres are entitled to repair these products.

⚠WARNING

Dropping the product, high mechanical stress or high ambient temperature

Possible damage to the internal non-removeable battery may occur. International transportation regulations might prohibit transportation of those batteries.

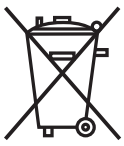
- ▸ Do not ship or transport by air.
- ▸ Send the affected product to the local customer service under consideration of the local transportation regulations.

⚠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.
- The product includes parts of Beryllium inside. Any modification of some internal parts can release dust or fragments, creating health hazard.

Precautions:

- ▸ 

  The product must not be disposed with household waste. Dispose of the product appropriately in accordance with the national regulations in force in your country. Always prevent access to the product by unauthorised personnel.

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

⚠WARNING

Improperly repaired equipment

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

Precautions:

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

1.6 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.

⚠CAUTION

Electromagnetic radiation

Electromagnetic radiation can cause disturbances in other equipment.

Precautions:

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

⚠CAUTION

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

This may cause disturbances in other equipment.

Precautions:

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

⚠CAUTION

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

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

Precautions:

- Check the plausibility of results obtained under these conditions.

⚠CAUTION

Electromagnetic radiation due to improper connection of cables

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

Precautions:

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

⚠CAUTION

Exceeding the RF radiation exposure limits for general population

Health risk

Precautions:

- The antennas used for this transmitter must be installed such that a minimum separation distance of at least 20 cm is always maintained between the radiator (antenna) and all persons.
- The antennas used for this transmitter must not be co-located or operated with any other antenna or transmitter.

⚠WARNING

Use of product with radio or digital cellular phone devices

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

Precautions:

- Although the product meets the strict regulations and standards which are in force in this respect, Leica 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 medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircrafts.
- Do not operate the product with radio or digital cellular phone devices for long periods with the product immediately next to your body.

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2 Description of the System

2.1 System Components

Main components

Component	Description
Instrument	To calculate a position from the computed ranges to all visible GNSS (Global Navigation Satellite System) satellites. To estimate a tilt compensated pole tip position by combining the GNSS position with attitude information from an Inertial Measurement Unit (IMU).
Antenna	To receive the satellite signals from the GNSS satellites.
Leica Infinity	The office software including a series of help programs which support working with Leica instruments.

Instrument

Instrument	Description
GS05	GPS, GLONASS, BeiDou, Galileo GNSS receiver, QZSS, multi-band, code and phase, real-time capable, internal memory and integrated Inertial Measurement Unit.

2.2 System Concept

2.2.1 Software Concept

Description

All instruments use the same software concept.

Software for all GS05 GNSS instruments

Software type	Description
GS05 firmware	GS05_Captivate_vX.XX.fw This software covers all functions of the instrument.

Software upload

☞ Uploading GS firmware can take some time. Ensure that the battery is at least 75% full before beginning the upload, and do not remove the battery during the upload process.

Software for	Description
All GS05 models	The software can be updated loading the firmware file to the internal memory of the GS05 instrument. Refer to 4.1.6 Updating the Firmware.

2.2.2 Power Concept

General

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

Power options

Power for the instrument can be supplied either internally or externally.

Model	Power supply
Internally	Integrated battery, not removable
Externally	5 V DC / 500 mA minimal via USB-C, or

Model	Power supply
	110 V / 240 V AC to 5 V DC / 3 A maximal via USB-C power supply

☞ For permanent operations use **U**ninterruptible **P**ower **S**upply units as a back-up in a main power failure.

2.2.3 Data Storage Concept

Description

Data (Leica GNSS raw data and RINEX data) can be recorded in the internal memory.

Memory device

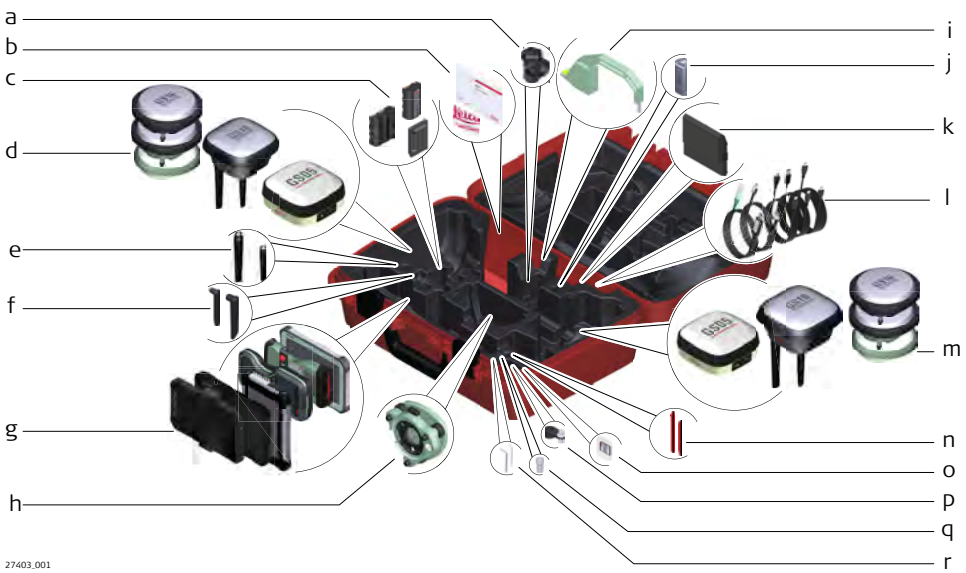
Internal memory:	The GS05 GNSS instrument has an internal memory. Available capacity: Up to 4 GB

☞ Unplugging connecting cables or interrupting the power supply during the measurement can cause loss of data. Only unplug connecting cables or interrupt the power supply when the GS GNSS instrument is switched off.

2.3 Container Contents

2.3.1 GVP754 GNSS Base & Rover Container

Container for GS instrument and accessories 1/2

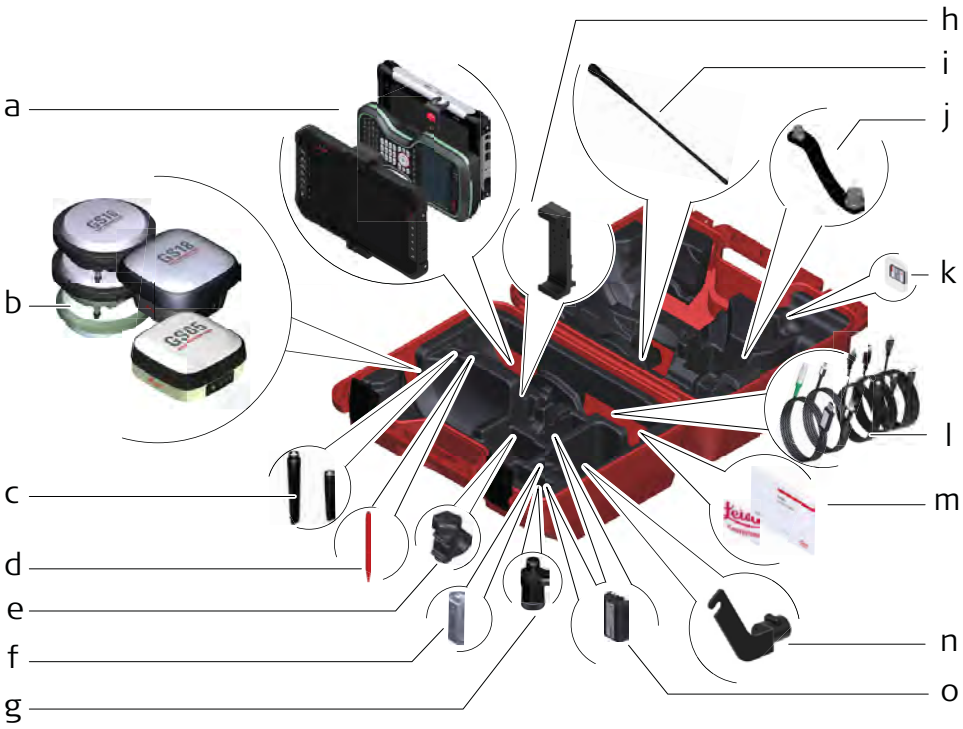


a GHT63 clamp
b Manuals and USB documentation card
c GEB212, GEB260 or GEB334 batteries
d Antenna
e LTE antennas, for example GAT36
f Radio antennas, for example GAT35
g Field controller or tablet with holder
h Tribrach
i Height hook
j USB stick
k CBA4, Li-ion battery for CC200
l Cables
m Antenna
n Stylus
o SD cards
p GAD34 arm 3 cm
q TNC QN-adapter
r Allen key and adjustment tool

Container for GS instrument and accessories 2/2

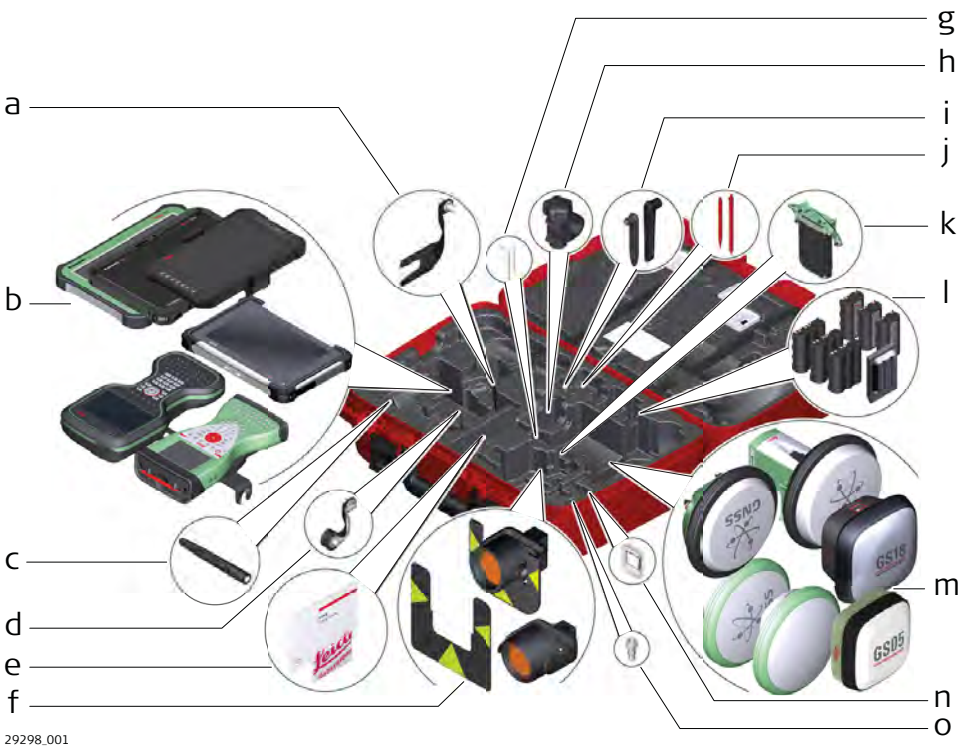
a Antenna arm
b GHT87 tablet holder bracket
c GFU RTK modem
d GAD32 telescopic rod
e GAT radio antennas, long flexible
f GHT36 base for telescopic rod
g GEB212, GEB260 (spare battery for CS30) or GEB334 batteries
h GRT146 or GRT247 carrier
i GAD33 arm
j GHT58 tripod bracket for GFU
k External battery

Container for GS instrument and accessories



a Field controller with holder
b Antenna
c LTE antennas, for example GAT36
d Stylus
e GHT63 clamp
f USB stick
g CRP15, quick release adaptor for quick mounting and demounting the GS05 to the pole without screwing
h GHT87 tablet holder
i GAT1, GAT2 or GAT35 radio antennas
j Antenna arm
k microSD card including adapter or SD card
l Cables
m Manual and USB documentation card
n GHT87 tablet holder bracket
o GEB212, GEB260 (spare battery for CS30) or GEB334 batteries

Container for GS05
1/2



a GAD33 arm
b Field controller or tablet with holder
c GAT33 Multiband GSM/UMTS/LTE antenna, or GAT27/GAT28/GAT36
d Antenna arm
e Manuals and USB documentation card
f GPR121 circular prism PRO or GZT4 target plate for GPH1 and GPH1 prism holder with GPR1 circular prism
g Allen key and adjustment tool
h GHT63 clamp
i GAT25 radio antenna
j Stylus
k SLXX RTK modem
l GEB212 or GEB331/GEB333/GEB334 batteries
m Antenna
n SD cards
o TNC QN-adapter

Container for GS05
2/2

a GHT87 tablet holder bracket
b GAD103 adapter
c Protective cover for instrument, sunshade for objective lens and cleaning cloth
d CBA4, Li-ion Battery for CC200
e GAT radio antennas, long flexible
f GKL311 battery charger
g GRZ101 mini prism
h Cables
i GRZ4 or GRZ122 prism
j Standard handle or RadioHandle
k GAD110 adapter for antenna
l GAD31 screw to stub adapter
m Mini prism spike

2.4 Instrument Components

GS05 components

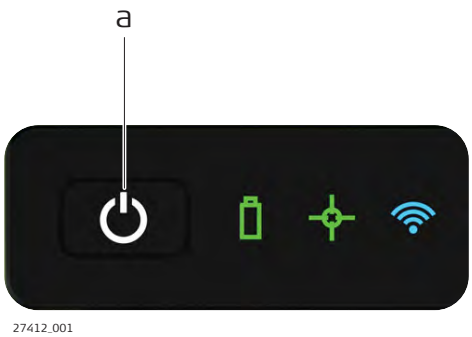
a LEDs and ON/OFF button
b USB-C port
c Antenna Reference Plane (ARP)
d RP-SMA connector for external UHF or LTE antenna

☞ A Bluetooth port is included inside all GS GNSS instruments enabling connectivity to the field controller.

3 User Interface

3.1 Keyboard

Keyboard GS05



a ON/OFF button

ON/OFF button

Button		Function
ON/OFF		**If GS05 is off** Turns on GS05 when held for 2 s. ☞ While the GS05 is booting, the Battery, Position and Connectivity LEDs light up sequentially one at a time.
		If GS05 is off Battery status of GS05 is shown when the button is pressed for < 1 s.
		If GS05 is on Turns off GS05 when held for 2 s. ☞ The Battery, Position and Connectivity LEDs light up sequentially one at a time.
		If GS05 is on Forces shutdown of GS05 when held for 12 s.
		If GS05 is on Press and hold button for 7 s. System configuration and network settings on the GNSS instrument are reseted. After the reset, the GNSS instrument is rebooted. ☞ The Position and Connectivity LEDs flash in orange and blue.

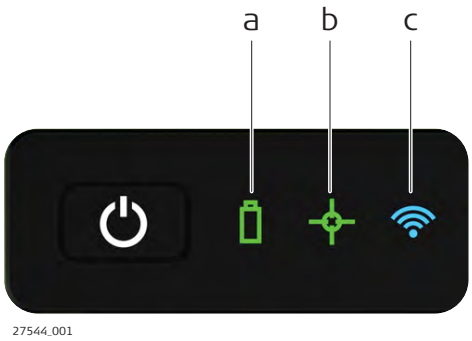
3.2 LED Indicators on GS05

LED indicators

Description

The GS05 instrument has Light Emitting Diode (LED) indicators. They indicate the basic instrument status.

Diagram



a Battery LED
b Position LED
c Connectivity LED

Description of the LEDs

LED	LED Status	Status of the Instrument
Battery LED	off	GS05 is switched off and is not being charged.
	green	GS05 is switched on and the battery power is > 30%. OR While being charged, GS05 is switched off and the battery power is 100%. OR Status check while GS05 is switched off and the battery power is > 30%.
	slow flashing green	While being charged, GS05 is switched off and the battery power is < 100%. OR While being charged, GS05 is switched on and the battery power is < 100%.
	red	GS05 is switched on and the battery power is 10% to 30%. OR Status check while GS05 is switched off and the battery power is 10% to 30%.
	flashing red	GS05 is switched on and the battery power is < 10%. OR Status check while GS05 is switched off and the battery power is < 10%.
Position LED	off	No satellites are tracked or GS05 is switched off.
	flashing orange	Satellites are tracked, a position is not yet available.
	orange	A navigated position is available.
	flashing green	A code-only position is available.
	green	A fixed RTK position is available.
Connectivity LED	off	GS05 is not powered or module is not ready.

LED	LED Status	Status of the Instrument
	green	GS05 is on and ready for connecting.
	blue	GS05 is connected to a field controller via Bluetooth.

3.3 Operating Principles

Operating the instrument

The GS05 GNSS instrument is operated by pressing the ON/OFF button or by the field controller.

Operation by button

The GS05 GNSS instrument is operated by pressing its button. Refer to 3.1 Keyboard for a detailed description of the buttons and their function.

Operation by field controller

The GS05 GNSS instrument is operated by the field controller using the Captivate software. Refer to the User Manual of the field controller for a detailed description of the keys and their function.

Turn on GS05

To turn on the instrument press and hold the ON/OFF button for 2 s.

Turn off GS05

To turn off the instrument:

- press and hold the ON/OFF button for 2 s
- confirm to power down the instrument when exiting the software on the field controller

4 Operation

4.1 Equipment Setup

4.1.1 Setting up as a Post-Processing Base

Use

The equipment setup described is used for static operations over markers.

Description

The instrument can be programmed with the field controller before use which can then be omitted from the setup.

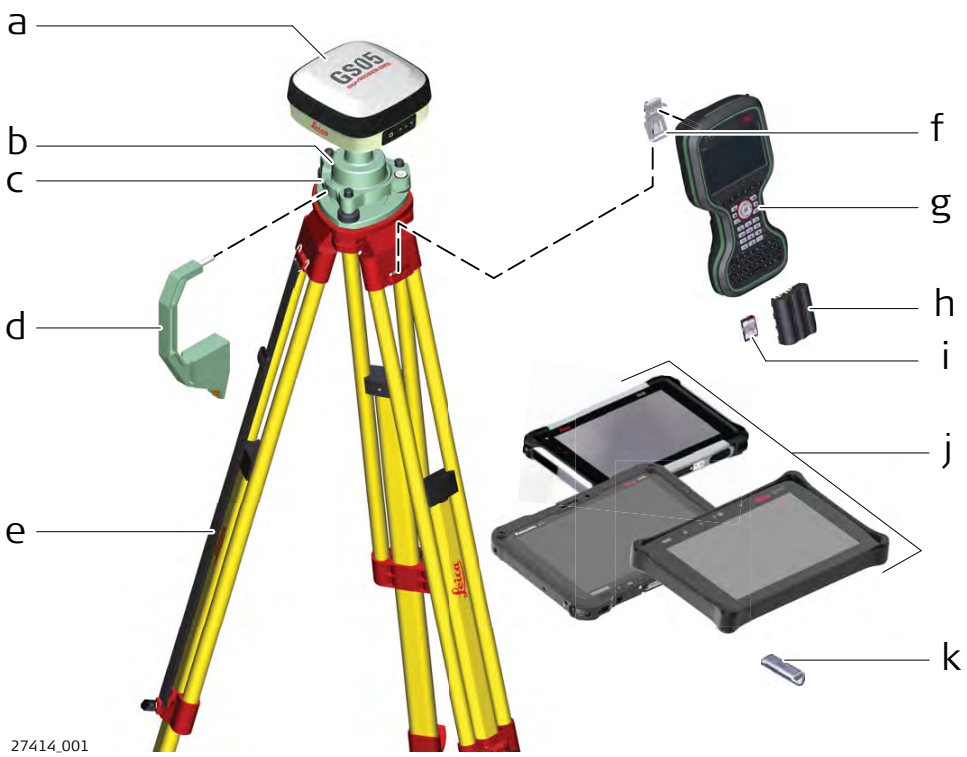
☞

- The antenna is mounted directly using screw fitting. If using stub and adapter, procedures can vary slightly.
- When using the adapter and carrier, ensure that the antenna and the adapter assembly slide down the full length of the carrier stub. An incorrectly mounted antenna will have a direct effect on the results.

☞

Use an external power supply to ensure operation for a full day.

Equipment setup



a	GS instrument	g	CS20 field controller
b	GRT146 carrier	h	GEB334 battery
c	Tribrach	i	SD card
d	Height hook	j	CS30, CC180 or CC200 tablet
e	Tripod	k	USB stick
f	Utility hook		

Equipment setup step-by-step

1.	Set up the tripod.
2.	Mount and level the tribrach on the tripod.
3.	Ensure that the tribrach is over the marker.
4.	Place and lock the carrier in the tribrach.
5.	Screw the GS onto the carrier.
6.	Check that the tribrach is still level.
7.	Insert the data storage device and the battery into the field controller.
8.	Switch on the field controller and connect it to the instrument if necessary.
9.	To hang the field controller on the tripod leg, use the hook on the hand strap or use the utility hook. Refer to the User Manual of the field controller.
10.	Insert the height hook into the carrier.
11.	Measure the antenna height using the height hook.
12.	Press the ON/OFF button on the instrument for at least 2 s to switch on the instrument.

4.1.2 Setting up as a Real-Time Base

Use

The equipment setup described is used for real-time base stations with the need of optimal radio coverage. Raw observation data can also be collected for post-processing.

Description

The GS05 instrument can be programmed with the field controller before use which can then be omitted from the setup.

The connection between GS05 and the field controller is made via Bluetooth.

The radio antenna (GAT35) is directly mounted downwards facing at the GNSS antenna.

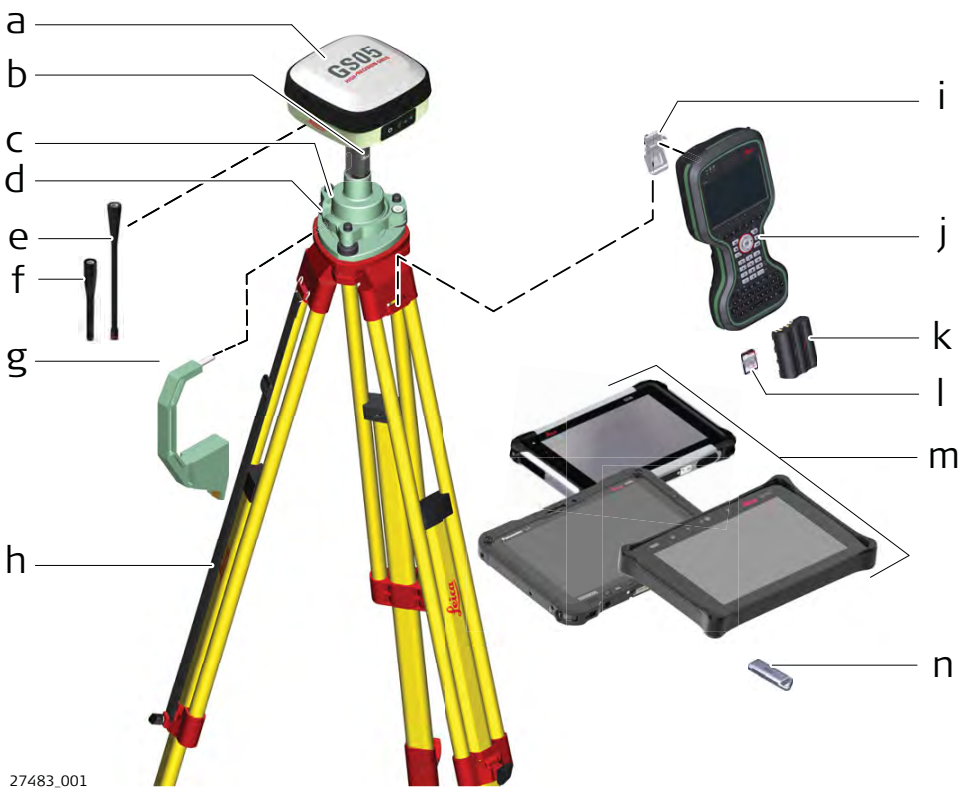
☞

- The GNSS antenna is mounted directly using screw fitting. If using stub and adapter, procedures can vary slightly.
- When using the adapter and carrier, ensure that the antenna and the adapter assembly slide down the full length of the carrier stub. An incorrectly mounted antenna will have a direct effect on the results.
- Standard radio is used throughout the instructions. Digital cellular phones can also be used but the setup can differ slightly.

☞

Use an external power supply to ensure operation for a full day.

Equipment setup - GS05 cellular or GS05 UHF



a	GS instrument with integrated cellular modem or UHF modem	f	GAT36 LTE antenna
b	GAD54 adapter, only required in combination with GAT35 UHF antenna	g	Height hook
c	GRT146 carrier	h	Tripod
d	Tribrach	i	Utility hook
e	GAT35 UHF antenna	j	CS20 field controller
		k	GEB334 battery
		l	SD card
		m	CS30, CC180 or CC200 tablet
		n	USB stick

Equipment setup step-by-step

1.	Set up the tripod.
2.	Mount and level the tribrach on the tripod.
3.	Ensure that the tribrach is over the marker.
4.	Place and lock the carrier in the tribrach.
5.	Screw the GS05 onto the carrier.
6.	Check that the tribrach is still level.
7.	Connect the UHF or LTE antenna to the GS05.
8.	Insert the data storage device and the battery into the field controller.
9.	Connect the field controller to the instrument if necessary.
10.	To hang the field controller on the tripod leg, use the hook on the hand strap or use the utility hook. Refer to the User Manual of the field controller.
11.	Insert the height hook into the carrier.
12.	Measure the antenna height using the height hook.

13. Press the ON/OFF button on the instrument for at least 2 s to switch on the instrument.

4.1.3 Setting up as a Real-Time Rover

Use

The equipment setup is used for real-time rover with extended periods of use in the field.

Description

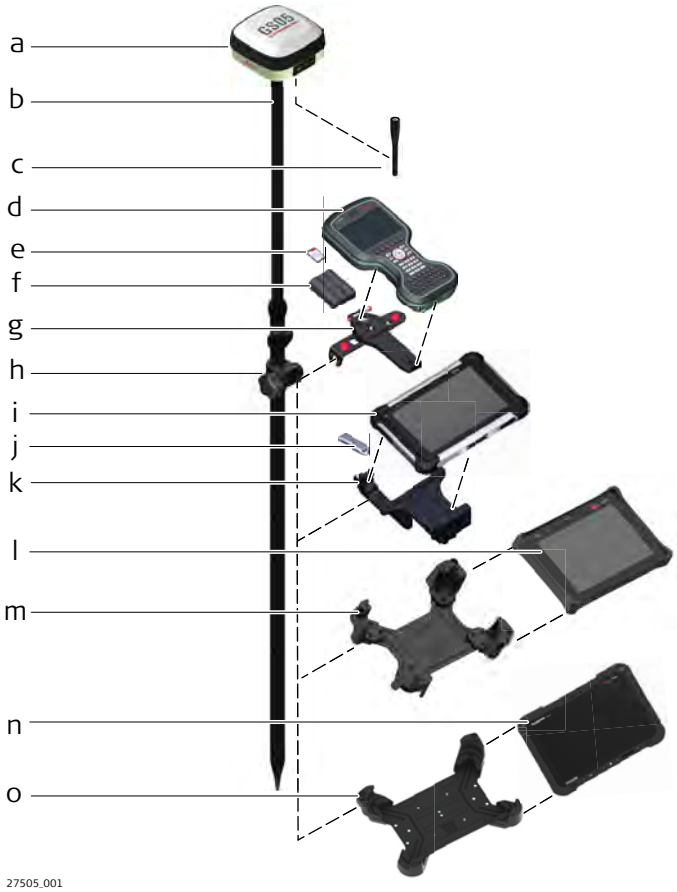
Connections are made to the GNSS antenna, radio antenna and field controller.

The field controller is fixed to the pole with the GHT63. Connection between the GS05 instrument and the field controller is made through Bluetooth.

☞

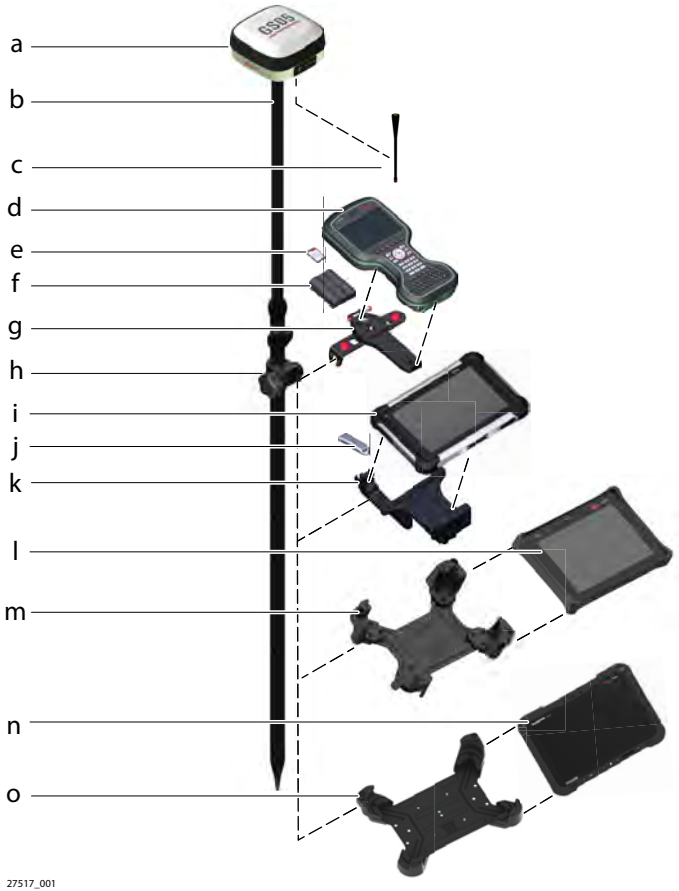
- The antenna is mounted directly using screw fitting. If using stub and adapter, procedures can vary slightly.
- When using the pole with stub, ensure that the antenna and the screw-to-stub adapter slide down the full length of the stub before tightening the locking ring. An incorrectly mounted antenna will have a direct effect on the results.
- Standard radio is used throughout the instructions. Digital cellular phones can also be used but the setup can differ slightly.

Equipment setup - GS05 LTE



a	GS instrument	i	CS30 tablet
b	GLS30 carbon fibre pole	j	USB stick
c	GAT36 LTE antenna	k	GHT81 holder
d	CS20 field controller	l	CC180 tablet
e	SD card for CS20	m	GHT90 holder
f	GEB334 battery	n	CC200 tablet
g	GHT66 holder	o	CMB16 holder
h	GHT63 pole clamp		

Equipment setup - GS05 UHF



a	GS instrument with integrated UHF radio modem	h	GHT63 pole clamp
b	GLS30 carbon fibre pole	i	CS30 tablet
c	GAT35 radio antenna	j	USB stick
d	CS20 field controller	k	GHT81 holder
e	SD card for CS20	l	CC180 tablet
f	GEB334 battery	m	GHT90 holder
g	GHT66 holder	n	CC200 tablet
		o	CMB16 holder

Equipment setup step-by-step

1.	Attach the GHT66 for CS20 holder to the pole.
2.	Insert the data storage device and the battery into the field controller.
3.	Clip the field controller into the holder and lock it by pushing the locking pin into the locked position.
4.	Press ON/OFF button on the field controller to switch on.
5.	Press ON/OFF button on the GS05 to switch on.
6.	Screw the GS05 to the top of the pole.
7.	The field controller and GS05 are connected via Bluetooth.

4.1.4 Fixing the Field Controller to a Holder and Pole

☞ Refer to the User Manual of the field controller.

4.1.5 Connecting to a Personal Computer

Description

Leica USB drivers are not needed for GS05. Standard Windows drivers support all USB cables used for GS05.

Cables

Windows USB drivers support:

Name	Description
GEV278 GEV288	USB data cable, USB-C to USB-C
GEV284	USB data cable, USB-C to USB-A

Connect to PC via USB cable step-by-step

1. Start the PC.
2. Plug the cable into the instrument.
3. Turn on the instrument.
4. Plug the cable into the USB port of the PC.
5. Open the File Explorer on your PC.
6. Select **This PC** and select the Leica GS05 in section **Devices and drives**.
7. Transfer your data from the internal memory of the Leica GS05 to your Windows PC.

4.1.6 Updating the Firmware

Description

The firmware of the GS05 GNSS instrument is updated by copying the firmware file onto the internal memory of the GS05.

Update firmware step-by-step

1. Firmware packages are available for download at the following Internet address: https://myworld-portal.leica-geosystems.com/ -> myDownloads
2. Connect to PC via USB cable. Refer to 4.1.5 Connecting to a Personal Computer.
3. Follow the instructions mentioned in myWorld.
4. Once followed all the steps required in previous point, the GS05 starts the update process automatically. LEDs indicate the process.
5. Once the update process is complete, the GS05 instrument reboots automatically.

4.2 Batteries

4.2.1 Operating Principles

First-time use/ charging batteries

- The battery must be charged before using it the first time
- The permissible temperature range for charging is from 0 °C to +50 °C/ +32 °F to +122 °F. For optimal charging, we recommend charging the batteries at temperature of +10 °C to +20 °C/+50 °F to +68 °F
- It is normal for the batteries to become warm during charging. The chargers provided by Leica Geosystems automatically interrupt the charging when 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 a discharge/charge cycle
- For Li-Ion batteries, a single discharge/charge 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 -30°C to +60°C/-22°F to +140°F.
- Low operating temperatures reduce the capacity that can be drawn; high operating temperatures reduce the service life of the battery.

4.2.2 Battery for GS05

GS05 has an internal battery that cannot be removed. Refer to 2.2.2 Power Concept for information about how to charge the battery.

4.3 Working with the Tilt Compensation

Description

The pole can be held in a slanting position up to 30 degrees over the point to be measured without checking the circular bubble on the pole.

Measurements are reliable and accurate even if the pole is not levelled as the tilt values are calculated by an Inertial Measurement Unit. Tilt values contain information about the 3D position of the pole.

The measurements are immune to magnetic disturbances as there is no magnetometer used.

Tilt compensation also works with Navigated and Code solutions. High accuracy positions are recommended to speed up the tilt compensation initialization.

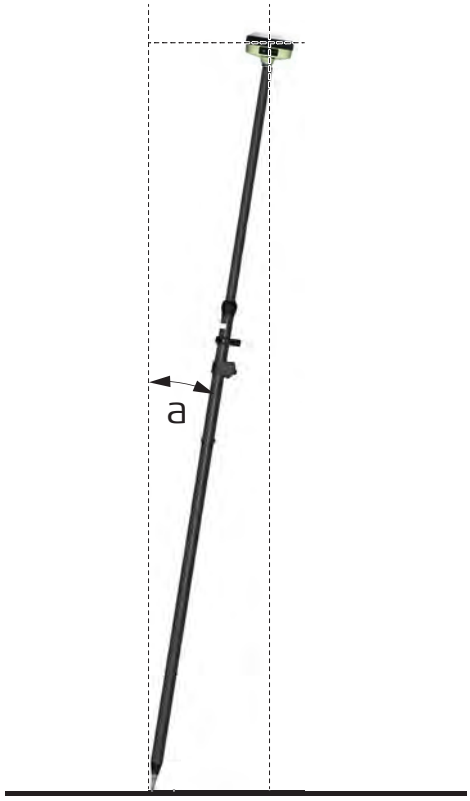
Tilt compensation is turned off when RINEX logging is on.

When measuring a point, the pole tip must be stable on the point while the pole should be in slight movement.

Advantages:

- No need to level the pole
- Faster surveying procedure

Diagram

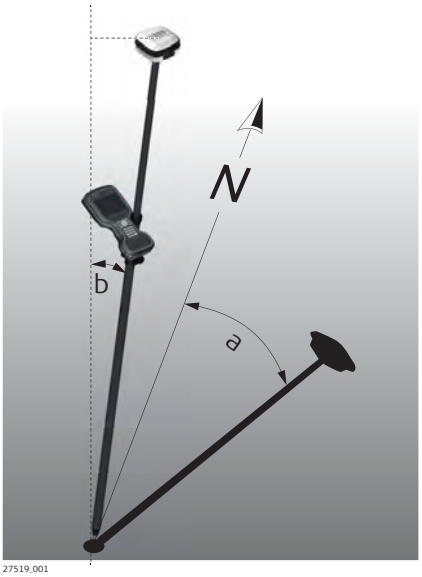
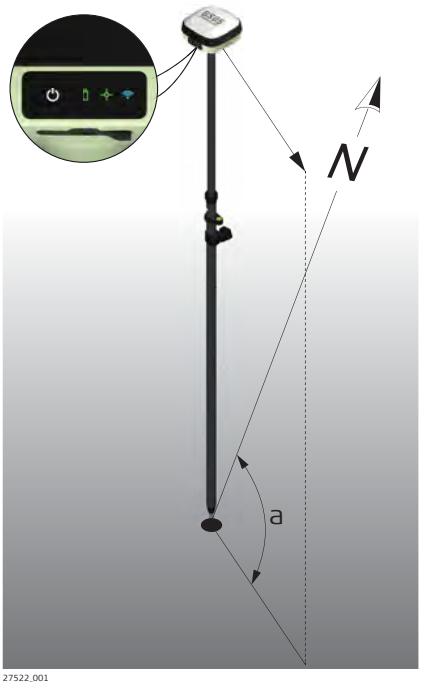


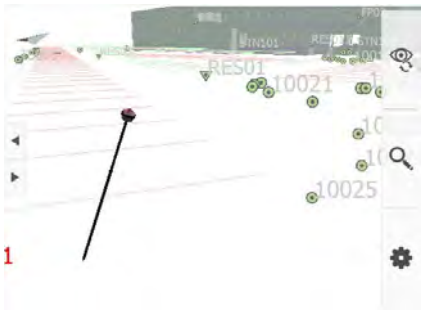
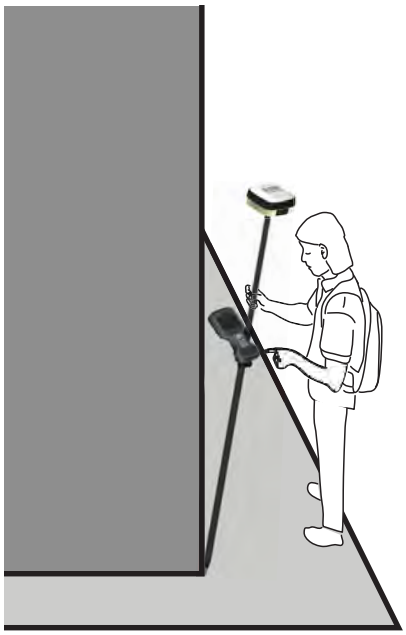
27518_001

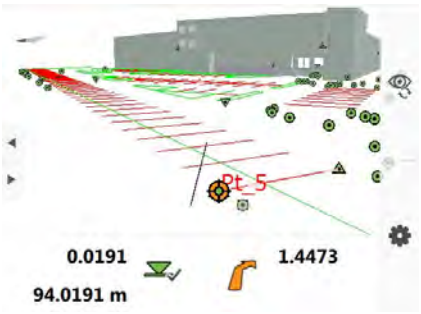
α **Tilt**

Tilt compensation step-by-step

Action		Result
☞	A GS05 must be configured as real-time rover and connected to a field controller running Captivate software.	
1.	**Leica Captivate - Home**: **Settings\GS sensor\Tilt compensation**	
2.	**Tilt Compensation** **Use tilt compensation**: Check box checked. Set **Use tilt compensator to**: **Compensate & store tilt**.	
3.	**OK**	
☞	Move the antenna for initialisation. Walking to the survey mark is sufficient. A message and a voice promt indicate that the tilt compensation is being applied.	
☞	The green background of the position icon on the field controller indicates when a tilt compensated measurement is possible.	
4.	**For an overview of the current position in the survey area**	

Action		Result
	Click the GS position icon. Select **Current position**.	
5.	**Current GS position**, **Tiltpage** The fields are updated according to the setting for **GS position update rate** in **Screen, Audio & Text Input**.	 27519_001 α **Direction of tilt** β **Tilt**  27522_001 α **GS heading**
6.	**For an overview of the current position in the survey area**	

Action		Result
	Use the 3D viewer with dxf data or a background image:	
7.	**Measure points** **Leica Captivate - Home**: **Measure** The position of the tilted GS05 is shown in the 3D viewer. **Measure** **Stop** **Store**	
	Application example:	 27524_001
8.	**Stake points** **Leica Captivate - Home**: **Stake points** The position of the tilted GS05 is shown in the 3D viewer.	

Action		Result
9.	Stake out the point. The values are valid for the tip of the pole.	

4.4 Configuring an eSIM

Description

Some devices are without physical SIM but with integrated eSIM.

The GS05 LTE integrates eSIM which do not need a physical SIM.

Manage eSIM profiles and their respective states:

- Enable and disable eSIM
- View existing eSIM profiles
- Create, edit, deactivate, delete and navigate eSIM profiles

Terms and abbreviations

Term	Description
eSIM	embedded Subscriber Identity Module An eSIM is a SIM card embedded within the phone that can be updated over the air. The user must download the eSIM profile over the air and activate via a remote SIM provisioning process.
ICCID	Integrated Circuit Card Identifier This is a unique numerical code that identifies a SIM card or an eSIM in a mobile device. Every eSIM has its own ICCID, enabling mobile networks to accurately associate the eSIM card with a specific user or account.
SM-DP+	Subscription Manager Data Preparation Protocol+ The SM-DP+ address+ is a unique identifier that specifies the address of the subscription management server used to activate the eSIM. The activation code is an one-time code provided by the service provider that enables the eSIM to be activated on the device.

eSIM provisioning

The GS05 has been specifically designed as an IoT device, meaning that its internal cellular modem supports only LTE networks tailored for IoT applications, specifically LTE-M (also known as Cat-M or Cat-M1) and Cat-1bis.

When ordering your eSIM, please ensure that your Mobile Network Operator (MNO) supports Cat-M or Cat-1bis in the area where the GS05 will be deployed. Additionally, the eSIM should be properly provisioned for these networks to ensure seamless operation.

Configuring eSIM step-by-step

1.	Contact your eSIM network service provider and ask for the SM-DP+ adress, activation code and confirmation code for your eSIM.

	You receive an QR code. This contains: • SM-DP+ Adress: Unique identifier of the profile. This will be stored on the eUICC. • Activation code: One-time code • Confirmation code: Optional
☞	With a QR code scanner, extract the QR code SM-DP+ Adress, the activation code and the confirmation code (optional). The information must be entered manually in Captivate.
2.	Start Captivate.
3.	Connect GS05 to the Internet via WLAN: In **Connection Settings**, **GS connections** page, highlight **GS WLAN** and press **Edit**. Enter the settings.
4.	In **Connection Settings**, **GS connections** page, highlight **GS internet** and press **Edit**.
5.	In **Internet Connection**, select **Connect using**: **GS modem**. Press **OK**.
6.	In **Connection Settings**, highlight a connection which has an eSIM capable device integrated.
7.	**Control**.
8.	Check **Enable eSIM**.
9.	Press **New**.
10.	In Internet Connection, **eSIM** page enter the information from the QR code • **eSIM profile label** as name for the profile. • **SM-DP+ address** as provided • **Activation code** as provided • **Confirmation code (optional)** if provided
11.	Press **OK** to install the profile.
12.	Press **Enable** to activate the eSIM profile.
13.	Configure the phone settings. • In Internet Connection, **APN** page enter the APN. • In Internet Connection, **Sim codes** page enter the PIN and PUK. Most eSIM profiles do not require any PIN code.
14.	GS05 is connected to the Internet.

4.5 Licence Activation

First time licence activation

The GS05 is delivered with all purchased licenses not yet activated. Connect the GS05 to the Internet for the initial license activation. For simplicity, we recommend doing this via the GS05 WLAN.

Subsequent licence activation

If new licenses have been re-ordered, they will be activated on the GS05 during application startup, after re-connection to the Internet, or every hour while the device is connected to the Internet.

For more information please check https://leica-geosystems.com/services-and-support/product-services/license-activation?sc_lang=en.

4.6 Guidelines for Correct Results with GNSS Surveys

Undisturbed satellite signal reception	Successful GNSS surveys require undisturbed satellite signal reception, especially at the instrument which serves as a base. Set up the instrument in locations which are free of obstructions such as trees, buildings or mountains.
Steady instrument for static surveys	For static surveys, the instrument must be kept perfectly steady throughout the entire occupation of a point. Place the instrument on a tripod or pillar.
Centred and levelled instrument	Centre and level the instrument precisely over the marker.
Tilt compensation for kinematic surveys	If tilt compensation is available and activated then tilt compensation is applied for stakeout and surveys with instantaneous point measurement, auto points or point measurements with short occupation time. The pole tip can be placed on the marker, while the antenna does not have to remain levelled and steady.

5 Care and Transport

5.1 Transport

Transport in the field

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

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

Transport in a road vehicle

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

Shipping

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

Shipping, transport of batteries

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

5.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to 6 Technical Data for information about temperature limits.

Li-Ion batteries

- Refer to 6 Technical Data for information about storage temperature range
- Remove batteries from the product and the charger before storing
- After storage recharge batteries before using
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use
- A storage temperature range of 0 °C to +30 °C / +32 °F to +86 °F in a dry environment is recommended to minimize self-discharging of the battery
- At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged

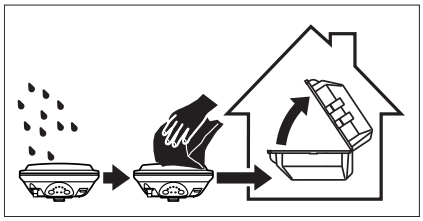
5.3 Cleaning and Drying

Product and accessories

- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Cleaning and drying

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40 °C [104 °F] and clean them. Remove the battery cover and dry the battery compartment. Do not repack until everything is 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.
Connectors with dust caps	Wet connectors must be dry before attaching the dust cap.

6 Technical Data

6.1 GS05 Technical Data

6.1.1 Tracking Characteristics

Satellite reception

Multi-band

Instrument channels

☞ Depending on the satellite systems and signals configured, a maximum number of 184 channels is allocated.

Supported signals

System	Signal
GPS	L1, L2C
GLONASS	L1, L2C
Galileo	E1, E5b
BeiDou	B1I, B2I
QZSS	L1, L2C
SBAS	Enabled through future firmware updates

☞ Carrier phase and code measurements on L1, L2 and L5 (GPS) are fully independent with AS on or off.

6.1.2 Accuracy

☞ Accuracy is dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities.

The following accuracies, given as **r**oot **m**ean **s**quare, are based on measurements processed using Leica Infinity and on real-time measurements.

The use of multiple GNSS systems can increase accuracy by up to 30% relative to GPS only.

Differential code

The baseline precision of a differential code solution for static and kinematic surveys is 25 cm.

Differential phase in post-processing

Type	Horizontal	Vertical
Static and rapid static	5 mm + 0.5 ppm	10 mm + 0.5 ppm
Kinematic	10 mm + 1 ppm	20 mm + 1 ppm
Static with long observations	3 mm + 0.5 ppm	6 mm + 0.5 ppm

Differential phase in real-time

Type	Horizontal	Vertical
Single Baseline (<30 km)	10 mm + 1 ppm	20 mm + 1 ppm
Network RTK	10 mm + 0.5 ppm	20 mm + 0.5 ppm

Tilt

Tilt compensated in real-time

Additional Hz uncertainty:

Typically less than 1.5 cm tilt down to 30° tilt

6.1.3 Technical Data

Dimensions

Length	118.9 mm
Width	118.9 mm
Height	75.5 mm

Weight

Type	Weight [kg]/[lbs]
GS05	0.75 / 1.76

Recording

Data (Leica GNSS raw data and RINEX data) can be recorded on the internal memory or on the connected controller/tablet.

1 GB is sufficient for over 1 year of raw data logging based on logging every 15 s from an average of 15 satellites.

Power

Power consumption:	2.5 W typically
External supply voltage:	15 W maximal in charging mode via USB-C

Internal battery

Battery	Voltage	Capacity	Operating time, typical*
Li-Ion	3.6 V	6.0 Ah	10 h

* Operating time depends on use of wireless communication devices.

Operating times

The given operating times are valid for

- GS05 instrument; one fully charged internal battery
- Room temperature; operating times will be shorter when working in cold weather.

Type		Operating time
Static		10 h continuously
Rover	with cellular modem	8 h continuously
	with radio modem	10 h continuously
Base	with cellular modem	8 h continuously
	with radio modem	10 h continuously

Electrical data

GNSS Signal	Frequency	GS05
Galileo E5b BeiDou B2I	1207.1400 MHz	✓

GNSS Signal	Frequency	GS05
GPS L2C	1227.6000 MHz	✓
GLONASS L2C	1243.375 – 1248.625 MHz	✓
BeiDou B1I	1561.0980 MHz	✓
GPS L1 Galileo E1	1575.4200 MHz	✓
GLONASS L1	1598.625–1605.375 MHz	✓
Gain (LNA)		Typically 22 dB
Noise Figure		Typically < 2 dB

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
GS05	With internal power: −30 to +55 With external power: −40 to +65	−40 to +80

Protection against water, dust and sand

Type	Protection
GS05	IP66 & IP68, dust tight IEC 60529 MIL STD 810H 506.6 Proc II MIL STD 810H 512.6 Proc I MIL STD 810H 510.7 Proc II Protected against continuous immersion in water Tested for 2 hours in 1.40 m depth

Pollution degree

Type	Pollution
GS05	4

Humidity

Protection
Up to 95% The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

Altitude

Type	Protection
GS05	Unrestricted

Sound level

Type	Value
All instruments	No sound emitted or no physical moving parts

6.2 Conformity to National Regulations

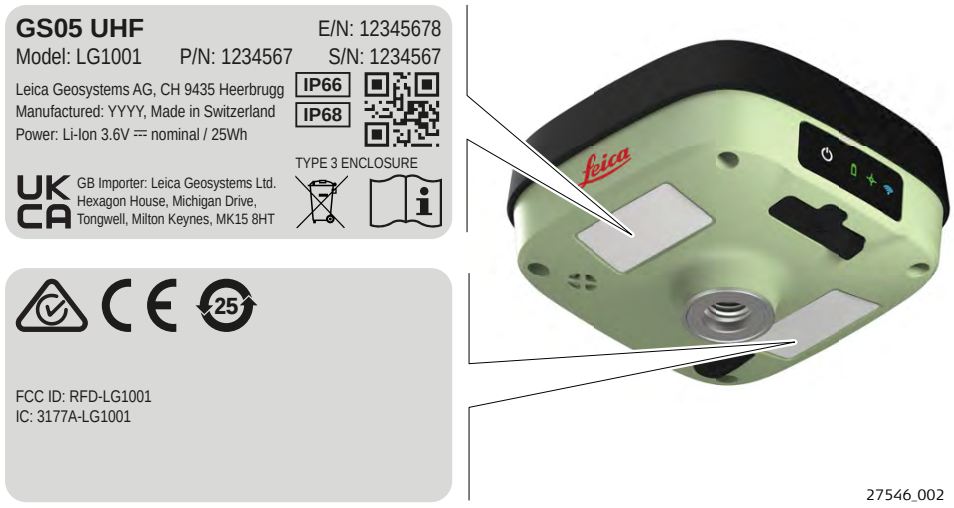
6.2.1 GS05

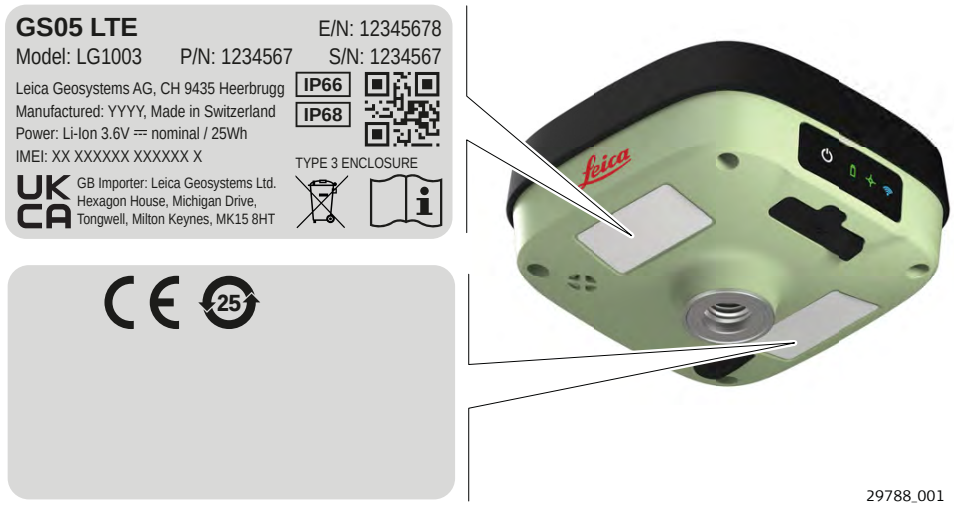
Labelling

GS05 (LG1001 (UHF))

GS05 (LG1002 (LTE Cat M1))

GS05 (LG1003 (LTE Cat 1 Bis))





Antenna

Type	Antenna	Gain [dBi]
GNSS	Internal GNSS antenna element (receive only)	-
Bluetooth	Internal Microstrip antenna	2 max.
UHF	External antenna	0
WLAN	Internal Patch antenna	2 max.
LTE	External antenna	2 max.

Frequency bands, output power

Type	Frequency band [MHz]	Output power[1)] [dBm]	Country restrictions
Bluetooth	2402–2480	8.00	
WLAN	2401–2495	18.00	
Radio	413–473	13.00	
LTE (Cellular CatM)	700 (B12, B13, B28, B85) 800 (B18, B19, B20, B26, B27) 850 (B5) 900 (B8) AWS-3 (B66) AWS-1 (B4) 1800 (B3) 1900 (B2,B25) 2100 (B1)	20	This variant is the one used within articles 949991 and 949992.
LTE (Cellular Cat1Bis)	2100 (B1) 1900 (B2) 1800 (B3) 2100 (B4) 850 (B5) 2600 (B7) 900 (B8) 800 (B20) 700 (B28) TDD2600 (B38) TDD2300 (B40) TDD2500 (B41) 2100 (B66)	23	This variant is the one used with article 949990.
GS05	1207.14 1227.60 1243.375–1248.625 1561.098 1575.42 1598.625–1605.375	Receive only n/a[2)]	

[1)] Conducted power for mobile technologies and EIRP for other technologies.

[2)] Not applicable

Radiation Exposure Statement

The radiated output power of the instrument is below the radio frequency exposure limits. Nevertheless, the instrument should be used in such a manner that the potential for human contact during normal operation is minimised.

EU

CE

Hereby, Leica Geosystems AG declares that the radio equipment type

GS05 (LG1001 (UHF))

GS05 (LG1002 (LTE Cat M1))

GS05 (LG1003 (LTE Cat 1 Bis))

is in compliance with Directive 2014/53/EU and other applicable European Directives.
The full text of the EU declaration of conformity is available at the following Internet address: http://www.leica-geosystems.com/ce.

⚠CAUTION

This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

USA

FCC ID: LG1001 (UHF): RFD-LG1001, LG1002 (LTE): RFD-LG1002
Part 15, Part 15 B, 22, 24

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.

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, it may cause harmful interference to radio communications.

However, there is no guarantee that interference does 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.

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

Canada

CAN ICES-003 B/NMB-003 B
IC: LG1001 (UHF): 3177A-LG1001, LG1002 (LTE): 3177A-LG1002

Canada Compliance Statement
This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

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

Canada Déclaration de Conformité
L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

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

Japan

- This device is granted pursuant to the Japanese Radio Law (電波法).
- This device should not be modified (otherwise the granted designation number will become invalid).

Others

The conformity for countries with other national regulations has to be approved prior to use and operation.

6.2.2 Dangerous Goods Regulations

Dangerous Goods Regulations

Many products of Leica Geosystems are powered by Lithium batteries.

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

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

☞ There are guidelines on **How to carry** and **How to ship** products with Lithium batteries. Before any transportation of a Leica product, we ask you to consult the guidelines on the web page (IATA Lithium Batteries) to ensure that you are in accordance with the IATA Dangerous Goods Regulations and that the Leica products can be transported correctly.

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

7 Software Licence Agreement/Warranty

International Limited Warranty

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PART OF HEXAGON

- when it has to be **right**

Leica Geosystems