

Leica iCON gps 60 User Manual



Version 2.7
English

- when it has to be **right**

Leica
Geosystems

Introduction

Purchase

Congratulations on the purchase of a Leica iCON gps 60 system.



This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "1 Safety Directions" for further information. Read carefully through the User Manual before you switch on the product.

Product Identification

The model and serial number of your product are indicated on the type plate. Always refer to this information when you need to contact your agency or Leica Geosystems authorised service centre.



Trademarks

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

Validity of this manual

This manual applies to the Leica iCON gps 60 SmartAntenna.

Available documentation

Name	Description/Format		
Leica iCON gps 60 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference field guide.	✓	✓
Leica iCON gps 60 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.		✓

Refer to the following resources for all Leica iCON gps 60 documentation/software:

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



myWorld@Leica Geosystems (<https://myworld.leica-geosystems.com>) offers a wide range of services, information and training material. With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you, 24 hours a day, 7 days per week. This increases your efficiency and keeps you and your equipment instantly updated with the latest information from Leica Geosystems.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.

Service	Description
mySupport	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.
myTraining	Enhance your product knowledge with Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material on your products and register for seminars or courses in your country.
myTrustedServices	Add your subscriptions and manage users for Leica Geosystems Trusted Services, the secure software services, that assist you to optimise your workflow and increase your efficiency.

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1 Safety Directions

1.1 General Introduction

Description

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

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

About Warning Messages





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

Warning messages...

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

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

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

Type	Description
 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.
 - 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.
-

Reasonably foreseeable misuse

- Use of the product without instruction.
 - Use outside of the intended use and limits.
 - Disabling safety systems.
 - Removal of hazard notices.
 - Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
 - Modification or conversion of the product.
 - Use after misappropriation.
 - Use of products with obvious damages 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 application 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.



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.

1.4

Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To ensure that it is used in accordance with the instructions.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of e.g. radio transmitters or lasers are respected.
- To ensure that the radio modem is not operated without the permission of the local authorities on frequencies and/or output power levels other than those specifically reserved and intended for use without a specific permit.
The internal and external radio modems have been designed to operate on frequency ranges and output power ranges, the exact use of which differs from one region and/or country to another.

1.5

Hazards of Use



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 as well as 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.



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, accident prevention and road traffic.



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.



DANGER

If the product is used with accessories, for example on masts, staffs, poles, you may increase the risk of being struck by lightning. Danger from high voltages also exists near power lines. Lightning, voltage peaks, or the touching of power lines can cause damage, injury and death.

Precautions:

- Do not use the product in a thunderstorm as you can increase the risk of being struck by lightning.
 - Be sure to remain at a safe distance from electrical installations. Do not use the product directly under or close to power lines. If it is essential to work in such an environment contact the safety authorities responsible for electrical installations and follow their instructions.
 - If the product has to be permanently mounted in an exposed location, it is advisable to provide a lightning conductor system. A suggestion on how to design a lightning conductor for the product is given below. Always follow the regulations in force in your country regarding grounding antennas and masts. These installations must be carried out by an authorised specialist.
 - To prevent damages due to indirect lightning strikes (voltage spikes) cables, for example for antenna, power source or modem should be protected with appropriate protection elements, like a lightning arrester. These installations must be carried out by an authorised specialist.
 - If there is a risk of a thunderstorm, or if the equipment is to remain unused and unattended for a long period, protect your product additionally by unplugging all systems components and disconnecting all connecting cables and supply cables, for example, instrument - antenna.
-

Lightning conductors

Suggestion for design of a lightning conductor for a GNSS system:

1) On non-metallic structures

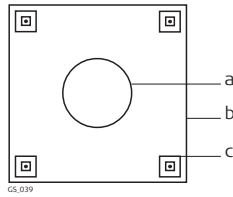
Protection by air terminals is recommended. An air terminal is a pointed solid or tubular rod of conducting material with proper mounting and connection to a conductor. The position of four air terminals can be uniformly distributed around the antenna at a distance equal to the height of the air terminal.

The air terminal diameter should be 12 mm for copper or 15 mm for aluminium. The height of the air terminals should be 25 cm to 50 cm. All air terminals should be connected to the down conductors. The diameter of the air terminal should be kept to a minimum to reduce GNSS signal shading.

2) On metallic structures

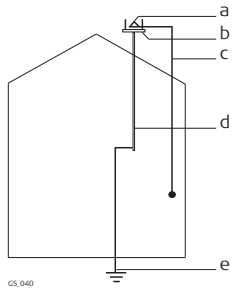
Protection is as described for non-metallic structures, but the air terminals can be connected directly to the conducting structure without the need for down conductors.

Air terminal arrangement, plan view



- a) Antenna
- b) Support structure
- c) Air terminal

Grounding the instrument/antenna



- a) Antenna
- b) Lightning conductor array
- c) Antenna/instrument connection
- d) Metallic mast
- e) Connection to earth



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

Precautions:

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



WARNING

Incorrect fastening of the external antenna to vehicles or transporters poses the risk of the equipment being broken by mechanical influence, vibration or airstream. This may result in accident and physical injury.

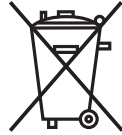
Precautions:

Attach the external antenna professionally. The external antenna must be secured additionally, for example by use of a safety cord. Ensure that the mounting device is correctly mounted and able to carry the weight of the external antenna (>1 kg) safely.

**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 distributor.

**WARNING**

Only Leica Geosystems authorised 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.

**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 or other electronic equipment, 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 or other electronic equipment, 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.



CAUTION

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

Precautions:

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

Radios or Digital Cellular Phones



WARNING

Use of product with radio or digital cellular phone devices:

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

Precautions:

Although the product meets the strict regulations and standards which are in force in this respect, Leica 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.
-

1.7

FCC Statement, Applicable in U.S.



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:

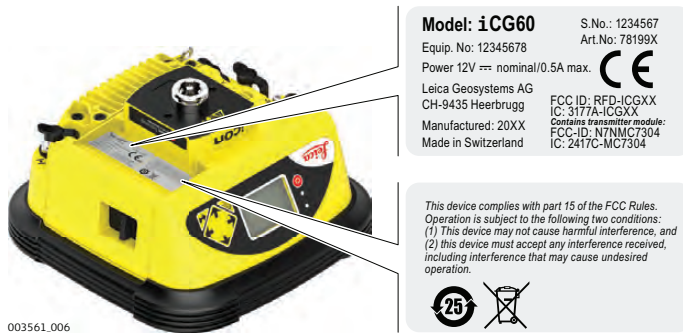
- Reorient or relocate the receiving antenna.
 - Increase the separation between the equipment and the receiver.
 - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
 - Consult the dealer or an experienced radio/TV technician for help.
-



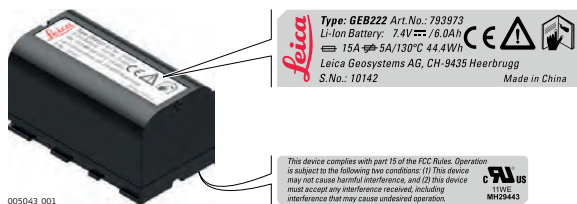
WARNING

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

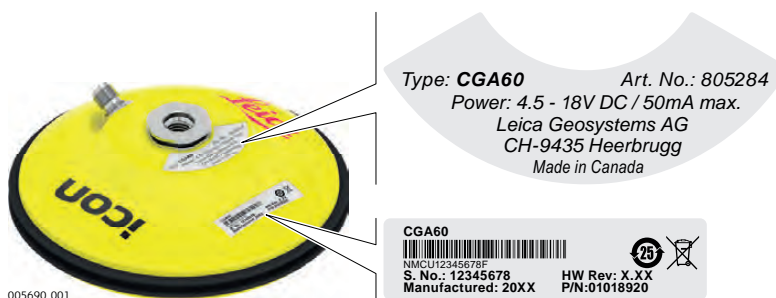
Labelling iCON gps 60 SmartAntenna



Labelling internal battery GEB222



Labelling CGA60



1.8

IC Statement, Applicable in Canada



WARNING

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

Canada Compliance Statement

This device complies with Industry Canada's licence-exempt RSS 247. Operation is subject to the following two conditions:
 1) This device may not cause interference; and
 2) This device must accept any interference, including interference that may cause undesired operation of the device.

Canada Déclaration de Conformité

Le présent appareil est conforme aux CNR 247 d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
 1) l'appareil ne doit pas produire de brouillage;
 2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

2 Description of the System

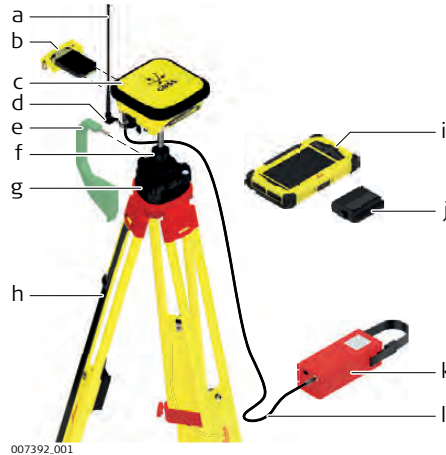
2.1 System Components

Description

The Leica iCON gps 60 SmartAntenna together with dedicated accessories like the Field Controllers, the Leica CGA60 GNSS antenna, a machine computer, or an external radio offers you highest productivity and flexibility. For example, a Base Station configuration as well as Rover configuration is possible, but the system also can be used in a Machine configuration.

Two example configurations are shown in the following paragraphs.

Main components, Base Station configuration



- a) Radio antenna
- b) Satel Radio CCD7
- c) iCON gps 60 SmartAntenna
- d) GAD108 Antenna arm
- e) GSZ4-1 Height hook
- f) GRT146 Carrier
- g) Tribrach
- h) Tripod
- i) CC60/CC61/CC65/CC66 Field Controller
- j) Battery for Field Controller
- k) GEB371 external battery
- l) GEV219 power cable

Component	Description
iCON gps 60 Smart-Antenna	To calculate the position from the computed ranges to all visible GNSS (Global Navigation Satellite System) satellites.
Field Controller	Compatible controllers running iCON field software can be used to operate the iCON gps 60 SmartAntenna.
Satel radio CCD7	For long-range data transmission.
Radio antenna	The use of an external radio antenna maximises radio coverage.
Tripod, tribrach, carrier	To setup the instrument as a Base Station.

Main components, Rover configuration



007407_002

- a) Satel Radio CCD7
- b) iCON gps 60 SmartAntenna
- c) GAD109 QN/TNC adapter
- d) Radio antenna
- e) Pole
- f) Pole clamp
- g) Holder for Field Controller
- h) GEB221/GEB222 battery
- i) CC80 Field Controller
- j) Battery for Field Controller

Component	Description
iCON gps 60 Smart-Antenna	To calculate the position from the computed ranges to all visible GNSS (G lobal N avigation S atellite S ystem) satellites.
Field Controller	Compatible controllers running iCON field software can be used to operate the iCON gps 60 SmartAntenna.
Satel radio CCD7	For long-range data transmission.
Radio antenna	The use of an external radio antenna maximises radio coverage.
Pole, pole clamp, holder for Field Controller	To setup the instrument as a Rover.

Satellite channels

Depending on the satellite systems and signals configured, a maximum number of 120 channels is allocated.

Instrument	Description
iCON gps 60 Smart-Antenna	GPS, GLONASS, BeiDou and Galileo GNSS receiver, triple frequency, code and phase, real-time capable

Special features iCON gps 60 Smart-Antenna

iCON gps 60 SmartAntenna is equipped with several special features:

- Wide supply voltage range of 9 V to 28 V
- Voltage peak protection and reverse polarity protection
- Can be used on a machine when being mounted inside the cabin
- Can be used near the sea
- Protection caps on connectors
- Display and keys for status and configuration
- Versatile connectivity including USB, Serial RS232, Ethernet and Bluetooth
- USB host port for data transfer and firmware upgrade
- Integrated high speed LTE (4G) / HSPA (3.5G) / GPRS (2G) modem for countries without 3G
- Integrated radio options
- Backwards compatibility: supports external GFU communication devices for cost effective upgrade from legacy Leica systems
- Robust, compact plastic housing

Special features CGA60

CGA60 antennas are equipped with several special features:

- Can be used near the sea
- Standard robust 5/8" Whitworth thread
- Robust TNC connector
- Future proof four constellation, triple frequency antenna element
- Robust, compact plastic housing

Commands for Remote Config

The iCON gps 60 SmartAntenna can be communicated:

- via the MPI protocol on the serial port P1 and Bluetooth.
 - via the Leica Machine Control Net Protocol on the serial port P1 and Bluetooth.
- Documentation for these communication protocols is available on request from the Leica Geosystems representative.

2.2

Unpacking the Container

Description

Available delivery packages:

- A hard-top container comprising all items for a GNSS Rover setup.
- Different hard-top containers comprising all items for a Base Station setup, including various Field Controllers.

2.2.1

Base Station Container

CTC5 Container upper shell

The large-size CTC5 container comprises all items for the Base Station setup. The content of the upper shell is the same for all available container configuration.



003489_002

- a) CGA60 Robust triple frequency GNSS antenna
- b) GFU radio
- c) GSZ4-1 Height hook
- d) Cable set

- e) GHT36 Base for telescopic rod
- f) GHT58 Tripod bracket for GFU housing
- g) GAD34 Arm, adapter antenna to extension
- h) GRT146 Carrier

**CTC5 container
lower shell - iCON
CC60/CC61/CC65/CC
66**

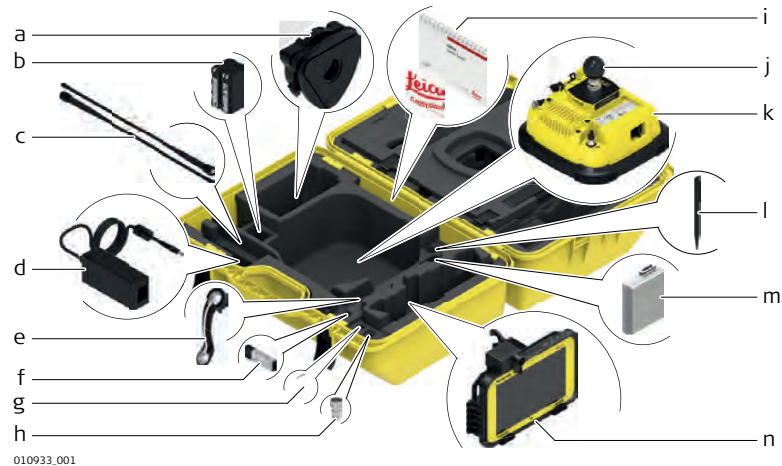
Large-size CTC5 container configuration with iCON CC60/CC61/CC65/CC66 Field Controller.



- | | |
|---|---|
| a) Tribrach | h) QN/TNC adapter |
| b) GEB221/GEB222 Battery | i) Manuals & USB documentation card |
| c) Radio antennas | j) Ball mount |
| d) AC-adaptor for Field Controller | k) iCON gps 60 SmartAntenna |
| e) GAD108 Antenna arm | l) Spare stylus for Field Controller |
| f) MS1 Industrial 1 GB USB memory stick | m) Spare battery for Field Controller |
| g) Allen key | n) CC60/CC61/CC65/CC66 Field Controller |

**CTC5 container
lower shell - iCON
CC80**

Large-size CTC5 container configuration with iCON CC80 Field Controller.



- | | |
|---|---------------------------------------|
| a) Tribrach | h) QN/TNC adapter |
| b) GEB221/GEB222 Battery | i) Manuals & USB documentation card |
| c) Radio antennas | j) Ball mount |
| d) AC-adaptor for Field Controller | k) iCON gps 60 SmartAntenna |
| e) GAD108 Antenna arm | l) Spare stylus for Field Controller |
| f) MS1 Industrial 1 GB USB memory stick | m) Spare battery for Field Controller |
| g) Allen key | n) CC80 Field Controller |

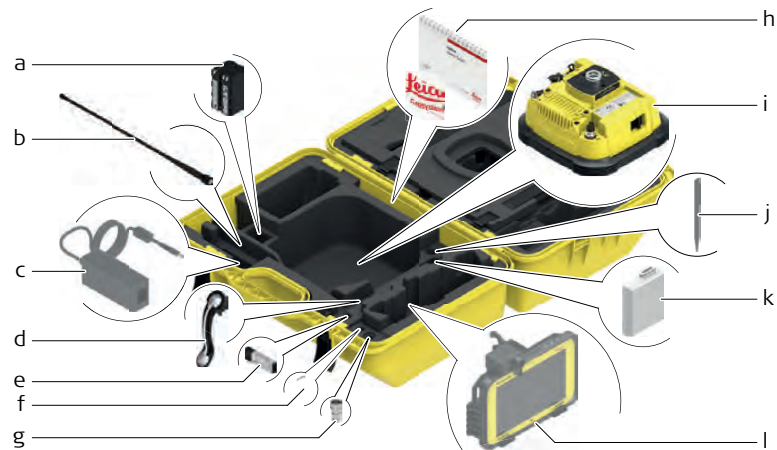
2.2.2

Rover Setup Container

CTC5 container - iCON gps 60 Smart- Antenna

The CTC5 container comprises the iCON gps 60 SmartAntenna and its accessories.
☞ The container can additionally hold a iCON CC80 Field Controller with accessories.

Lower shell



011001.001

- | | |
|---|--|
| a) GEB221/GEB222 Battery | g) QN/TNC adapter |
| b) Radio antenna | h) Manuals & USB documentation card |
| c) AC-adapter for Field Controller* | i) iCON gps 60 SmartAntenna |
| d) GAD108 Antenna arm | j) Spare stylus for Field Controller* |
| e) MS1 Industrial 1 GB USB memory stick | k) Spare battery for Field Controller* |
| f) Allen key | l) CC80 Field Controller* |

* optional accessory

Upper shell



011002.001

- a) Cable set

2.3

Instrument Components

iCON gps 60 Smart-Antenna components



- a) User interface, including ON/OFF button
- b) USB data port
- c) Antenna connector (QN)
- d) LEMO connector (serial)
- e) Whitworth thread, 5/8"
- f) Radio cover
- g) Battery holder
- h) Antenna connector (TNC)

Element	Function
USB 2.0	USB A data port, for data exchange, software updates.
LEMO connector (8-pin, female)	RS232 for connection of external power supply, data in/out or external radio.
Antenna connector (TNC)	For connection of an external GNSS antenna, for example CGA60 for reference setup and machine use case.
Antenna connector (QN)	For connection of an external radio antenna.

CGA60 components




- a) Whitworth thread, 5/8"
- b) Mechanical reference plane
- c) TNC female connector

2.4

Compatible Field Controllers

About the controllers

-  The iCON gps 60 SmartAntenna can be used as a standalone device or in combination with compatible controllers running iCON field software.

2.4.1

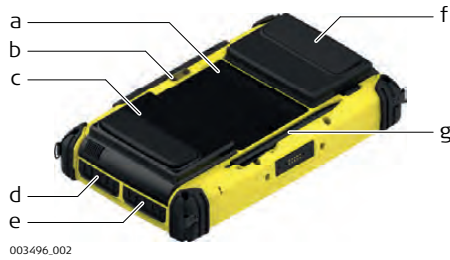
Available Field Controller

CC60/CC61/CC65/CC66 upside



- a) Screen
- b) D-SUB 9 port
- c) USB host port for USB stick
- d) Keyboard
- e) Speaker
- f) Docking station contacts

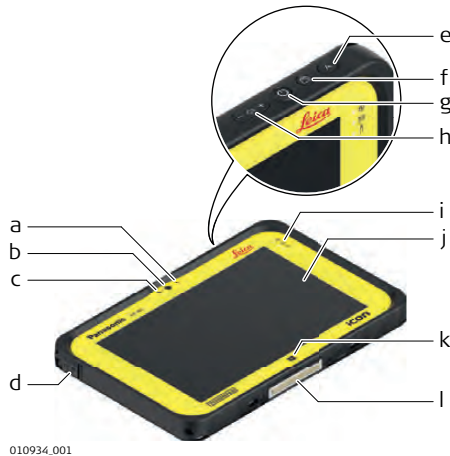
CC60/CC61/CC65/CC66 rear side



003496.002

- a) SIM card slot
- b) Digital camera
- c) Battery compartment L
- d) Micro in, Audio out and LAN
- e) Power socket and USB host port for USB stick
- f) Battery compartment R
- g) Stylus

CC80 upside



010934.001

- a) Camera Indicator
- b) Camera Lens
- c) Ambient Light Sensor
- d) Power connector, DC power supply in
- e) Measure key
- f) Touch mode selection
- g) Power key
- h) Volume key
- i) Status LEDs, for power, hard drive, and battery
- j) Display
- k) Windows key
- l) Docking station contacts

CC80 rear side



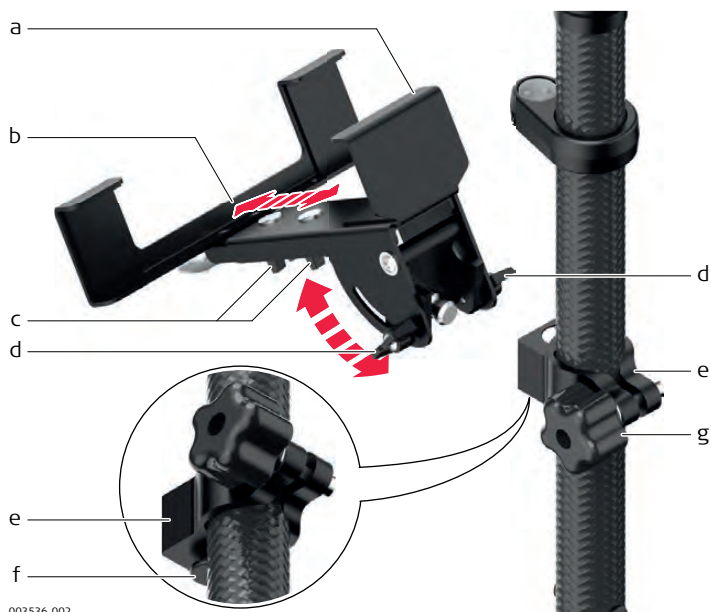
010935.001

- a) Microphone
- b) Battery pack
- c) Headset connector
- d) USB connector
- e) Rear camera: lens, light, and indicator
- f) Battery lock
- g) microSIM card slot
- h) microSD memory card slot

2.4.2

Holder and Clamps for Field Controllers

Holder for iCON CC60/CC61/CC65/CC 66



003536_002

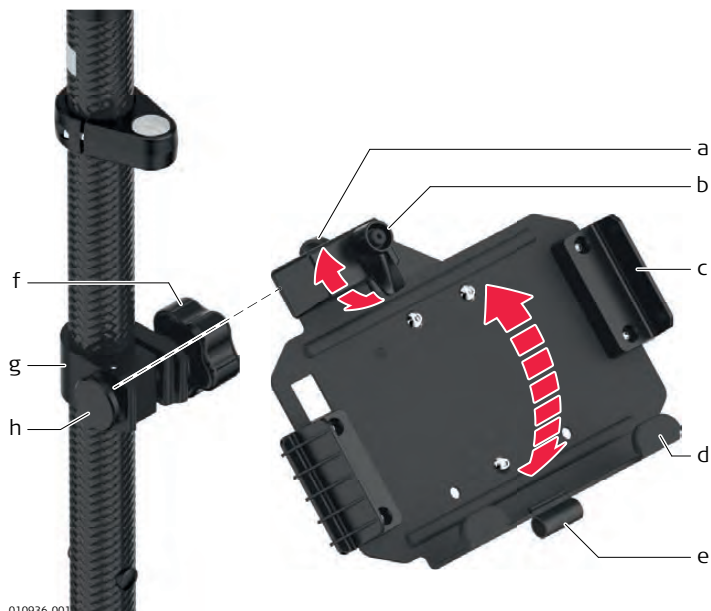
Holder:

- a) Upper holder (fixed)
- b) Lower holder (extendable)
- c) Fixation screws (size adjustment)
- d) Fixation screws (angle adjustment)

Clamp:

- e) Pole clamp
- f) Unlocking bolt
- g) Tightening screw

Holder for iCON CC80



010936_001

Holder:

- a) Mounting arm
- b) Locking lever
- c) Mounting brackets (side)
- d) Mounting brackets (bottom)
- e) Holder for stylus

Clamp:

- f) Tightening screw
- g) Pole clamp
- h) Clamping bolt

2.4.3

iCON Series Field Software Overview



The iCON site/iCON build Field Software is the recommended software on the compatible Field Controllers to run the iCON gps 60 SmartAntenna. Sole Base Station and Rover use is also possible with the on-board software.

iCON site software - main menu at a glance



Refer to the iCON site software and documentation for further information.

iCON build software - main menu at a glance



Refer to the iCON build software and documentation for further information.

3 Using the iCON gps 60 SmartAntenna

3.1 Power Supply

General

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



- The battery must be charged before using it for the first time.
- For new batteries or batteries that have been stored for more than 3 month, one charge and discharge cycle is recommended.

Internal and external power supply

Power for the instrument can be supplied by the internal GEB221/GEB222 battery or externally.

External power can be supplied by:

- 9 V to 28 V DC power supply (machine or vehicle) via a converter cable supplied by Leica Geosystems.
- GEB371 battery connected via a cable.
- 110 V/240 V AC to 12 V DC power supply unit, supplied by Leica Geosystems.



External power for the iCON gps 60 SmartAntenna can be supplied using the LEMO port.



The iCON gps 60 SmartAntenna can use internal and external power supply in parallel.



For permanent operations use **Uninterruptible Power Supply** units as a back-up in a main power failure.



In general, all installation works - including the setting up of a permanent power supply - must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

3.2 Batteries

3.2.1 Installing the Internal Battery

Insert and remove the battery step-by-step



003555.003

Step	Description
	Ensure the instrument is placed on a stable surface.
1.	Push the slide fastener in the direction of the arrow with the open-lock symbol.
2.	Pull out the battery holder.

Step	Description
3.	Orientate the battery to match with the pictogram on the base of the holder!
4.	Insert the battery into the holder. Check that the battery is locked in!
5.	Push the holder with battery into the battery compartment.
6.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

3.2.2

General Battery Handling

First-time Use / Charging Batteries

- 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.

3.3

Installing a SIM 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 the SIM card step-by-step



003558.003

Step	Description
	Ensure the instrument is placed on a stable surface.
1.	Push the slide fastener in the direction of the arrow with the open-lock symbol.
2.	Pull out the battery holder.
3.	Orientate the SIM card as illustrated.
4.	Insert the SIM card into the card slot and push it in until it locks in place.
5.	Insert the battery holder. Check for proper seating!
6.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

3.4 Slot-in-Device

Internal radios

Following internal radios can be used with the instrument:

Radio	Device
Satel TA13	CCD7
Intuicom 900SLR	CCD8



Please contact the local selling unit or dealer for information about exchanging the internal radio.

3.5 External Radios

External Radio Devices

Following external radios can be used with the instrument using a cable connection:

- Intuicom 1200DL, transceive
- Pacific Crest PDL, receive
- Pacific Crest ADL, transceive
- Satelline 3AS, transceive
- Satelline M3-TR1, transceive
- TFR-300L, receive

Pacific Crest radio modems

Pacific Crest radio modems must be ordered directly from your local Pacific Crest Office or Representative.

PDL receive only modems built into the Leica GFU radio housing with 12.5 or 25 kHz channel spacing within the following frequency bands are available:

- 410 - 430 MHz
- 430 - 450 MHz
- 450 - 470 MHz
- 223 - 235 MHz

3.6 Using USB Memory Devices

Insert and remove a USB Memory device step-by-step



007394_001

Step	Description
	Ensure the instrument is placed on a stable surface.
1.	Detach the USB port cover.
2.	Slide the USB Memory device firmly into the USB host port into position.
	Take care not to damage the USB Memory device when moving the iCON gps 60 SmartAntenna or when handling around the device.
	It's recommended to close the USB port cover when no USB Memory device is used.

Preconditions for using USB Memory devices

- USB Memory devices must be formatted in the FAT or FAT32 format.
- To import data from a USB Memory device to the iCON gps 60 SmartAntenna appropriate folders must be created on the USB device and the files placed in the correct folder. Refer to "6.6 Import, Export, or Delete Data" for further information.

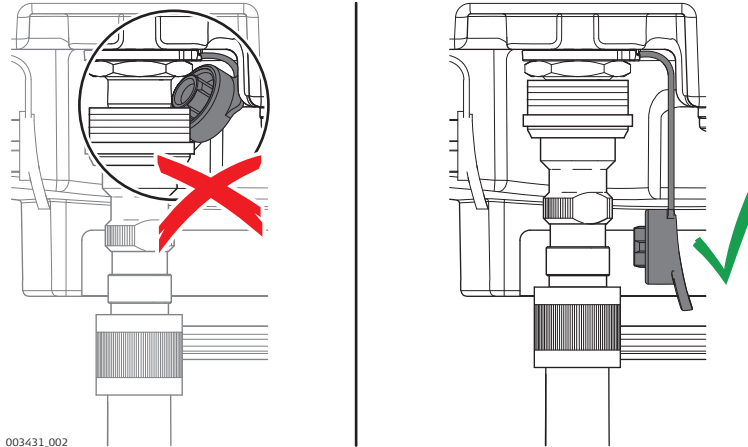
3.7

Installing Adapters

Installing a TNC adapter

A TNC adapter can be plugged onto the QN connector to attach external radio antennas.

- ☞ Make sure the rubber cap of the QN adapter does not get squeezed in between the iCON gps 60 SmartAntenna housing and the TNC adapter!



3.8

Installation on a Machine



In general, all installation works must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information. The installation information within this User Manual is indicated to increase the operators understanding of the system and its maintaining.



Before installation:

- Please observe the maximum vibration and ambient temperature values indicated in chapter "9 Technical Data".
- Check that all parts needed are delivered. Refer to "2.2 Unpacking the Container" for further information.
- It is strongly recommended that you bench test all components before commencing installation on the actual machine to make sure that all components are fully operational.

iCON gps 60 Smart-Antenna Installation location

The iCON gps 60 SmartAntenna must be installed in the machine cabin itself. For easy mounting the optional Machine Bracket CMB3 is recommended.

- ☞ The product must not be installed on the tool of the machine and/or on mechanical components that move the tool. Tools include for example bucket of excavator, blade of dozer, screed of paver. Mechanical parts include for example boom and stick of an excavator, hydraulic cylinder of a dozer or tow arm of an asphalt paver. Further, the instrument must not be installed near chassis, chain gear, wheels or on engine components connected to the engine itself. The cases stated are intended simply as examples. The instrument must not be installed on a mast as well.





Installation of a CGA60 GNSS antenna	For best results, it is recommended to mount the GNSS antenna in a way ensuring an unobstructed view of the sky.
Installation of external radio	A special bracket for proper mounting of the external GFU radio can be used. GFU bracket: MMB1250, GFU Bracket on Machine
Installation of antennas for internal/external radios and modems	<ul style="list-style-type: none"> • External antennas with a magnetic mount can be used and installed on the roof of the cabin. • This will increase the radio signal and therefore the reception of correction signals from a base station or when using a NTRIP solution.
Cable installation	<ul style="list-style-type: none"> • Ensure that the cables between iCON gps 60 SmartAntenna and CGA60 antenna in particular are installed so as to prevent them from becoming bent and stretched. • It is strongly recommended to use strain relief brackets. • Route the cable as directly as possible and avoid crossing cables. • Be sure not to tie the cables into "hot" hydraulic hoses.

3.9

Antenna Heights

3.9.1

Understanding Antenna Heights

Description	<p>The height of the GNSS antenna above a point consists of three components:</p> <ul style="list-style-type: none"> • the vertical height reading, • the vertical offset, • the vertical phase centre offset. <p>For most operations, pre-configured standard settings in the instrument can be used. They automatically take the vertical phase centre offsets into account.</p>
MRP	The antenna accepts vertical height readings to the Mechanical Reference Plane , MRP.
Vertical phase centre variations	These are handled automatically in the standard antenna records. The antenna calibrations to determine the phase centre variations were executed by Geo++® GmbH.
	Pillar setup. For other than the GRT146 carrier, the dimensions must be determined and the vertical offset must be adapted.
	Tripod setup. For height measurement devices other than the height hook, the dimensions must be determined and the vertical offset must be adapted.
	Pole setup. For other than Leica poles, the dimensions must be determined.
	Mast setup. The dimensions of the mast must be determined.

3.9.2

The Mechanical Reference Plane, MRP

Description

The **Mechanical Reference Plane**:

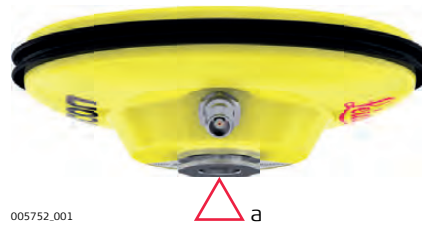
- is where the instrument heights are measured to.
- is where the phase centre variations refer to.
- varies for different instruments.

MRP of the antenna The MRP for the antenna is shown in the diagram.



- a) The mechanical reference plane is the underside of the threaded metal insert.

MRP of the antenna The MRP for the CGA60 antenna is shown in the diagram.



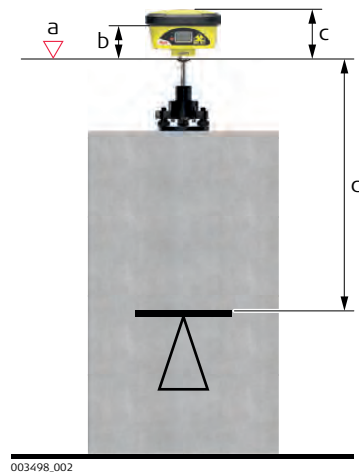
- a) The mechanical reference plane is the underside of the threaded metal insert.

3.9.3

Measuring the Antenna Height for a Pillar Setup

Measuring the antenna height - pillar setup

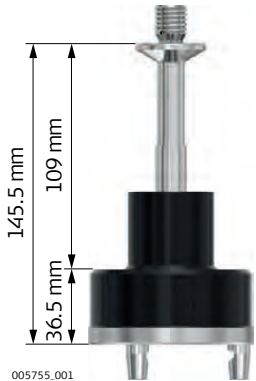
Setup type	Antenna name	The required measurement
Pillar	iCON gps 60 SmartAntenna	the vertical height reading to the MRP.



- a) Mechanical reference plane MRP
 b) Vertical phase centre offset for L1
 c) Vertical phase centre offset for L2
 d) **Vertical Height Reading**

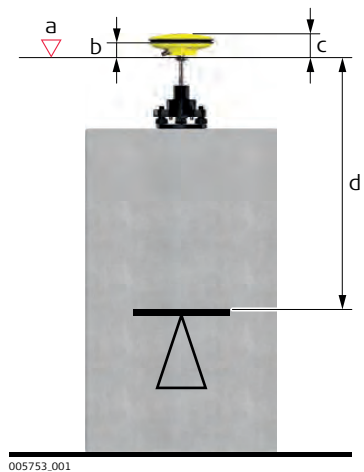
No vertical offset.

Determining the antenna height with the GRT146 carrier step-by-step

Step	Description
1.	Measure a height from the pillar benchmark to a surface on the carrier. 
2.	Use the appropriate measurement from the diagram above. Determine the height difference between the measured surface on the carrier and where the MRP of the antenna sits on the carrier.
3.	The vertical height reading = adding the values in step 1. and step 2.

Measuring the antenna height - pillar setup

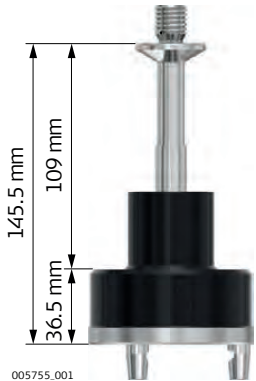
Setup type	Antenna name	The required measurement
Pillar	CGA60	the vertical height reading to the MRP.



- a) Mechanical reference plane MRP
- b) Vertical phase centre offset for L1
- c) Vertical phase centre offset for L2
- d) **Vertical Height Reading**

No vertical offset.

Determining the antenna height with the GRT146 carrier step-by-step

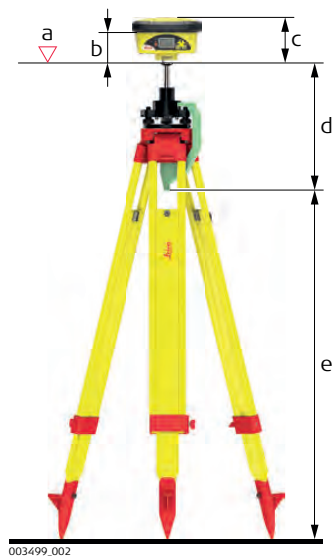
Step	Description
1.	Measure a height from the pillar benchmark to a surface on the carrier.  005755_001
2.	Use the appropriate measurement from the diagram above. Determine the height difference between the measured surface on the carrier and where the MRP of the antenna sits on the carrier.
3.	The vertical height reading = adding the values in step 1. and step 2.

3.9.4

Measuring the Antenna Height for a Tripod Setup

Measuring the antenna height - tripod setup

Setup Type	Antenna type	The required measurement
Tripod	iCON gps 60 SmartAntenna	the vertical height reading from the height hook.



- a) Mechanical reference plane MRP
- b) Vertical phase centre offset for L1
- c) Vertical phase centre offset for L2
- d) Vertical offset
- e) **Vertical Height Reading**

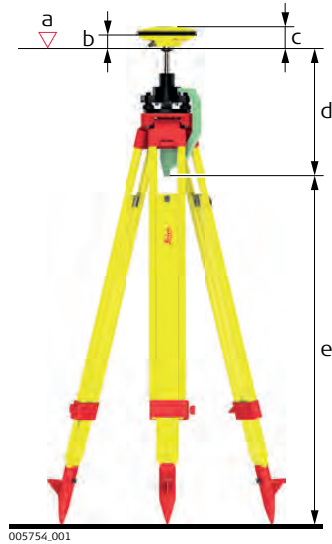
Vertical offset = 0.36

Determining the antenna height with the height hook step-by-step

Step	Description
1.	The vertical height reading = vertical height reading from the height hook. <ul style="list-style-type: none"> • The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. • The vertical offset of 0.36 m is automatically stored in the antenna setup record for a tripod setup and will automatically be taken into account. It does not need to be entered.

Measuring the antenna height - tripod setup

Setup Type	Antenna type	The required measurement
Tripod	CGA60	the vertical height reading from the height hook.



- a) Mechanical reference plane MRP
- b) Vertical phase centre offset for L1
- c) Vertical phase centre offset for L2
- d) Vertical offset
- e) **Vertical Height Reading**

Vertical offset = 0.36

Determining the antenna height with the height hook step-by-step

Step	Description
1.	<p>The vertical height reading = vertical height reading from the height hook.</p> <ul style="list-style-type: none"> • The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. • The vertical offset of 0.36 m is automatically stored in the antenna setup record for a tripod setup and will automatically be taken into account. It does not need to be entered.

3.9.5

Measuring the Antenna Height for a Pole Setup

Measuring the antenna height - pole setup

Setup Type	Antenna type	The required measurement
Pole	iCON gps 60 SmartAntenna	vertical height reading of the pole.

4 Setups with Accessories



In the following chapters example configurations are shown, covering the most common use cases.

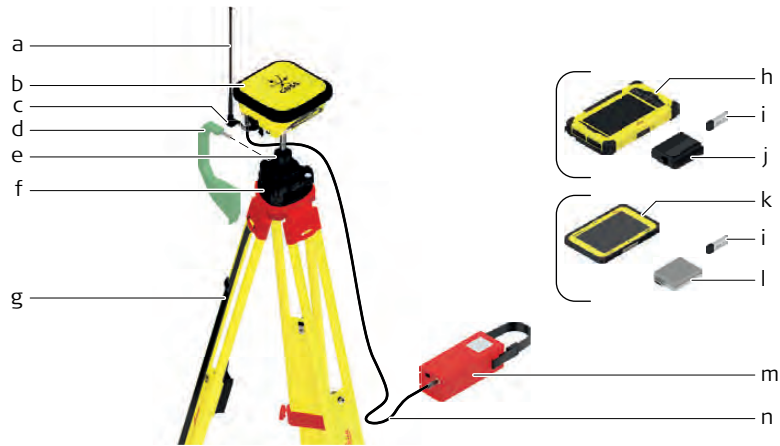
Further configurations are possible. Please contact the local selling unit or dealer for information regarding special use cases.

iCON gps 60 Smart-Antenna general description

The iCON gps 60 SmartAntenna is equipped with an integrated LTE modem for network access, for example Ntrip. To work with a local base, a radio module can be installed manually if required.

4.1 Real-Time Base Setup

Real-time reference setup with internal modem



003550.003

- | | |
|-----------------------------|---|
| a) Radio antenna | h) CC60/CC61/CC65/CC66 Field Controller |
| b) iCON gps 60 SmartAntenna | i) USB Memory device |
| c) GAD108 Antenna arm | j) Battery for CC60/CC61/CC65/CC66 Field Controller |
| d) GSZ4-1 Height hook | k) CC80 Field Controller |
| e) GRT146 Carrier | l) Battery for CC80 Field Controller |
| f) Tribrach | m) GEB371 external battery |
| g) Tripod | n) GEV219 power cable |

Real-time reference setup step-by-step

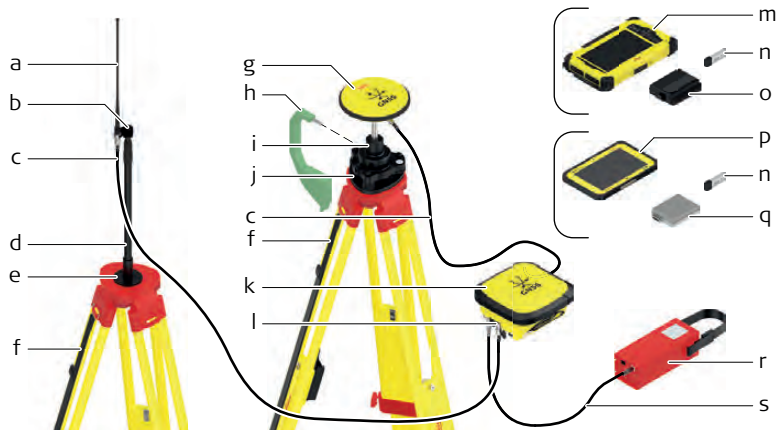
Step	Description
1.	Setting Up the Equipment
	<ul style="list-style-type: none"> Set up the tripod, mount and level the tribrach onto the tripod. Check that the tribrach is correctly centred over the marker. Place and lock the carrier into the tribrach. Screw the iCON gps 60 SmartAntenna onto the carrier. Check that the tribrach is still correctly positioned and levelled. Hang the external battery onto a tripod leg. Take the GEV219. Attach the 8 pin plug connector to the iCON gps 60 SmartAntenna. Attach the 5 pin plug connector to the external battery. Insert the battery into the field controller. Turn on the antenna and the controller.

Step	Description
2.	<p>Perform a Base Station setup on the iCON gps 60 SmartAntenna or run the Reference Setup application of the iCON site software</p> <ul style="list-style-type: none"> Refer to "6.1 Base Setup" respectively the iCON site software manual for further information.

4.2

Local Base Station Setup with External GNSS Antenna

Local Base Station setup with external GNSS antenna



003912.003

- | | |
|---|---|
| a) Radio antenna | k) iCON gps 60 SmartAntenna |
| b) GAD34 arm, 3 cm | l) GAD109 QN/TNC adapter |
| c) GEV120 antenna cable, 2.8 m, 2 x | m) CC60/CC61/CC65/CC66 Field Controller |
| d) GAD32 telescopic rod | n) USB Memory device |
| e) GHT36 base for telescopic rod | o) Battery for CC60/CC61/CC65/CC66 Field Controller |
| f) Tripod, 2 x | p) CC80 Field Controller |
| g) CGA60 Robust triple frequency GNSS antenna | q) Battery for CC80 Field Controller |
| h) GSZ4-1 Height hook | r) GEB371 external battery |
| i) GRT146 Carrier | s) GEV219 power cable |
| j) Tribrach | |

Local Base Station setup with external GNSS antenna step-by-step

Step	Description
1.	<p>Setting Up the CGA60 and radio antenna:</p> <ul style="list-style-type: none"> Set up both tripods. Mount and level the tribrach onto the tripod for the CGA60. Check that the tribrach is correctly centred over the marker. Place and lock the carrier into the tribrach. Screw the CGA60 antenna onto the carrier. Check that the tribrach is still correctly positioned and levelled. Mount the GHT36 on the 2nd tripod. Attach the telescopic rod and the GAD34 arm. Screw the radio antenna onto the GAD34 arm.
2.	<p>Setting Up the iCON gps 60 SmartAntenna:</p> <ul style="list-style-type: none"> Place the iCON gps 60 SmartAntenna e.g. in a container. Attach the QN/TNC adapter to the QN port. Connect the TNC cable to the QN/TNC adapter of the SmartAntenna and the GAD34 at the radio antenna.

Step	Description
	<ul style="list-style-type: none"> Connect a second TNC cable to the SmartAntenna and the CGA60 antenna. Connect the iCON gps 60 SmartAntenna via the 8-pin socket to an external power source. <ul style="list-style-type: none"> Use the GEV219 cable to connect the external battery GEB371 using the 5-pin socket. <p>OR</p> <ul style="list-style-type: none"> Use the GEV71 cable to connect i.e. a car battery with the free wire ends.
	<ul style="list-style-type: none"> Insert the battery into the field controller. Turn on the antenna and the controller.
3.	<p>Perform a Base Station setup on the iCON gps 60 SmartAntenna or run the Reference Setup application of the iCON site software</p> <ul style="list-style-type: none"> Refer to "6.1 Base Setup" respectively the iCON site software manual for further information.

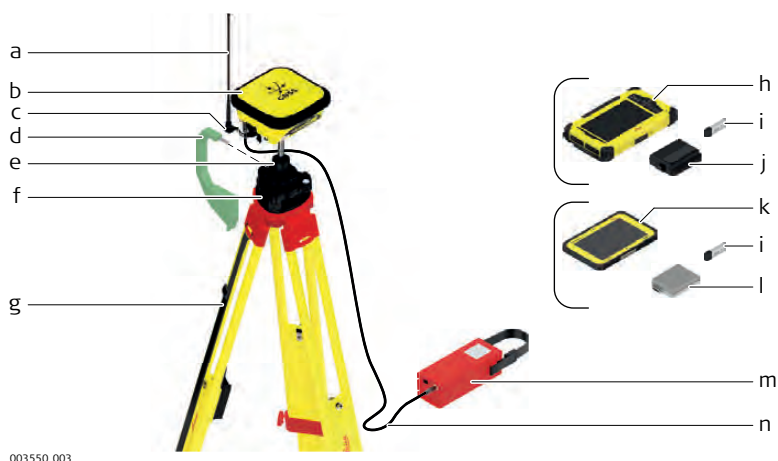


Connecting the GEV71 cable to an external power source (i.e. car battery) needs expert knowledge.

4.3

Real-Time Base with Raw Data Logging

Real-time reference setup for raw data logging



003550_003

- a) Radio antenna
- b) iCON gps 60 SmartAntenna
- c) GAD108 Antenna arm
- d) GSZ4-1 Height hook
- e) GRT146 Carrier
- f) Tribrach
- g) Tripod

- h) CC60/CC61/CC65/CC66 Field Controller
- i) USB Memory device
- j) Battery for CC60/CC61/CC65/CC66 Field Controller
- k) CC80 Field Controller
- l) Battery for CC80 Field Controller
- m) GEB371 external battery
- n) GEV219 power cable

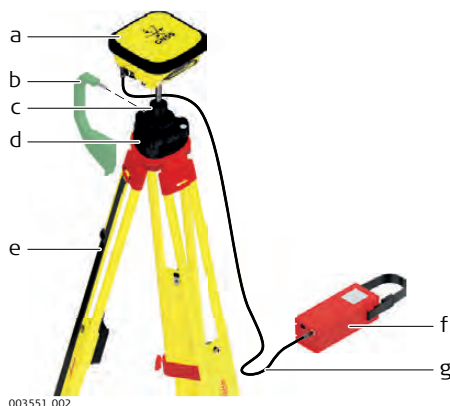
Real-time reference setup for raw data logging step-by-step

Step	Description
1.	<p>Setting Up the Equipment</p> <ul style="list-style-type: none"> Set up the tripod, mount and level the tribrach onto the tripod. Check that the tribrach is correctly centred over the marker. Place and lock the carrier into the tribrach.

Step	Description
	<ul style="list-style-type: none"> • Screw the iCON gps 60 SmartAntenna onto the carrier. • Check that the tribrach is still correctly positioned and levelled. • Hang the external batteries onto the tripod legs. • Take the GEV219 cable. • Attach the connector with the 8 pin plug to the iCON gps 60 SmartAntenna. • Attach the connector with the 5 pin plug to the external battery. • Turn on the antenna and the controller.
2.	Configuring the Raw Data Logging <ul style="list-style-type: none"> • Refer to "6.4 Raw Data Logging".
3.	Perform a Base Station setup on the iCON gps 60 SmartAntenna or run the Reference Setup application of the iCON site software <ul style="list-style-type: none"> • Refer to "6.1 Base Setup" respectively the iCON site software manual for further information.

4.4 Raw Data Logging Setup

Raw data logging setup for post-processing



- a) iCON gps 60 SmartAntenna
- b) GSZ4-1 Height hook
- c) GRT146 Carrier
- d) Tribrach
- e) Tripod
- f) GEB371 external battery
- g) GEV219 power cable

Raw data logging setup step-by-step

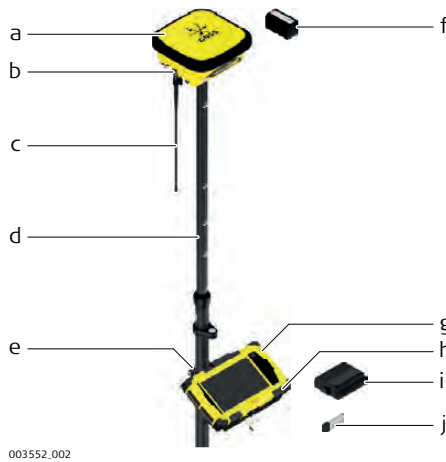
Step	Description
1.	Setting Up the Equipment <ul style="list-style-type: none"> • Set up the tripod, mount and level the tribrach onto the tripod. • Check that the tribrach is correctly centred over the marker. • Place and lock the carrier into the tribrach. • Screw the iCON gps 60 SmartAntenna onto the carrier. • Check that the tribrach is still correctly positioned and levelled. If available: <ul style="list-style-type: none"> • Hang the external battery onto a tripod leg. • Take the GEV219. • Attach the connectors with the 8 pin plug to the iCON gps 60 SmartAntenna. • Attach the connector with the 5 pin plug to the external battery. • Turn on the antenna. Else:

Step	Description
	<ul style="list-style-type: none"> Use internal battery of the antenna without battery cabling.
2.	Configuring the Raw Data Logging <ul style="list-style-type: none"> Refer to "6.4 Raw Data Logging".

4.5 Real-Time Rover Setup

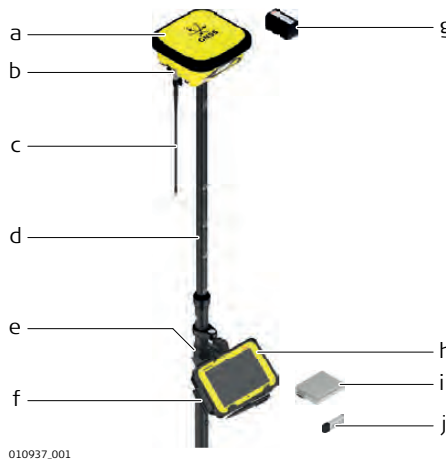
Use The equipment setup is used for real-time rover with extended periods of use in the field.

Real-time rover setup with iCON CC60/CC61/CC65/CC66



- a) iCON gps 60 SmartAntenna
- b) GAD109 QN/TNC adapter
- c) Radio antenna
- d) Pole
- e) Pole clamp
- f) GEB221/GEB222 battery
- g) CC60/CC61/CC65/CC66 Field Controller
- h) Holder for Field Controller
- i) Battery for Field Controller
- j) USB Memory device

Real-time rover setup with iCON CC80



- a) iCON gps 60 SmartAntenna
- b) GAD109 QN/TNC adapter
- c) Radio antenna
- d) Pole
- e) Pole clamp
- f) Holder for Field Controller
- g) GEB221/GEB222 battery
- h) CC80 Field Controller
- i) Battery for Field Controller
- j) USB Memory device

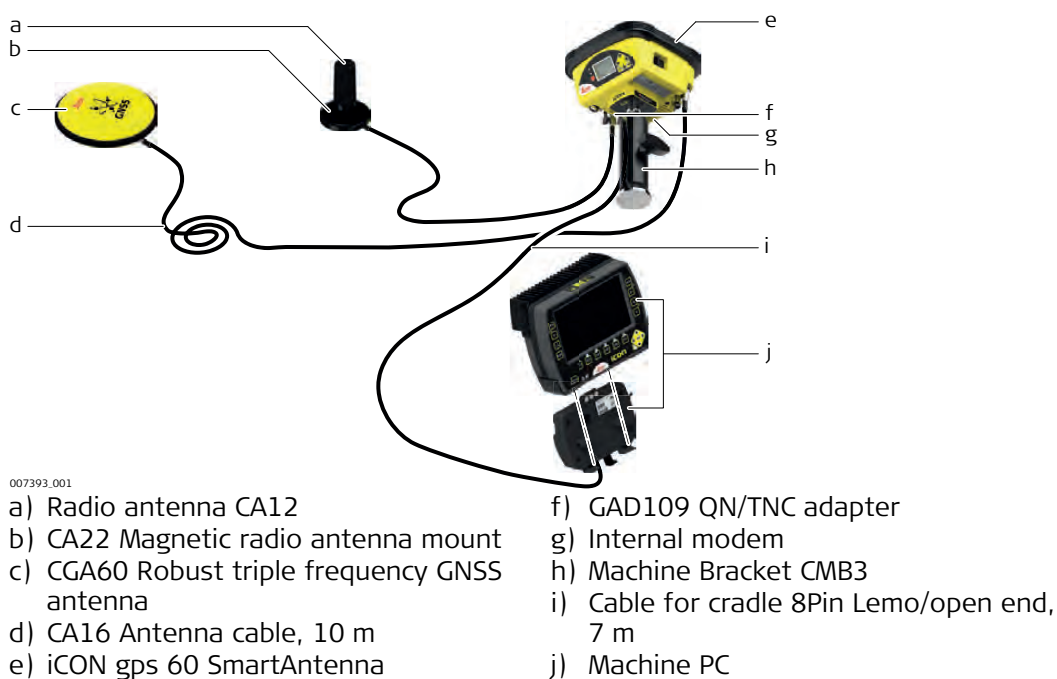
Real-time rover setup step-by-step

Step	Description
1.	Setting Up the Equipment <ul style="list-style-type: none"> Insert the battery into the iCON gps 60 SmartAntenna. Screw iCON gps 60 SmartAntenna onto the top of the telescopic pole. Ensure that the compression lock is not clamped. Extend the telescopic pole and ensure that the snap-lock clicks into its position. The snap-lock ensures that there is no slipping of the telescopic pole. Clamp the compression lock. The compression lock maintains straightness.

Step	Description
	<ul style="list-style-type: none"> Fix the holder to the clamp with the tightening screw. Before tightening, ensure that the holder is at a comfortable working height and angle. This can be achieved by sliding the clamp along the pole and rotating the holder about the clamp. Tighten the tightening screw. Insert the battery into the field controller. Clip the field controller onto the holder and lock into position. Turn on the antenna and the controller.
2.	<p>Run the data collection or stake-out application of the iCON Site software</p> <ul style="list-style-type: none"> Refer to the iCON site software manual for further information.

4.6 Setup for Machine Use

Setup for Machine use



All necessary installation works must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

4.7 Establish Bluetooth Data Connection

Bluetooth connection setup

Activate the internal Bluetooth module of the iCON gps 60 SmartAntenna. Refer to "Bluetooth Menu".

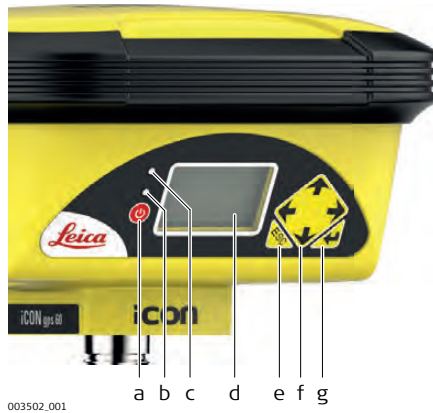


Follow the instructions of the controller user manual about how to establish a Bluetooth connection.

5 iCON gps 60 SmartAntenna User Interface

5.1 User Interface Description






User Interface overview








- a) ON/OFF key
- b) Power and status LED
- c) Ambient light sensor
- d) Display
- e) ESC key
- f) Navigation keys
- g) ENTER key



User Interface elements

The instrument can be controlled via the user interface elements.

Element	Function						
Navigation keys 	4-way navigation in the menus via left, right, up and down key.						
Enter key 	<ul style="list-style-type: none"> • To activate editing. • To accept changes. • To enter a menu or submenu. 						
ESC key 	<ul style="list-style-type: none"> • To cancel operations. • To leave a menu or submenu. 						
ON/OFF key 	Gives access to startup and shutdown: press for three seconds.						
Display	Displays status information and software functions.						
Ambient light sensor	Energy saving ambient light sensor.  When the display Backlight is set to Auto , the Backlight intensity is automatically adjusted on the ambient light sensor input.						
Power LED	<table border="0"> <tr> <td>off</td> <td>Instrument is switched off.</td> </tr> <tr> <td>continuously green</td> <td> <ul style="list-style-type: none"> • Normal operation mode. • No errors. • Battery level above 20%. </td> </tr> <tr> <td>continuously red</td> <td> <ul style="list-style-type: none"> • During start-up of the instrument. • For various errors occurring. The current status information is shown on the display. </td> </tr> </table>	off	Instrument is switched off.	continuously green	<ul style="list-style-type: none"> • Normal operation mode. • No errors. • Battery level above 20%. 	continuously red	<ul style="list-style-type: none"> • During start-up of the instrument. • For various errors occurring. The current status information is shown on the display.
off	Instrument is switched off.						
continuously green	<ul style="list-style-type: none"> • Normal operation mode. • No errors. • Battery level above 20%. 						
continuously red	<ul style="list-style-type: none"> • During start-up of the instrument. • For various errors occurring. The current status information is shown on the display. 						

 Use the  and  navigation keys to select a menu icon and to navigate within submenus.

 Use the  key to enter a submenu and confirm settings.


 Use the  key to discard settings, cancel operations and to go back one menu level.

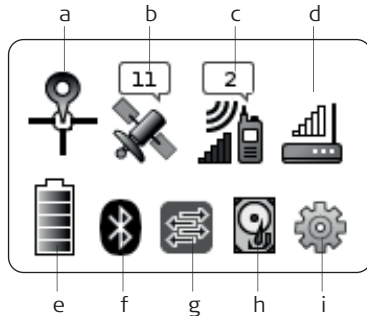
Description

The Main Menu is the first screen displayed when the instrument is switched on.

Main menu content

The Main Menu features a matrix set of menu icons.

 The appearance of the menu icons depend upon the current instrument status and setup.













GP560_003







- a) Position icon
- b) Satellite icon
- c) Radio icon
- d) Modem icon
- e) Battery/Power icon
- f) Bluetooth icon
- g) iCON telematics/Port Summary icon
- h) Memory and logging icon
- i) Settings icon







Additional icon information




The menu icons on the display provide additional information related to basic instrument status.






Icon	Description
Position	 Instrument has not obtained a position.
	 <ul style="list-style-type: none"> • Navigated position has been obtained. • Error ≤ 10 m.
	 <ul style="list-style-type: none"> • Float position has been obtained. • Error ≤ 0.5 m.
	 <ul style="list-style-type: none"> • xRTK position has been obtained. • Error < 0.05 to 0.10 m.
	 <ul style="list-style-type: none"> • High accuracy position has been obtained. • Error ≤ 0.05 m.
	 iCON gps 60 SmartAntenna is operating as a base .
	 BasePilot setup in progress.
	 BasePilot setup failed.






Icon	Description
Satellite	 No satellites tracked.
	 Number of tracked satellites.





Icon	Description
	Radio not in use.
	<ul style="list-style-type: none"> Radio set to receive correction data in rover mode. Active radio channel is displayed. Waves flash when correction data is received.
	<ul style="list-style-type: none"> Radio set to transmit correction data in base mode. Active radio channel is displayed. Waves flash when correction data is transmitted.
	Radio frequency set manually.
	Radio error.
	Sensor is receiving corrections over SmartLink due to an interrupted or broken radio link.


Icon	Description
	Modem not in use.
	Modem connected to a cell phone network.
	<ul style="list-style-type: none"> Modem set to receive correction data in rover mode. Waves flash when correction data is received.
	<ul style="list-style-type: none"> Modem set to transmit correction data in base mode. Waves flash when correction data is transmitted.
	Modem error.
	Sensor is receiving corrections over SmartLink due to an interrupted or broken modem link.

Icon	Description
	Bluetooth OFF.
	Bluetooth ON.
	Bluetooth connection active.

Icon		Description
Battery / Power		Internal battery in use. Bars indicate the battery power level.
		Internal battery low.
		<ul style="list-style-type: none"> External power is used. Internal battery is installed.
		<ul style="list-style-type: none"> External power is used. Internal battery is not installed.
		External power is used, low voltage warning.

Icon		Description
iCON Telematics/Port Summary		iCON Telematics is not configured or is configured but idle.
		New iCON gps 60 firmware is available for download from iCON Telematics .
		View function enabled in iCON Telematics .
		Flashing arrows in the icon: Track function enabled in iCON Telematics .
		iCON Telematics error.
		Port Summary: view the current status for the NMEA output and Remote (MPI).

Icon		Description
Memory and logging		Memory icon (internal memory).
		USB Memory device inserted.
		Raw data logging ongoing.
		Memory error (internal memory is full, needs attention).

Icon		Description
Settings		Settings icon.

5.3

Submenus

5.3.1


Navigation in Submenus

How to navigate in submenus


- Use the **↑** and **↓** navigation keys to select a submenu entry.
- To enter a submenu, highlight the menu entry of interest and press **↵**.
- Use the **←** and **→** navigation keys to navigate through a submenu with multiple pages.



Example of a submenu

Antenna 1	
Antenna :	CGA60
Height :	0.000 m
Measure :	Vertical
■■■■■■■■	

 Small boxes at the bottom of a submenu page indicate the number of pages within the submenu, while a solid black box indicates the current page.

Locked Submenus

Satellites Ant. 1	
GPS :	9 / 10
GLONASS :	4 / 6
Galileo :	-- / --
BeiDou :	
Total :	13 / 16
■■■■■■■■	

 Features that are not active due to a missing licence are marked with a **lock** symbol ().

5.3.2

How to Change Settings and Edit Values

How to change settings

Antenna 1	
Antenna :	CGA60
Height :	0.000 m
Measure :	Vertical
■■■■■■■■	

Antenna 1	
Antenna :	CGA60
Height :	0.000 m
Measure :	Height Hook
■■■■■■■■	




- Enter the desired submenu as described before, for example **Antenna 1** settings.
- The first editable value is automatically selected, indicated by a frame around the entry.
- Use the **↑** and **↓** navigation keys, to select the desired option, for example **Measure**.
- Press **↵** to enter the list of available options.
- Use the **←** and **→** navigation keys to scroll through the list of options.
- Press **↵** to confirm the selection, or
- press **ESC** to discard the setting and cancel the operation.

Select and edit values

Antenna 1	
Antenna :	CGA60
Height :	0.000 m
Measure :	Vertical



Antenna 1	
Antenna :	CGA60
Height :	1.800 m
Measure :	Vertical

- Enter the desired submenu as described before, for example **Antenna 1** settings.
- Use the **↑** and **↓** navigation keys, to select the desired option, for example **Height**.

- Press  to enter the input field.
- Use the **↑** and **↓** navigation keys, to change the value of a digit.
- Use the **←** and **→** navigation keys to change to another digit.
- Press  to confirm the setting, or
- press  to discard the setting and cancel the operation.





Enter numbers or text

The user interface is equipped with a virtual keyboard for alphanumerical and numerical input.

 The virtual keyboard works similar to a mobile phone keyboard. Press  repeatedly to toggle between the different characters.

Edit Point ID			
Base001			
1	2	3	« »
4	5	6	X
7	8	9	A>a>123
+ -	0	.	←

First select a submenu item, as shown in the example.

- Press  to edit a number/text field.
- Use the navigation keys to select a key on the virtual keyboard.
- Press  (if necessary repeatedly) to select and enter a character or number.
- Highlight  and press  to save the changes.

Special keys	Function
A>a>123	Switches between upper/lower case characters and the numerical keyboard.
« »	Moves the position of the cursor.
X	Deletes the character left of the cursor (backspace functionality).
←	Stores the current content of the description field and ends input mode.

Position Menu

Informs about:

- **Position Quality:**
 - **Position Quality**
 - **Height Quality**
 - **GDOP:** Geometric Dilution Of Precision. The smaller the number, the higher the possible precision.
 - **Solution: Navigated, Float, Fixed (XRTK) or Fixed**
- **Position Antenna:**
 - The coordinate system used: **WGS84, Via Network** or any loaded coordinate system files.
 - Position Coordinates
 - Position Height
- **Antenna 1:**
 - The active GNSS antenna
 - Height of the active antenna
 - Measurement mode of antenna height: **Vertical** or **Height Hook**
- **RTK Mode:**
 - The active **RTK Mode**
 - BasePilot: Used or Not Used
- Current **Date & Time**

Configurable values (if external antenna is connected):

- Antenna type
 - Antenna height
 - Measurement mode of Antenna height
-

Satellite Menu

Informs about:

- **Satellites Antenna1:**
 - The number of tracked satellites and available satellites, if no position is given (no base correction data received).
 - The number of used satellites and available satellites, when position is available (with base correction data).
 - **Cut-Off Angle:** below this defined angle satellites will not be taken into account for calculations.
- **Reference Satellites:**
 - The number of reference satellites, in rover mode only.

Configurable value:

- **Cut-Off Angle**
-

Radio Menu

Informs about:

- Radio status information, including managing internal power supply for the radio
- Connection details of the internal and / or external radio
- Base station information

Configurable values:

- Radio channel, frequency and bandwidth
- Internal power supply Yes/No, Radio On/Off
- Protocol (for some radio types only)
- Correction format (only in base mode)
When in base mode, the RTK correction format can be edited from within the radio menu.
- FEC (Forward Error Correction) (for some radio types only)



For an internal Satellite radio or an external GFU27 radio the frequency can be set manually and FEC turned On/Off, when radio firmware version 06.17.3.61 or higher is installed.

Modem Menu

Informs about:

- **Internal Modem:**
 - Modem type and connection details
 - Managing internal power supply for the modem
 - RTK status
 - Base Station information

Configurable values:

- Internal power supply for the modem Yes/No
 - Modem connect/disconnect
 - Selected mobile internet service type
 - Correction format (only in base mode)
When in base mode, the RTK correction format can be edited from within the modem menu.
-

Power Menu

Informs about:

- Battery level of internal and / or external battery

Configurable values:

- None
-

Bluetooth Menu

Informs about:

- Bluetooth connection details and status

Configurable value:

- Activate/deactivate Bluetooth
-

iCON Telematics and Port Summary Menu

Informs about:

- The status of **iCON Telematics** and its functions View, Track and Sync
- Enable or disable the **Share screen** function, to allow a remote user to view the instrument's screen
- The different ports and their usage/status

Configurable values:

- Activate/deactivate **Share screen**

Storage Menu

Informs about:

- **Internal Memory:**
 - Free/Used/Total Memory
 - Raw data logging active/inactive
- **USB Storage:**
 - Free/Used/Total Memory, when a USB memory device is inserted

Configurable values:



- None

Settings Menu

Contains following submenus:

- **Tools**
- **System Information**
- **System Configuration**
- **Service**
- **Copyrights**

Settings Menu: Tools




Functions	Description
Base Setup	Execute a Base Station setup. Refer to "6.1 Base Setup" for further information.
Rover Setup	Execute a Rover setup. Refer to "6.2 Rover Setup" for further information.
NMEA Output	Attend the NMEA Output settings. Refer to "6.3 ORP and NMEA Output" for further information.  The appropriate license must be installed to access the NMEA Output wizard.
Raw Data Logging	<ul style="list-style-type: none">• Setup/Start Raw Data Logging. Refer to "6.4 Raw Data Logging" for further information.• View the Log file list.• Export Log files to a connected USB memory device.• Delete all Log files.
iCON Telematics	<ul style="list-style-type: none">• View the current iCON Telematics Status.• iCON Sync Download: download data from the iCON telematics web page.• iCON Sync Upload: upload data to the iCON telematics web page.• iCON Telematics Firmware: search for and execute available instrument firmware updates from the iCON telematics web page.• Perform a iCON Telematics Setup.  Refer to "6.5 iCON Telematics" for further information on the different functions.


Functions	Description
Import / Export / Delete	<ul style="list-style-type: none"> • Import data from a connected USB memory device. • Export data to a connected USB memory device. • Delete data stored on the instrument. Available options to delete: Base point list, Welcome screen, Support logs, and Coordinate systems.
Licenses	<ul style="list-style-type: none"> • View active licenses. • Upload license file from a connected USB memory device. • Enter license key. • Delete all licenses stored on the instrument.


Settings Menu: System Information

Functions	Description
System Information	<ul style="list-style-type: none"> • Instrument Type and Serial Number. • Active firmware version. • Information about the Measurement Engine, the Internal Radio, and the Internal Cell Modem.

Settings Menu: System Configuration

Functions	Description
Upload Firmware	Single Firmware file selectable to upgrade the instrument's firmware. Firmware file must be placed in a folder called system on a USB memory device.
GNSS Settings	<ul style="list-style-type: none"> • Configure GNSS tracking settings GPS L2C, GPS, GLONASS, Galileo & BeiDou • To activate or deactivate xRTK. <ul style="list-style-type: none">  xRTK is a slightly less accurate RTK position type, typically 5 to 10 cm, automatically providing more availability for phase fixed positions with a reliability of 99%. Recommended when working in heavy canopy environments. For NMEA messages, positions measured with the xRTK mode are flagged as fixed. • To activate or deactivate SmartLink. <ul style="list-style-type: none"> - SmartLink is available for all RTK formats and independently from the xRTK configuration. - SmartLink is a correction service delivered via Satellite to bridge RTK corrections outages for long periods of time, for example 10 minutes. Use SmartLink to work for longer without the consistent usage of the RTK infrastructure.  GPS L5, Galileo E5a/E5b/AltBOC and BeiDou B2 satellite signals are unavailable in SmartLink mode.  The SmartLink functionality is licenced.
Coordinate systems	To set the Coordinate system used. Choose from WGS84 , Via Network or any loaded coordinate system files.

Functions	Description
Reset Options	<p>Reset options are available for the Memory, the External Port Configurations, the Instrument, Almanac, and the Antenna list.</p> <p> The Almanac is a set of data that every GNSS satellite transmits, and it includes information about the state of the entire satellite constellation, and coarse data on every satellite's orbit. When the iCON gps 60 instrument has current almanac data in memory, it can acquire satellite signals and determine initial position more quickly.</p>
Choose Language	Change system language.
Screen Settings	<ul style="list-style-type: none"> • Set display Backlight options: <ul style="list-style-type: none"> - Auto: Ambient light sensor is used to automatically adjust screen backlight for best display. - Full: Screen backlight is set to full brightness. - Off: Backlight is turned off. • Set display Power Saver options: <ul style="list-style-type: none"> - Off: Screen backlight will not turn off. - 5 s, 30 s, 1 min., ...: Screen backlight remains on for the time period set following the last key press.
Startup & Shutdown	<ul style="list-style-type: none"> • When Start on Pulse to Port is set to On: The instrument will automatically start up after receiving a pulse signal on port P1. • When Start on Power to Port is set to On: The instrument will automatically start up when power is available on port P1.
Date & Time	Define Time Zone and Daylight Saving Time .
Units & Formats	<ul style="list-style-type: none"> • Set the Unit used for Distance. • Define Date and Time format.
Upload ME Firmware	Single ME (Measurement Engine) files selectable to upgrade the ME(s). ME file must be placed in a folder called system on a USB memory device
Remote Config	Configure the instrument for remote control using the Leica Machine Control Net Protocol. It is possible to access this protocol via Serial P1 or Bluetooth. Define the settings for Serial . If settings were done previously, switch on/off or select as needed.

Functions	Description
User Defined Antennas	<p>Create or edit up to 50 user defined antennas.</p> <ul style="list-style-type: none"> • Give the antenna a user defined Name. • Enter values for Hz offset, Vrt offset, and the phase centre offset values L1 ph.off. and L2 ph.off. • Enter the IGS name and a Serial nr.. IGS stands for International GNSS Service. It is possible to register antennas and receivers at IGS, and these items are then kept in an official list. <p>All input fields, but the Serial nr., must be completed. Therefore a list showing these values for the user defined antenna should be present.</p> <p> Copy add. corr. allows to copy an existing additive constant.</p> <p>User defined antennas are available in the antenna fields for selection, for example in wizards or sub-menus. When a user defined antenna was used for a Base Station setup it is also shown in the Base Point List.</p>
iCON Analytics	<ul style="list-style-type: none"> • Use Usage Report to enable/disable this feature. • Use About iCON Analytics to view detailed information about the matters and capacity of this feature. Further information can be found below.

iCON Analytics - detailed information

Leica Geosystems would like your help to improve this product. Your iCON device can automatically collect diagnostic and usage info from your device and send it to Leica Geosystems for analysis - but only with your permission. Diagnostic and usage information may include details about hardware and operating system specifications, performance statistics, and data about how you use your devices and applications. The collected information may also contain the location and serial number of the hardware. This collected information is stored on a cloud based server and will be used for troubleshooting and for shaping future development of the product. We encourage users to select the option to **Auto Send** diagnostic and usage info when prompted. You may also, at any time, choose to turn off the monitoring of usage altogether. To do so, open **System Configuration**, **iCON Analytics**, and choose **Don't send**.

Settings Menu: Service

Functions	Description
Service	Password protected - for Service & Support staff only.

Settings Menu: Copyrights

Functions	Description
Copyrights	Includes Open Source Software License information.

This software contains copyright-protected software that is licensed under various open source licenses.

- Press **Settings** > **Copyrights** to view the copyright information and a link to download the source code and license text.

And/Or

- The according copyright statements and license texts are part of the documentation delivered with this product.

If foreseen in the corresponding open source licence, you may obtain the source code, license texts and other related data on the open source centre website of Leica Geosystems, <http://opensource.leica-geosystems.com>.

6 Software Tools

6.1 Base Setup

6.1.1 Base Setup Description

Setup iCON gps 60 SmartAntenna as Base Station


The iCON gps 60 SmartAntenna can be setup and used as Base Station. Measured Base Points can be recorded in the instrument and a Base Point list can be imported and used for future Base Setups.

There are different options to setup the iCON gps 60 SmartAntenna as Base Station:

- **Manual Base Setup:**
 - When no Base Setup has been performed and recorded before to the iCON gps 60 SmartAntenna and no Base Point List has been imported, it is necessary to perform a manual Base Setup.
 - Manual Base Setup is always possible, also with a imported Base Point List or a previously recorded Base Setup.
 - **Base Setup using BasePilot:**
 - iCON gps 60 SmartAntenna features a tool for automatic Base Setup called BasePilot.
 - BasePilot is enabled automatically when the iCON gps 60 SmartAntenna is powered up on an existing base point. BasePilot recognises that the instrument is in base mode, is over a known point and automatically loads the previously stored base configuration.
-

Using the Base Point List

The Base Point List comprises a list of known base points with all corresponding base system configuration data. It is used with the BasePilot functionality for fast automatic base configuration.

 The Base Point List can be exported, imported and deleted via the **Import / Export / Delete** submenu. Refer to "6.6 Import, Export, or Delete Data" for further information.

No stored positions nearby

If no base point in the Base Point List is close to the current instrument position an information message shows up:

There are no existing Base Points nearby!

If this information appears:

- Confirm the message by pressing  on **Continue**.
 - Use the **Edit** or **Smart Get here** function to set up the base station.
-

6.1.2 Manual Base Setup

Base Setup














The instrument can be manually set up as a stand-alone base station without a controller. This can be done in three different ways using the Base Setup wizard:





- **Smart Get here:**
Instrument determines position and **uses current position as a new base point**.
- **Edit:**
Manual input of coordinates to **generate a new base point**.
- **Find nearest:**
Searches through the **Base Point List for a known base point** within a radius of 20 m of the current instrument position.












 The following step-by-step descriptions explain the different options in detail.



Smart Get here step-by-step




The **Smart Get here** function determines the current coordinates of the instrument and uses this position as the base point.

Step	Description
1.	According to your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via Settings > Tools > Base Setup .
3.	In the Position screen highlight Modify and press  .
4.	Select Smart Get here and press  to confirm.
5.	In the Antenna screen select the active Antenna , the Height of the active antenna, and the Measure mode of antenna height. Select Continue and press  to confirm. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
6.	In the Measure Setup screen select, set the Meas. Time according to your needs and press  to confirm.
7.	<ul style="list-style-type: none"> • If needed, select Corr. Source and press  to confirm. Continue with 12. • When ready to determine the current position, select Measure and press  to confirm.
8.	The instrument measures the current position. Subsequently it searches the Base Point List for stored base points in the vicinity. <ul style="list-style-type: none"> • If necessary, select Remeasure and press  to confirm. • When measurement is okay, select OK and press  to confirm.
9.	If there is already a point within a 40 m radius of the measured point stored in the instrument a message is displayed: <ul style="list-style-type: none"> • Select Overwrite to use the newly measured position, or • select Use existing to use the known point. <ul style="list-style-type: none"> – In case the existing point has been chosen, a second warning message is displayed where you can choose between Saved setup to use the saved Base point setup, including Antenna and Communication settings, or Current to use the currently loaded configuration. If no point is found within a 40 m radius of the measured position the instrument returns to the Position screen.
10.	Back in the Position screen select Modify and Edit and press  to confirm, in case the Point ID and/or coordinates want to be adapted. Otherwise select Continue and press  to confirm.
11.	In the Edit Position screen: <ul style="list-style-type: none"> • Select Pt. ID and press  to confirm. • Enter a Point ID and press  to confirm. • If needed, position and height values can be changed. • When finished, select Continue and press  to confirm. New Point ID, position and height values are stored and instrument returns to the Position screen.

Step	Description
12.	<p>Use the → navigation key to proceed to the Communication setup screen, for example to establish a connection via radio.</p> <p> It is possible to use three communication devices running in parallel.</p> <ul style="list-style-type: none"> • To configure the settings for Internal Radio continue with 13. • To configure the settings for External Radio P1 continue with 14. • To configure the settings for Network continue with 15. • Otherwise continue with 38.
13.	<p>For the Internal Radio select On, Off or Edit and press  to confirm.</p> <p>When Edit was selected:</p> <ul style="list-style-type: none"> • In the Internal Radio (1) screen the Model is displayed. • In the Internal Radio (2) screen select the Channel, Frequency, and Bandwidth. Protocol and FEC can be defined under Advanced Settings. Please note that Protocol and FEC is only available for the internal Satel radio TA13. For the Intuicom 900SLR only Channel can be selected. <p> For an internal Satel radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed.</p> <p> If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.</p> <ul style="list-style-type: none"> • In the RTK Settings screen select the Corr.Format: <ul style="list-style-type: none"> - Leica: The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. - Leica 4G: The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments. - CMR: CMR and CMR+ are compacted formats used to broadcast data for third-party instruments. - RTCM 3.1, RTCM 3.2 MSM3, RTCM 3.2 MSM5: Use RTCM when rover units from a different manufacturer are to be used. Use to decode the standard RTCM v3 and the RTCM v3 (MSM) messages from the base. Message according to RTCM version 3. A new standard format for transmission of Global Navigation Satellite System correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. • Still in the RTK Settings screen define the time interval and the use for Time Slicing. • When finished, confirm in the Save Settings screen.





Step	Description
14.	<p>For the External Radio P1 select On, Off or Edit and press  to confirm. When Edit was selected:</p> <ul style="list-style-type: none"> • In the External Radio (1) screen select the Model: <ul style="list-style-type: none"> – For generic radio setting (Generic RS232), where no device is auto-detected, select Baud rate and Flow contr. – For external radios which are automatically detected, the Model is also selected automatically. In the External Radio (2) screen select the Channel. Protocol and FEC can be defined under Advanced Settings. – For external radios which are not automatically detected, select the Model in the External Radio (1) screen and in the External Radio (2) screen select the Channel and the Protocol.  Protocol and FEC are available and the frequency can be set manually just for the external GFU27 radio, when radio firmware version 06.17.3.61 or higher is installed.  If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well. • In the RTK Settings screen select the Corr.Format from Leica, Leica 4G, CMR, RTCM 3.1, RTCM 3.2 MSM3, RTCM 3.2 MSM5. Refer to step 13. for details. • Still in the RTK Settings screen define the time interval and the use for Time Slicing. • When finished, confirm in the Save Settings screen.
15.	<p>For the Network select On, Off or Edit and press  to confirm. When Edit was selected:</p> <ul style="list-style-type: none"> • In the Internet conn. screen Modem is displayed as device. • Use the  navigation key to proceed to the next step. • In the Int. Modem screen select NTRIP Base, NTRIP Source, TCP Server, or Dialup as Mode. • To configure the settings for NTRIP Base continue with 16. • To configure the settings for NTRIP Source continue with 23. • To configure the settings for TCP Server continue with 28. • To configure the settings for Dialup continue with 35.
16.	<p>In the Int. Modem screen select NTRIP Base as Mode, enter PIN, APN (Access Point Name) and select Use/Don't use for the APN ID. When Use is selected:</p> <ul style="list-style-type: none"> • Use the  navigation key to proceed to the next step. • In the APN ID screen enter User ID and Password.
17.	<p>Use the  navigation key to proceed to the next step.</p>
18.	<ul style="list-style-type: none"> • In the DynDNS Settings (for Dynamic Domain Name System) screen select the Provider and enter Host, Username and Password. • When using a SIM card with a fixed IP set DynDNS to Off. <p> The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.</p>
19.	<p>Use the  navigation key to proceed to the next step.</p>
20.	<p>In the NTRIP Settings screen enter Port number, Username and Password.</p> <p> The port number entered must be accessible from outside your local cell network.</p>
21.	<p>Use the  navigation key to proceed to the next step.</p>




Step	Description
22.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 13. for details. Use the → navigation key to save the settings and enable the device.
23.	In the Int. Modem screen select NTRIP Source as Mode , enter PIN , APN (Access Point Name) and select Use/Don't use for the APN ID . When Use is selected: <ul style="list-style-type: none"> • Use the → navigation key to proceed to the next step. • In the APN ID screen enter User ID and Password.
24.	Use the → navigation key to proceed to the next step.
25.	In the Caster Settings screen select the Mode and enter Address , Port , Mnt.Pt. (mount point) and Password . <ul style="list-style-type: none"> • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
26.	Use the → navigation key to proceed to the next step.
27.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 13. for details. Use the → navigation key to save the settings and enable the device.
28.	In the Int. Modem screen select TCP Server as Mode , enter PIN , APN (Access Point Name) and select Use/Don't use for the APN ID . When Use is selected: <ul style="list-style-type: none"> • Use the → navigation key to proceed to the next step. • In the APN ID screen enter User ID and Password.
29.	Use the → navigation key to proceed to the next step.
30.	<ul style="list-style-type: none"> • In the DynDNS Settings (for Dynamic Domain Name System) screen select the Provider and enter Host, Username and Password. • When using a SIM card with a fixed IP set DynDNS to Off.  The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
31.	Use the → navigation key to proceed to the next step.
32.	In the TCP Server screen enter Port number and a number for Max. clients .  The port number entered must be accessible from outside your local cell network.
33.	Use the → navigation key to proceed to the next step.
34.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 13. for details. Use the → navigation key to save the settings and enable the device.
35.	In the Int. Modem screen select Dialup as Mode , and enter PIN .
36.	Use the → navigation key to proceed to the next step.
37.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 13. for details. Use the → navigation key to save the settings and enable the device.
38.	Use the → navigation key to proceed to the Antenna screen. The active Antenna , the Height of the active antenna, the Measure mode of antenna height and the Ref.Stn.ID (Reference Station Identification) might be changed again.




Step	Description
39.	<p>Use the → navigation key to proceed to the final step.</p> <ul style="list-style-type: none"> To save and apply the new Base Station settings select Save and press  to confirm. To discard the new Base Station settings select Undo and press . To actually discard the settings confirm the following Warning by pressing  on OK.












Find nearest step-by-step



The **Find nearest** function searches through the Base Point List for base points in the vicinity.




Step	Description
1.	According your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via Settings > Tools > Base Setup .
3.	In the Position screen highlight Modify and press  .
4.	Select Find nearest and press  to confirm.
5.	The instrument searches for base points within a 20 m radius, which are stored in the Base Point List. The closest base point is selected automatically.
6.	<p>If a Base Point is found within a 20 m radius of the current position:</p> <ul style="list-style-type: none"> Select Saved setup to use the saved Base point setup, including Antenna and Communication settings, or select Current to use the currently used Base point setup. Press  to confirm the selection. <p>If no Base Point is found within a 20 m radius an according information message is displayed. In this case the Smart Get here or Edit function is needed to setup a base station.</p>
7.	Back in the Position screen, re-check the selected base point information.
8.	<p>Use the → navigation key to proceed to the Communication setup screen, for example to establish a connection via radio.</p> <p> It is possible to use three communication devices running in parallel.</p> <ul style="list-style-type: none"> To configure the settings for Internal Radio continue with 9. To configure the settings for External Radio P1 continue with 10. To configure the settings for Network continue with 11. Otherwise continue with 34.

Step	Description
9.	<p>For the Internal Radio select On, Off or Edit and press  to confirm. When Edit was selected:</p> <ul style="list-style-type: none"> • In the Internal Radio (1) screen the Model is displayed. • In the Internal Radio (2) screen select the Channel, Frequency, and Bandwidth. Protocol and FEC can be defined under Advanced Settings. Please note that Protocol and FEC is only available for the internal Satel radio TA13. For the Intuicom 900SLR only Channel can be selected. <p> For an internal Satel radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed.</p> <p> If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.</p> <ul style="list-style-type: none"> • In the RTK Settings screen select the Corr.Format: <ul style="list-style-type: none"> - Leica: The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. - Leica 4G: The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments. - CMR: CMR and CMR+ are compacted formats used to broadcast data for third-party instruments. - RTCM 3.1, RTCM 3.2 MSM3, RTCM 3.2 MSM5: Use RTCM when rover units from a different manufacturer are to be used. Use to decode the standard RTCM v3 and the RTCM v3 (MSM) messages from the base. Message according to RTCM version 3. A new standard format for transmission of Global Navigation Satellite System correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. • Still in the RTK Settings screen define the time interval and the use for Time Slicing. • When finished, confirm in the Save Settings screen.

Step	Description
9.	<p>For the Internal Radio select On, Off or Edit and press  to confirm. When Edit was selected:</p> <ul style="list-style-type: none"> • In the Internal Radio (1) screen the Model is displayed. • In the Internal Radio (2) screen select the Channel, Frequency, and Bandwidth. Protocol and FEC can be defined under Advanced Settings. Please note that Protocol and FEC is only available for the internal Satel radio TA13. For the Intuicom 900SLR only Channel can be selected. <p> For an internal Satel radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed.</p> <p> If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.</p> <ul style="list-style-type: none"> • In the RTK Settings screen select the Corr.Format: <ul style="list-style-type: none"> - Leica: The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. - Leica 4G: The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments. - CMR: CMR and CMR+ are compacted formats used to broadcast data for third-party instruments. - RTCM 3.1, RTCM 3.2 MSM3, RTCM 3.2 MSM5: Use RTCM when rover units from a different manufacturer are to be used. Use to decode the standard RTCM v3 and the RTCM v3 (MSM) messages from the base. Message according to RTCM version 3. A new standard format for transmission of Global Navigation Satellite System correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. • Still in the RTK Settings screen define the time interval and the use for Time Slicing. • When finished, confirm in the Save Settings screen.




Step	Description
10.	<p>For the External Radio P1 select On, Off or Edit and press  to confirm. When Edit was selected:</p> <ul style="list-style-type: none"> • In the External Radio (1) screen select the Model: <ul style="list-style-type: none"> – For generic radio setting (Generic RS232), where no device is auto-detected, select Baud rate and Flow contr. – For external radios which are automatically detected, the Model is also selected automatically. In the External Radio (2) screen select the Channel. Protocol and FEC can be defined under Advanced Settings. – For external radios which are not automatically detected, select the Model in the External Radio (1) screen and in the External Radio (2) screen select the Channel and the Protocol.  Protocol and FEC are available and the frequency can be set manually just for the external GFU27 radio, when radio firmware version 06.17.3.61 or higher is installed.  If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well. • In the RTK Settings screen select the Corr.Format from Leica, Leica 4G, CMR, RTCM 3.1, RTCM 3.2 MSM3, RTCM 3.2 MSM5. Refer to step 9. for details. • Still in the RTK Settings screen define the time interval and the use for Time Slicing. • When finished, confirm in the Save Settings screen.
11.	<p>For the Network select On, Off or Edit and press  to confirm. When Edit was selected:</p> <ul style="list-style-type: none"> • In the Internet conn. screen Modem is displayed as device. • Use the  navigation key to proceed to the next step. • In the Int. Modem screen select NTRIP Base, NTRIP Source, TCP Server, or Dialup as Mode. • To configure the settings for NTRIP Base continue with 12. • To configure the settings for NTRIP Source continue with 19. • To configure the settings for TCP Server continue with 24. • To configure the settings for Dialup continue with 31.
12.	<p>In the Int. Modem screen select NTRIP Base as Mode, enter PIN, APN (Access Point Name) and select Use/Don't use for the APN ID. When Use is selected:</p> <ul style="list-style-type: none"> • Use the  navigation key to proceed to the next step. • In the APN ID screen enter User ID and Password.
13.	Use the  navigation key to proceed to the next step.
14.	<ul style="list-style-type: none"> • In the DynDNS Settings (for Dynamic Domain Name System) screen select the Provider and enter Host, Username and Password. • When using a SIM card with a fixed IP set DynDNS to Off. <p> The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.</p>
15.	Use the  navigation key to proceed to the next step.
16.	<p>In the NTRIP Settings screen enter Port number, Username and Password.</p> <p> The port number entered must be accessible from outside your local cell network.</p>
17.	Use the  navigation key to proceed to the next step.

Step	Description
18.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 9. for details. Use the → navigation key to save the settings and enable the device.
19.	In the Int. Modem screen select NTRIP Source as Mode , enter PIN , APN (Access Point Name) and select Use/Don't use for the APN ID . When Use is selected: <ul style="list-style-type: none"> • Use the → navigation key to proceed to the next step. • In the APN ID screen enter User ID and Password.
20.	Use the → navigation key to proceed to the next step.
21.	In the Caster Settings screen select the Mode and enter Address , Port , Mnt.Pt. (mount point) and Password . <ul style="list-style-type: none"> • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
22.	Use the → navigation key to proceed to the next step.
23.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 9. for details. Use the → navigation key to save the settings and enable the device.
24.	In the Int. Modem screen select TCP Server as Mode , enter PIN , APN (Access Point Name) and select Use/Don't use for the APN ID . When Use is selected: <ul style="list-style-type: none"> • Use the → navigation key to proceed to the next step. • In the APN ID screen enter User ID and Password.
25.	Use the → navigation key to proceed to the next step.
26.	<ul style="list-style-type: none"> • In the DynDNS Settings (for Dynamic Domain Name System) screen select the Provider and enter Host, Username and Password. • When using a SIM card with a fixed IP set DynDNS to Off.  The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
27.	Use the → navigation key to proceed to the next step.
28.	In the TCP Server screen enter Port number and a number for Max. clients .  The port number entered must be accessible from outside your local cell network.
29.	Use the → navigation key to proceed to the next step.
30.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 9. for details. Use the → navigation key to save the settings and enable the device.
31.	In the Int. Modem screen select Dialup as Mode , and enter PIN .
32.	Use the → navigation key to proceed to the next step.
33.	In the Save Settings screen select the Corr.Format (Correction Format). Refer to step 9. for details. Use the → navigation key to save the settings and enable the device.
34.	Use the → navigation key to proceed to the Antenna 1 screen. The active Antenna , the Height of the active antenna, the Measure mode of antenna height and the Ref.Stn.ID (Reference Station Identification) might be changed. Refer to "3.9 Antenna Heights" for information about Antenna Heights.

Step	Description
35.	Use the → navigation key to proceed to the final step. <ul style="list-style-type: none"> To save and apply the new Base Station settings select Save and press  to confirm. To discard the new Base Station settings select Undo and press . To actually discard the settings confirm the following Warning by pressing  on OK.

Edit step-by-step

The **Edit** function can be used to enter a set of coordinates manually.



Step	Description
1.	According your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via Settings > Tools > Base Setup .
3.	In the Position screen highlight Modify and press  .
4.	Select Edit and press  to confirm.
5.	In the Edit Position screen enter a Point ID, a set of coordinates and the height of the desired Base Station. Select Continue and press  .
6.	The instrument searches for base points in the vicinity, which are stored in the Base Point List.
7.	If there is already a Base Point within a 40 m radius of the measured point stored in the instrument a message is displayed: <ul style="list-style-type: none"> Select Overwrite to use the newly measured position, or select Use existing to use the known point. <ul style="list-style-type: none"> In case the existing point has been chosen, a second warning message is displayed where you can choose between Saved setup to use the saved Base point setup, including Antenna and Communication settings, or Current to use the currently used Base point setup. <p>If no Base Point is found within a 40 m radius an according information message is displayed and the newly entered information is stored as Base Point.</p>



6.1.3

Base Setup using BasePilot

BasePilot setup

BasePilot is a feature which configures and starts the iCON gps 60 SmartAntenna running as a Base when the instrument (antenna) is setup over a known base point. Predefined base configurations are automatically loaded.

Step	Description
1.	According to your needs, setup the hardware needed over a known base point. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	<ul style="list-style-type: none"> If iCON gps 60 SmartAntenna is in Base mode: <ul style="list-style-type: none"> BasePilot starts up automatically. If iCON gps 60 SmartAntenna is in Rover mode: <ul style="list-style-type: none"> Go to Settings > Tools > Base Setup and choose Find nearest. Press  to confirm. Refer to "6.1.2 Manual Base Setup" for further information.
3.	While BasePilot is setting up: The position icon  is displayed.

Step	Description
4.	<p>After the BasePilot has been completed: The position icon  is displayed. The radio/modem now starts transmitting corrections!</p> <p> On RTK Mode page, in the Position submenu the line BasePilot shows: Successful.</p>









When using BasePilot, always check in the **Position** submenu that the iCON gps 60 SmartAntenna has selected the correct base point! **Using the wrong base point can lead to an error of more than 20 m for a rover!**





6.2 Rover Setup




Rover setup description

The instrument can be manually set up as a stand-alone Rover without a controller, using the Rover Setup wizard.




Step	Description
1.	Access the wizard via Settings > Tools > Rover Setup .
2.	<p>In the Communication screen press  and select the communication device using the  and  navigation keys:</p> <ul style="list-style-type: none"> • Int. Radio: Select this option to use the internal radio. A slot-in-radio must be inserted in its slot. Refer to "3.4 Slot-in-Device" for further information. • Ext. Radio P1: Select this option to use an external radio connected to Port P1. • Int. Modem: Select this option to use the internal modem. A SIM card must be inserted in the card slot. Refer to "3.3 Installing a SIM Card" for further information.
3.	<p>Press  to confirm your selection and use the  navigation key to proceed to the next step.</p> <p> The following step-by-step descriptions explain the different options in detail.</p>



Rover setup with internal radio step-by-step

Step	Description
1.	Access the wizard via Settings > Tools > Rover Setup .
2.	In the Communication screen select Int. Radio .
3.	Use the  navigation key to proceed to the next step.
4.	<ul style="list-style-type: none"> • In the Internal Radio (1) screen the Model is displayed. • In the Internal Radio (2) screen select the Channel, Frequency, and Bandwidth. Protocol and FEC can be defined under Advanced Settings. <p> Protocol and FEC are available and the frequency can be set manually just for an internal Satellite radio TA13, when radio firmware version 06.17.3.61 or higher is installed.</p> <p> If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.</p>
5.	Use the  navigation key to proceed to the next step.




Step	Description
6.	In the RTK Settings screen select the Corr.Format (Correction Format), the Ref.Rec. (Reference Receiver), the Ref.Ant. (Reference Antenna) and the Accept Ref. (Accepted References).  Refer to "RTK correction format" for further information about the correction formats.
7.	Use the → navigation key to proceed to the next step.
8.	In the Antenna screen select the active Antenna , the Height of the active antenna, and the Measure mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
9.	Use the → navigation key to proceed to the final step.
10.	In the Save Settings screen the signal waves will flash if the Channel and the Corr.Format are correctly set.
11.	<ul style="list-style-type: none"> Use the → navigation key to save and apply the rover settings. To discard the changes press  and confirm the following Warning by pressing  on Continue.

Rover setup with external radio step-by-step




Step	Description
1.	Access the wizard via Settings > Tools > Rover Setup .
2.	In the Communication screen select Ext. Radio P1 .
3.	Use the → navigation key to proceed to the next step.
4.	In the External Radio (1) screen select the Model : <ul style="list-style-type: none"> For generic radio setting (Generic RS232), where no device is auto-detected, select Baud rate and Flow contr.. For external radios which are automatically detected, the Model is also selected automatically. In the External Radio (2) screen select the Channel and the Protocol. For external radios which are not automatically detected, select the Model in the External Radio (1) screen and in the External Radio (2) screen select the Channel and the Protocol.  Protocol is available and the frequency can be set manually just for the external GFU27 radio, when radio firmware version 06.17.3.61 or higher is installed.  If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.
5.	Use the → navigation key to proceed to the next step.
6.	In the RTK Settings screen select the Corr.Format (Correction Format), the Ref.Rec. (Reference Receiver), the Ref.Ant. (Reference Antenna) and the Accept Ref. (Accepted Reference ID).  Refer to "RTK correction format" for further information about the correction formats.
7.	Use the → navigation key to proceed to the next step.
8.	In the Antenna screen select the active Antenna , the Height of the active antenna, and the Measure mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
9.	Use the → navigation key to proceed to the final step.
10.	In the Save Settings screen the signal waves will flash if the Channel and the Corr.Format are correctly set.

Step	Description
11.	<ul style="list-style-type: none"> Use the → navigation key to save and apply the rover settings. To discard the changes press  and confirm the following Warning by pressing  on Continue.


Rover setup with internal modem using NTRIP Client step-by-step



Step	Description
1.	Access the wizard via Settings > Tools > Rover Setup .
2.	In the Communication screen select Int. Modem .
3.	Use the → navigation key to proceed to the next step.
4.	<p>In the Int. Modem screen select NTRIP Client as Mode, enter PIN, APN (Access Point Name) and select Use/Don't use for the APN ID.</p> <p>When Use is selected:</p> <ul style="list-style-type: none"> Use the → navigation key to proceed to the next step. In the APN ID screen enter User ID and Password.
5.	Use the → navigation key to proceed to the next step.
6.	<p>In the NTRIP Settings screen select the Address Mode, enter Address, Port number, User and Password.</p> <ul style="list-style-type: none"> Address mode WWW allows the entry of a web address. Address mode IP allows the entry of an IP address.
7.	Use the → navigation key to proceed to the next step.
8.	<p>In the Mount Point screen select the Method.</p> <ul style="list-style-type: none"> If the Method Source Table is selected, then start the mount point search by selecting Start in the Search line. Once the source table has been downloaded, the desired mount point can be selected from the list available in the Mountpoint line. If the Method Manual is selected, then it is possible to manually enter the mount point name.
9.	Use the → navigation key to proceed to the next step.
10.	<p>In the RTK Settings screen select the Corr.Format (Correction Format), the Network type, the Ref.Rec. (Reference Receiver), and the Ref.Ant. (Reference Antenna).</p> <p> Refer to "RTK correction format" for further information about the correction formats.</p>
11.	Use the → navigation key to proceed to the next step.
12.	<p>In the Antenna screen select the active Antenna, the Height of the active antenna, and the Measure mode of antenna height.</p> <p>Refer to "3.9 Antenna Heights" for information about Antenna Heights.</p>
13.	Use the → navigation key to proceed to the final step.
14.	In the Save Settings screen the signal waves will flash if the Channel and the Corr.Format are correctly set.
15.	<ul style="list-style-type: none"> Use the → navigation key to save and apply the rover settings. To discard the changes press  and confirm the following Warning by pressing  on Continue.

Rover setup with internal modem using TCP Client step-by-step


Step	Description
1.	Access the wizard via Settings > Tools > Rover Setup .
2.	In the Communication screen select Int. Modem .
3.	Use the → navigation key to proceed to the next step.
4.	In the Int. Modem screen select TCP Client as Mode , enter PIN , APN (Access Point Name) and select Use/Don't use for the Provider ID. When Use is selected: <ul style="list-style-type: none"> • Use the → navigation key to proceed to the next step. • In the APN ID screen enter the User ID and the Password.
5.	Use the → navigation key to proceed to the next step.
6.	In the Server Settings screen select the Address Mode , enter Address and the Port number. <ul style="list-style-type: none"> • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the → navigation key to proceed to the next step.
8.	In the RTK Settings screen select the Corr.Format (Correction Format), the Network type, the Ref.Rec. (Reference Receiver), and the Ref.Ant. (Reference Antenna).  Refer to "RTK correction format" for further information about the correction formats.
9.	Use the → navigation key to proceed to the next step.
10.	In the Antenna screen select the active Antenna , the Height of the active antenna, and the Measure mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
11.	Use the → navigation key to proceed to the final step.
12.	In the Save Settings screen the signal waves will flash if the Channel and the Corr.Format are correctly set.
13.	<ul style="list-style-type: none"> • Use the → navigation key to save and apply the rover settings. • To discard the changes press  and confirm the following Warning by pressing  on Continue.

Rover setup with internal modem using DialUp step-by-step

Step	Description
1.	Access the wizard via Settings > Tools > Rover Setup .
2.	In the Communication screen select Int. Modem .
3.	Use the → navigation key to proceed to the next step.
4.	In the Int. Modem screen select Dialup as Mode , enter PIN and PUK .
5.	Use the → navigation key to proceed to the next step.
6.	In the Dial-Up Settings screen enter the Ph. Number and select the Modem Prot. , the Net Data Rate , and if the Connection should be transparent.
7.	Use the → navigation key to proceed to the next step.
8.	In the RTK Settings screen select the Corr.Format (Correction Format), the Ref.Rec. (Reference Receiver), and the Ref.Ant. (Reference Antenna).  Refer to "RTK correction format" for further information about the correction formats.
9.	Use the → navigation key to proceed to the next step.

Step	Description
10.	In the Antenna screen select the active Antenna , the Height of the active antenna, and the Measure mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
11.	Use the → navigation key to proceed to the final step.
12.	In the Save Settings screen the signal waves will flash if the Channel and the Corr.Format are correctly set.
13.	<ul style="list-style-type: none"> Use the → navigation key to save and apply the rover settings. To discard the changes press  and confirm the following Warning by pressing  on Continue.

RTK correction format



Option	Description
Leica	The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2.
Leica 4G	The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments.
CMR / CMR+	CMR and CMR+ are compacted formats used to broadcast data for third-party instruments.
RTCM 3.1 / 3.2 MSM, RTCM 2.3 18/19, RTCM 2.3 20/21	<p>Use RTCM when rover units from a different manufacturer are to be used.</p> <p>Use to decode the standard RTCM v3 and the RTCM v3 (MSM) messages from the base.</p> <p>RTCM 3.2 MSM supports GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2.</p> <p>Message according to RTCM version 3. A new standard format for transmission of Global Navigation Satellite System correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth.</p> <p> Both RTCM MSM3 and RTCM MSM5 are supported. RTCM MSM3 is a compact version of the format and is suitable for low bandwidth transmission. RTCM MSM5 is an extended version of the format.</p>

6.3






ORP and NMEA Output

NMEA Output description

To transmit data using the NMEA standard protocol, the instrument must be configured accordingly.

-  The appropriate position rate licences must be installed to access all output rates.
-  The NMEA interface must be assigned to one of the serial ports.

NMEA Output settings step-by-step

Step	Description
1.	Access the wizard via Settings > Tools > NMEA Output .
2.	In the NMEA Output screen select On , Off , or Edit for each NMEA interface.
3.	When the NMEA Output settings have been done before, select On or Off to active/deactivate the output and press  to confirm. Then press  to save the setting and return to the Tools menu.
4.	When the NMEA Output settings have not been done before, select Edit to start the NMEA Output wizard and confirm with  .
5.	Select P1 or Bluetooth as Port for the NMEA output. For the Talker ID select between Auto or User . When User is selected set the User Talker ID additionally. Finally select Baud rate and Flow contr. , if P1 is selected as Port .
6.	Use the → navigation key to proceed to the next step.
7.	For ORP , select Off , Edit , or set a rate. When Edit is selected: set the Rate and the Coords (coordinate format) additionally. <ul style="list-style-type: none"> The Height is set automatically according to the coordinate system used: for WGS84 it is Ellipsoidal, and Orthometric for Local Grid. Refer to "Appendix B ORP – Orientation and Position" for further information about ORP. For GGA , GPK , GKQ , and GLL select Off or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
8.	Use the → navigation key to proceed to the next step.
9.	For GNS , GSA , GSV , HDT , and LLK select Off or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
10.	Use the → navigation key to proceed to the next step.
11.	For LLQ , RMC , VTG , and ZDA select Off or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
12.	Use the → navigation key to proceed to the final step.
13.	<ul style="list-style-type: none"> To save the changes select Save and confirm with . To discard the changes select Undo and confirm with .

ORP Output

The ORP output differs from standard NMEA messages:

- The ORP message is a Leica proprietary message and delivers position information of one or two antennas.

Configurable values

- Rate:** Define the output rate.
- Output:** It is possible to stream one position.
- Coords** and **Height:** The available Height format depends on the selected Coordinate format. For local coordinates a "*.lok", a "*.xml" or "TRFSET.DAT" file is required.


ORP settings can be accessed via **Settings** > **Tools** > **NMEA Output**. Toggle to **Edit** for **NMEA Out 1** or **NMEA Out 2**. ORP is available on the second page of the wizard. Refer to "Appendix B ORP – Orientation and Position" for further information about ORP.

6.4

Raw Data Logging

Raw Data logging

To log RINEX data the instrument must be configured for Raw Data logging. Access the settings via **Settings > Tools > Raw Data Logging**.

 RINEX is used for post processing when high accurate coordinates are required.


6.5


iCON Telematics

Description

With a connection between the instrument and the iCON telematics web page, **iCON Telematics** offers:





- **View:** Enables a remote user to access the instrument to view or control it.
- **Sync:** To exchange data between the instrument and a remote web page.
- **Track:** Enables a remote user to track the current position of the instrument.
- **Remote firmware upgrade:** Allows new instrument firmware files to be downloaded and installed remotely.



 To use this functionality an account is needed for the iCON telematics web page. The license is handled on the instrument. Ask your agency or your Leica Geosystems representative for information about licensing and how to get an account.

 An Internet connection on the instrument is needed, using a 4G modem. Refer to "3.3 Installing a SIM Card" for information about SIM card installation.

iCON Telematics first setup step-by-step

To use the **iCON Telematics** functionality perform following setup works in the given order:

Step	Description
1.	<p>Establish an Internet connection on the instrument, following these steps:</p> <p> Refer to "3.3 Installing a SIM Card" for information about SIM card installation.</p> <ul style="list-style-type: none">• Access the wizard via Settings > Tools > iCON Telematics > iCON Telematics Setup.• In the Internet conn. screen, use the → navigation key to proceed to the next step.• In the Int. Modem screen enter PIN and APN (Access Point Name) and select Use/Don't use for the APN ID.• When Use is selected:<ul style="list-style-type: none">– Use the → navigation key to proceed to the next step.– In the APN ID screen enter User ID and Password.• Use the → navigation key to proceed to the next step.• Ensure that Server is set to icontelematics.com.• Select Start pairing ... and press  to confirm.• The software starts connecting to the selected Web page. After a successful connection the pairing code is displayed. Be sure to leave this screen open or note down the code.
	In case of failure, check PIN and APN .
2.	<p>Pair the instrument to the iCON telematics web page.</p> <p> This is only necessary for the first time the instrument is connected to the iCON telematics web page.</p>


Step	Description
3.	<p>On the remote computer:</p> <ul style="list-style-type: none"> • Start a web-browser. Google Chrome is recommended for best performance. • Go to the iCON telematics web page: www.icontelematics.com. • Use your User name and Password to login. <p> To use this functionality an account is needed for the iCON telematics web page. The license is handled on the instrument. Ask your agency or your Leica Geosystems representative for information about licensing and how to get an account.</p> <ul style="list-style-type: none"> • Now create a new Unit: <ul style="list-style-type: none"> – Select the Company or create a new one. – Select the Project, that the Unit should be assigned to. If no project is available, create a project first. – Tap Configure, and select Units. – Tap the + icon. – Enter the desired Unit Name and select the Unit Type. If desired, use Note to enter additional information. Tap Next. – Set Equipment Type to GNSS Smart Antenna. Tap Add Equipment to create a Unit with the current settings. • To pair the instrument and the created (Web) Unit, enter the pairing code and tap Pair.
4.	<p>On the instrument:</p> <ul style="list-style-type: none"> • The screen with the pairing code should have been replaced by a confirmation that the instrument is paired with the server. The device is now paired/registered on the web page, and ready to connect. • Use the → navigation key to proceed to the next step. • In the Telematics Project screen the selected Project is highlighted. If needed, select another project from the list. • Use the → navigation key to proceed to the next step. • To allow to send the position of the paired instrument to the iCON telematics web page, set Track to Yes. Select the Interval as well in the Telematics Track screen. • Use the → navigation key to proceed to the next step. • In the Save Settings screen use the → navigation key to save the settings and exit the setup.
	<p>The device is connected to the iCON telematics web page now and ready for View, Sync and Track. Information about the different functions can be found on the following paragraphs.</p>


iCON Telematics Status

Use **Settings > Tools > iCON Telematics > iCON Telematics Status** to:

- enable or disable the **Share screen** function, to allow a remote user to view the instrument's screen,
- view the status of **iCON Telematics** and its functions **View**, **Track** and **Sync**.


iCON Sync Download

- 1) To download data from the iCON telematics web page to the instrument select **Settings > Tools > iCON Telematics > iCON Sync Download**.
- 2) Set **Base Point List, Coord. Systems, Antenna List, and Licenses** according to your needs.
- 3) Use the → navigation key to proceed to the next step.
- 4) Select **Start Download ...** and press  to confirm.

 Base point list, system configuration, antenna list and licences are automatically available after import on the instrument. The imported coordinate systems can be selected under **Settings > System Configuration > Coordinate systems** as active coordinate system.


 When copying files onto the iCON telematics server via the web page, it is important that the files are copied to the following folders: **Base point list** must be stored in **System**, while **Coordinate systems** must be stored in **CoordinateSystems/**.

iCON Sync Upload



- 1) To upload data from the instrument to the iCON telematics web page select **Settings > Tools > iCON Telematics > iCON Sync Upload**.
- 2) Set **Base Point List, System Config, Coord. Systems, Support Logs, and Raw Data Logs** according to your needs.
- 3) Use the → navigation key to proceed to the next step.
- 4) Select **Start Upload ...** and press  to confirm.


Uploaded data will be stored on the iCON telematics web page, inside the assigned project folder:

- The base point list will be stored at **System/iCG60-SN.bpl**.
- The system configuration will be stored at **System/iCG60-SN.cfg**.
- Coordinate systems will be stored at **CoordinateSystems/**.
- Support Logs will be stored at **Logging/logs-iCG60-SN/** and deleted from the instrument after successful upload.
- Raw Data Logs will be stored at **Logging/RINEX-iCG60-SN-yyyyMMdd** and be kept on the instrument after successful upload.

 SN stands for the Serial Number of the instrument, yyyyMMdd for the logging date.



iCON Telematics Firmware

- 1) To download a firmware version from the iCON telematics web page and install it on the instrument select **Settings > Tools > iCON Telematics > iCON Telematics Firmware**.
- 2) The software searches for available firmware on the iCON telematics web page.
- 3) If successful, select the firmware version needed, select **Start download ...** and press  to confirm.
- 4) When download is completed, select **Install** and press  to start installation.

 Ensure a proper power supply as the instrument will restart after the firmware installation.

 If **iCON Telematics** is enabled, the  icon on the Main Menu automatically informs when a new firmware is available. Download and installation of the new firmware can also be started from within the **iCON Telematics** sub-menu, entered from the Main Menu.

iCON Telematics settings step-by-step

Step	Description
1.	Access the wizard via Settings > Tools > iCON Telematics > iCON Telematics Setup .
2.	In the Internet conn. screen, use the → navigation key to proceed to the next step.
3.	In the Int. Modem screen enter PIN and APN (Access Point Name) and select Use/Don't use for the APN ID . <ul style="list-style-type: none"> When Use is selected: <ul style="list-style-type: none"> Use the → navigation key to proceed to the next step. In the APN ID screen enter User ID and Password.
4.	Use the → navigation key to proceed to the next step.
5.	Ensure that Server is set to icontelematics.com .
6.	If required, select Pair again ... and press  to confirm. After a successful connection, an appropriate message is displayed. Otherwise skip this step.
7.	Use the → navigation key to proceed to the next step.
8.	In the Telematics Project screen select a Project from the list. <p> System configuration, coordinate systems, support and raw data logfiles are stored within the selected project on the iCON telematics web page when using iCON Sync Upload.</p>
9.	Use the → navigation key to proceed to the next step.
10.	<ul style="list-style-type: none"> To allow to send the position of the paired instrument to the iCON telematics web page, set Track to Yes. Select the Interval.
11.	Use the → navigation key to proceed to the next step.
12.	In the Save Settings screen use the → navigation key to save the settings and exit the setup.

6.6 Import, Export, or Delete Data

Access the Import / Export / Delete function

Select **Settings > Tools > Import / Export / Delete** to import or export data from/to a USB Memory device installed in the instruments USB port or to delete data from the instruments internal memory.

Import data from USB

Select **Settings > Tools > Import / Export / Delete > Import from USB** to import data from a USB Memory device installed in the instruments USB port.


Import options	Description
Base point list	imports a list of base points
Antenna list	imports a list of external antennas
Welcome screen	imports a customisable welcome screen, for example a company logo
System configuration	overwrites the current system configuration
Coordinate systems	imports coordinate system files



To import data from a USB Memory device to the instrument appropriate folders must be created on the USB device and the files placed in the correct folder: for Coordinate Systems a folder called **CoordinateSystems** is needed, while files for Base Point list, Antenna list, Welcome Screen, and System Configuration need to be placed in a **system** folder.

Export data to USB Select **Settings > Tools > Import / Export / Delete > Export to USB** to export data to a USB Memory device installed in the instruments USB port.

Export options	Description
Base point list	exports a list of stored base points
System configuration	generates a backup of the current system configuration, for example to restore it in the future or to share settings to other instruments
Support logs	instrument related error messages are stored in the log file and can be exported
Coordinate systems	exports coordinate system files

 To export data to a USB Memory device no folders must be created on the device. The appropriate folders are automatically created by the software.

Delete data on the instrument Select **Settings > Tools > Import / Export / Delete > Delete on instrument** to delete data from the instruments internal memory.




Delete options	Description
Base point list	deletes the list of stored base points
Welcome screen	deletes the customised welcome screen
Support logs	removes all entries from the Support Log File
Coordinate systems	removes all Coordinate systems stored on the instrument

Licences

In the **Licensing** menu active licenses can be viewed or deleted, licenses can be uploaded and a license key entered. Access the settings via **Settings > Tools > Licences**.

Licences can be ordered at your local sales representative. The following options are available for iCON gps 60 SmartAntenna:

- CSW501, RTK low Accuracy
 - CSW502, RTK high Accuracy
 - CSW503, Enables Base Station
 - CSW504, Position update 2 Hz
 - CSW505, Position update 10 Hz
 - CSW506, Position update 20 Hz
 - CSW507, RTK Baseline optional 2.5 km
 - CSW508, RTK unlimited Baseline
 - CSW509, RTK Network access
 - CSW510, GPS L2 Support
 - CSW511, GLONASS Support
 - CSW512, GPS L5 Support
 - CSW513, Galileo Support
 - CSW514, BeiDou Support
 - CSW515, Raw Data Logging
 - CSW516, NMEA streaming
 - CSW517, Open Interface
 - CSW518, Demo License
 - CSW591, iCON telematics 1 Year
 - CSW592, iCON telematics 2 Years
 - CSW593, iCON telematics 3 Years
 - CSW594, iCON telematics 1 Day
 - CSW905, SmartLink Service 2 Years
-

Description	<p>GNSS measured points are always stored based on the global geocentric datum known as WGS 1984. Most surveys require coordinates in a local grid system. For example, based on a country's official mapping datum or an arbitrary grid system used in a particular area such as a construction site. To convert the WGS 1984 coordinates into local coordinates a coordinate system must be created. Part of the coordinate system is the transformation used to convert coordinates from the WGS 1984 datum to the local datum.</p> <p>A coordinate system</p> <ul style="list-style-type: none"> • allows the conversion from WGS 1984 geodetic or cartesian coordinates to local grid coordinates and back. • can be directly received from a reference network. • can be uploaded from a USB Memory device. • can be exported to a USB Memory device. <p> Refer to "6.6 Import, Export, or Delete Data" for information about importing, exporting, or deleting coordinate systems.</p>
Default coordinate systems	<p>The default coordinate system is WGS 1984. It cannot be deleted. It is not possible to create a coordinate system called WGS 1984. Additional default coordinate systems may be available for certain countries.</p>
Active coordinate system	<p>The active coordinate system is the one selected under Settings > System Configuration > Coordinate systems. One coordinate system is always considered as the active coordinate system.</p>
Automatic coordinate system (RTCM transformation parameters)	<p>When Via Network is selected under Settings > System Configuration > Coordinate systems, the coordinate system is directly received from the reference network via RTCM correction data.</p> <p> Reference networks do not always provide a coordinate system. This will depend on how the network provider has chosen to configure their data streams.</p>
Coordinate system components	<p>The iCON gps 60 SmartAntenna supports the same coordinate system formats as other Leica iCON products including iCON 3D, iCON Office, iCONstruct field software, as well as Leica RedLine and GNSS Leica Viva sensors.</p> <p>Coordinate systems can be made up of up to three linked files:</p> <ul style="list-style-type: none"> • .lok: Localisation file, contains all the needed parameters and settings, for example datum, map projection and local transformation. • .ccg: Correction grid (Country Specific Coordinate System model). Refer to "CSCS model (*.ccg)" for information about CSCS. • .grd: Geoid model. Refer to "Geoid model" for further information. <p>TRFSET.DAT files can also be imported and used on the iCON gps 60 SmartAntenna.</p> <ul style="list-style-type: none"> • TRFSET.DAT: Localisation file, contains all the needed parameters and settings, for example datum, map projection and local transformation. • .csc: Correction grid (Country Specific Coordinate System model). • .gem: Geoid model. <p> TRFSET.DAT files are read only and cannot be exported in .lok or .xml format.</p>

8 Care and Transport

8.1 Transport

Transport in the field	<p>When transporting the equipment in the field, always make sure that you</p> <ul style="list-style-type: none">• 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	<p>Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container, original packaging or equivalent and secure it.</p>
Shipping	<p>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.</p>
Shipping, transport of batteries	<p>When transporting or shipping batteries, the person responsible for the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.</p>

8.2 Storage

Product	<p>Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "9 Technical Data" for information about temperature limits.</p>
Li-Ion batteries	<ul style="list-style-type: none">• Refer to "Environmental specifications" 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.

8.3

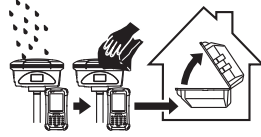
Cleaning and Drying

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.
-

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 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.

9

Technical Data

9.1

Technical Data iCON gps 60 SmartAntenna

9.1.1

Tracking Characteristics


Instrument technology

SmartTrack

Satellite reception

Triple frequency

Instrument channels

 Depending on the satellite systems and signals configured, a maximum number of 120 channels is allocated.

Supported codes and phases

GPS

Type	L1	L2	L5
iCON gps 60 Smart-Antenna	Carrier phase, C/A-code	Carrier phase, C code (L2C) and P2-code	Carrier phase, code

GLONASS

Type	L1	L2
iCON gps 60 Smart-Antenna	Carrier phase, C/A-code	Carrier phase, P2-code

Galileo

Type	E1	E5a	E5b	Alt-BOC
iCON gps 60 Smart-Antenna	Carrier phase, code	Carrier phase, code	Carrier phase, code	Carrier phase, code

BeiDou

Type	B1	B2
iCON gps 60 Smart-Antenna	Carrier phase, code	Carrier phase, code



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

9.1.2

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 **root mean square**, are based on measurements processed using LGO 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

Static and rapid static

Static		Kinematic	
Horizontal	Vertical	Horizontal	Vertical
5 mm + 0.5 ppm	10 mm + 0.5 ppm	10 mm + 1 ppm	20 mm + 1 ppm

Static with long observations

Static		Kinematic	
Horizontal	Vertical	Horizontal	Vertical
3 mm + 0.1 ppm	3.5 mm + 0.4 ppm	10 mm + 1 ppm	20 mm + 1 ppm

Differential phase in real-time

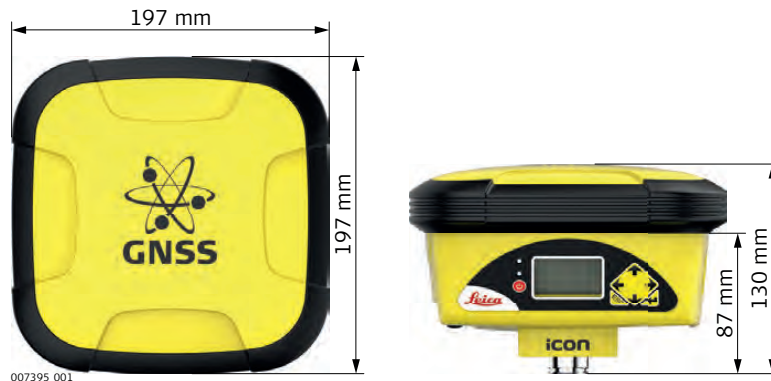
Type	Horizontal	Vertical
Single Baseline (< 30 km)	8 mm + 1 ppm	15 mm + 1 ppm
Network RTK	8 mm + 0.5 ppm	15 mm + 0.5 ppm

9.1.3

General Technical Data of the Instrument

Dimensions

The overall dimensions are given for the housing including the sockets.



Type	Length [mm]	Width [mm]	Thickness [mm]
iCON gps 60 SmartAntenna	197	197	130

Weight

Instrument weight without battery:

Type	Weight [kg]/[lbs]
iCON gps 60 SmartAntenna	1.45/3.20 (including internal LTE modem)

The internal modem is installed by default.

Recording

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

Capacity [MB]	Data capacity
<ul style="list-style-type: none"> 466 	466 MB is typically sufficient for about GPS only (12 satellites) <ul style="list-style-type: none"> 3600 h L1 + L2 + L5 data logging at 15 s rate 14000 h L1 + L2 + L5 data logging at 60 s rate GPS + GLONASS (12/8 satellites) <ul style="list-style-type: none"> 3100 h data logging at 15 s rate 12300 h data logging at 60 s rate

Power	Power consumption:	iCON gps 60 SmartAntenna, radio excluded: 6 W typically, 500 mA
	External supply voltage:	Nominal 12 V DC (---, GEV71 car battery cable to a 12 V car battery), voltage range 9 V-28 V DC

Internal battery	Type:	Li-Ion
	Voltage:	7.4 V
	Capacity:	GEB221/GEB222: 4.4 Ah/6.0 Ah

Battery external	Type:	NiMH
	Voltage:	13 V
	Capacity:	GEB371: 16.6 Ah

- Operating times** The given operating times are valid for
- iCON gps 60 SmartAntenna: fully charged GEB221 battery.
 - room temperature. Operating times will be shorter when working in cold weather.

Equipment			Operating time
Type	Radio	Digital cellular phone	
Static (iCON gps 60 SmartAntenna)	-	-	6 h continuously
Rover (iCON gps 60 SmartAntenna)	SATELLINE M3-TR1, receive (CCD7)	-	5 h continuously
Rover (iCON gps 60 SmartAntenna)	-	built-in LTE Modem	4.75 h continuously

Electrical data

Type	iCON gps 60 SmartAntenna
Voltage	Nominal 12 V
Current	6.0 W typically, 12 V @ 500 mA
Frequency	GPS L1 1575.42 MHz GPS L2 1227.60 MHz GPS L5 1176.45 MHz GLONASS L1 1602.5625 MHz - 1611.5 MHz GLONASS L2 1246.4375 MHz - 1254.3 MHz Galileo E1 1575.42 MHz Galileo E5a 1176.45 MHz Galileo E5b 1207.14 MHz Galileo AltBOC 1191.795 MHz BeiDou B1 1561.098 MHz BeiDou B2 1207.14 MHz BeiDou B3 1268.52 MHz Bluetooth 2400 MHz - 2483.5 MHz
Gain	Typically 27 dBi
Noise Figure	Typically < 2 dBi



For corresponding information for optional, internal radios refer to their specifications.



Galileo AltBOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
Instrument	-40 to +60	-40 to +80
Battery internal	-20 to +55	-40 to +70

Protection against water, dust and sand

Type	Protection
Instrument	IP67 (IEC 60529) Dust tight Waterproof to 1 m temporary immersion

Humidity

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

Vibration/Shock

Type	iCON gps 60 SmartAntenna
Vibration	MIL-STD 810F, Figure 514.5C-3
Shock	40 g - 6 msec; compliance ISO 9022-31-06, No loss of lock to satellite signal when used on a pole set-up and submitted to pole bumps up to 150 mm
Drops Withstands	1.2 m drop onto hard surfaces
Topple over Withstands	Topple over from a 2 m pole onto hard surfaces

9.2

Antennas Technical Data

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

Type	Description	Use
CGA60	GPS, GLONASS, Galileo, BeiDou SmartRack+ antenna with built-in ground plane.	Machine Control, RTK Base Station, RTK Rover and Network RTK applications.

Dimensions

Type	CGA60
Height	62 mm
Diameter	170 mm

Connector

TNC female

Mounting

5/8" Whitworth

Weight

0.4 kg

Electrical data

Type	CGA60
Voltage	4.5 V to 18 V DC
Current	35 mA typical
Frequency	
GPS L1	1575.42 MHz
GPS L2	1227.60 MHz
GPS L5	1176.45 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 AltBOC	1191.795 MHz
BeiDou B1	1561.098 MHz
BeiDou B2	1207.14 MHz
BeiDou B3	1268.52 MHz
Gain (typically)	27 dBi
Noise Figure (typically)	< 2 dBi



Galileo AltBOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
CGA60	-40 to +70	-55 to +85

Protection against water, dust and sand

Type	Protection
CGA60	IP67 (IEC 60529) Dust tight Protected against water jets Waterproof to 1 m temporary immersion

Humidity

Type	Protection
CGA60	Up to 100 % The effects of condensation are to be effectively counteracted by periodically drying out the antenna.

Vibration/Shock

Type	CGA60
Vibration	10 - 10000 Hz, ± 1.5 mm, 10 g 8 - 150 Hz, ± 15 mm, 15 g ISO9022-36-08 MIL-STD 810F - 514.5-Cat24
Shock	100 g, 2 ms

Cable length

Separation distance from instrument ...	to antenna	Optional cable lengths [m]
iCON gps 60	CGA60	2.8, 5, 10

9.3

Pin Assignments and Sockets

Expert knowledge required

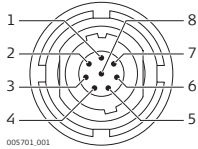
Modification or adaption on base of the pin assignments and socket descriptions need expert knowledge.



WARNING

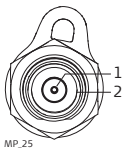
Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Port 1- Lemo



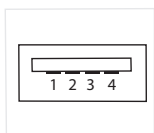
Pin	Name	Function	Direction
1	RTS	RS232, Request To Send	Out
2	CTS	RS232, Clear To Send	In
3	GND	Ground	-
4	RxD	RS232, receive data	In
5	TxD	RS232, transmit data	Out
6	ID	Identification pin	In
7	PWR in	Power in, 9 to 28 V DC	In
8	+12 V out	12 V DC power supply out	Out

ANT



Pin	Description
1	Antenna signal and antenna power
2	Shield/Ground

USB 2.0 host connector



Type: USB-A receptacle

Pin	Name	Description	Direction
1	+5V	+5V Power supply	Out
2	D-	Data signal negative	In/Out
3	D+	Data signal positive	In/Out
4	GND	Power supply return and signals reference	In

Picture: Receptacle viewed from mating side.

9.4

Conformity Declarations

Conformity to National Regulations

For products which do not fall under R&TTE directive:



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

- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

9.4.1

iCON gps 60

Conformity to national regulations

- FCC Part 15, 22, 24 and 27 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product iCON gps 60 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 EEA member state.

- The conformity for countries with other national regulations not covered by the FCC part 15, 22, 24 and 27 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
Bluetooth	2402 - 2480
WCDMA	WCDMA 2100 Tx: 1920 - 1980 Rx: 2110 - 2170
	WCDMA 1900 Tx: 1850 - 1910 Rx: 1930 - 1990
	WCDMA 850 Tx: 824 - 849 Rx: 869 - 894
	WCDMA 800 Tx: 830 - 840 Rx: 875 - 885
	WCDMA 900 Tx: 880 - 915 Rx: 925 - 960

Type	Frequency band [MHz]
GSM	GSM 850 Tx: 824 - 849 Rx: 869 - 894
	EGSM 900 Tx: 880 - 915 Rx: 925 - 960
	GSM 1800 Tx: 1710 - 1785 Rx: 1805 - 1880
	GSM 1900 Tx: 1850 - 1910 Rx: 1930 - 1990
LTE	Band 1 Tx: 1920 - 1980 Rx: 2110 - 2170
	Band 3 Tx: 1710 - 1785 Rx: 1805 - 1880
	Band 7 Tx: 2500 - 2570 Rx: 2620 - 2690
	Band 8 Rx: 880 - 915 Tx: 925 - 960
	Band 20 Rx: 791 - 821 Tx: 832 - 862

Output power

Type	Output power [mW]
Bluetooth	2.5
UMTS	Band 1, 2, 5, 8: 200
GSM / EDGE	GSM 850, EGSM 900: GMSK mode: 1585 8PSK mode: 500
	GSM 1800, GSM 1900: GMSK mode: 795 8PSK mode: 400
LTE	Band 1, 3, 8, 20: 200 Band 7: 160

Antenna

Type	Antenna type	Connector	Frequency band [MHz]
Bluetooth	Integrated antenna	-	2402 - 2480
GSM/EDGE/ UMTS/LTE	Integrated antenna	-	800 - 2600

Specific Absorption Rate (SAR)

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

9.4.2**GFU14, SATEL Sateline 3AS, GFU27, SATEL Sateline M3-TR1****Conformity to national regulations**

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GFU14, GFU27 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at <http://www.leica-geosystems.com/ce>.

- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.



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:

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

GFU14, GFU27: 0.5 W - 1.0 W

Antenna

Type	GAT1	GAT2
Frequency band [MHz]	400 - 435	435 - 470
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 guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GFU15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at <http://www.leica-geosystems.com/ce>.

- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.



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:

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

Receive only

Antenna

Type	GAT1	GAT2
Frequency band [MHz]	400 - 435	435 - 470
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 guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product TFR-300L is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at <http://www.leica-geosystems.com/ce>.

- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.



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:

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

348.56 MHz - 348.80 MHz

Output power

Receive only

Antenna

The appropriate antenna must be ordered directly from your local Tescom Office or Representative.

Specific Absorption Rate (SAR)

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

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product CCD7 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at <http://www.leica-geosystems.com/ce>.

- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.



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:

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

0.5 W - 1.0 W

Antenna

Type	GAT1	GAT2	CA12	CA13
Frequency band [MHz]	400 - 435	435 - 470	406 - 440	430 - 480
Type	Detachable $\lambda/2$ antenna	Detachable $\lambda/2$ antenna	External stub antenna	External stub antenna
Connector	TNC	TNC	TNC (CA22, Magnetic antenna mount)	TNC (CA22, Magnetic antenna mount)

Specific Absorption Rate (SAR)

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

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product CCD14 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at <http://www.leica-geosystems.com/ce>.

- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.



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:

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
 - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
 - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

902 MHz - 928 MHz

Output power

CCD8: 5 mW - 1.0 W

Antenna

Type	CA6
Frequency band [MHz]	902 - 928
Type	Detachable $\lambda/2$ antenna
Connector	TNC

Specific Absorption Rate (SAR)

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

Software Licence Agreement

This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online according to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

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Open source information

The software on the product may contain copyright-protected software that is licensed under various open source licences.

Copies of the corresponding licences

- are provided together with the product (for example in the About panel of the software)
- can be downloaded on <http://opensource.leica-geosystems.com/icon>

If foreseen in the corresponding open source licence, you may obtain the corresponding source code and other related data on <http://opensource.leica-geosystems.com/icon>.

Contact opensource@leica-geosystems.com in case you need additional information.

Appendix A NMEA Message Formats

A.1 Overview

Description National Marine Electronics Association is a standard for interfacing marine electronic devices. This chapter describes all NMEA-0183 messages which can be output by the instrument.

Access Select **Settings > Tools > NMEA Output**.



A Talker ID appears at the beginning of the header of each NMEA message. The Talker ID can be user defined or standard (based on the NMEA 4.0). The standard is normally GP for GPS but can be changed in **Settings > Tools > NMEA Output**.

A.2 Symbols Used for Describing the NMEA Formats

Description NMEA messages consist of various fields. The fields are:

- Header
- Special format fields
- Numeric value fields
- Information fields
- Null fields

Certain symbols are used as identifier for the field types. These symbols are described in this section.

Header

Symbol	Field	Description	Example
\$	-	Start of sentence	\$
--ccc	Address	<ul style="list-style-type: none">• -- = alphanumeric characters identifying the talkerOptions:<ul style="list-style-type: none">GN = Global Navigation Satellite SystemGP = GPS onlyGL = GLONASSGA = GalileoBD = BeiDou• ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message.	<ul style="list-style-type: none">GNGGAGPGGAGLGGAGAGGABDGGA

Special format fields

Symbol	Field	Description	Example
A	Status	<ul style="list-style-type: none"> A = Yes, Data Valid, Warning Flag Clear V = No, Data Invalid, Warning Flag Set 	V
llll.ll	Latitude	<ul style="list-style-type: none"> Degreesminutes.decimal Two fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes. Leading zeros are always included for degrees and minutes to maintain fixed length. 	4724.538950
yyyy.yy	Longitude	<ul style="list-style-type: none"> Degreesminutes.decimal Three fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes. Leading zeros are always included for degrees and minutes to maintain fixed length. 	00937.046785
eeeeee.eee	Grid Easting	At the most six fixed digits for metres and three fixed digits for decimal fractions of metres.	195233.507
nnnnnn.nnn	Grid Northing	At the most six fixed digits for metres and three fixed digits for decimal fractions of metres.	127223.793
hhmmss.ss	Time	<ul style="list-style-type: none"> hoursminutesseconds.decimal Two fixed digits of hours, two fixed digits of minutes, two fixed digits of seconds and a variable number of digits for decimal fraction of seconds. Leading zeros are always included for hours, minutes and seconds to maintain fixed length. 	115744.00
mmddy	Date	<ul style="list-style-type: none"> Monthdayyear - two fixed digits of month, two fixed digits of day, two fixed digits of year. Leading zeros always included for month, day and year to maintain fixed length. 	093003
No specific symbol	Defined field	<ul style="list-style-type: none"> Some fields are specified to contain predefined constants, most often alpha characters. Such a field is indicated by the presence of one or more valid characters. Excluded from the list of valid characters are the following that are used to indicate other field types: A, a, c, x, hh, hhmmss.ss, llll.ll, yyyy.yy. 	M

Numeric value fields

Symbol	Field	Description	Example
x.x	Variable numbers	<ul style="list-style-type: none">Integer or floating numeric fieldOptional leading and trailing zeros. Decimal point and associated decimal-fraction are optional if full resolution is not required.	73.10 = 73.1 = 073.1 = 73
hh_	Fixed HEX field	Fixed length HEX numbers	3F

Information fields

Symbol	Field	Description	Example
c--c	Variable text	Variable length valid character field	A
aa_	Fixed alpha field	Fixed length field of upper case or lower case alpha characters	N
xx_	Fixed number field	Fixed length field of numeric characters	1

Null fields

Symbol	Field	Description	Example
No symbol	Information unavailable for output	Null fields do not contain any information.	,,



Fields are always separated by a comma. Before the Checksum field there is never a comma.



When information for a field is not available, the position in the data string is empty.

A.3

GGA - Global Positioning System Fix Data

Syntax

`$--GGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxx*hh<CR><LF>`

Description of fields

Field	Description
<code>\$--GGA</code>	Header including Talker ID
<code>hhmmss.ss</code>	UTC time of position
<code>llll.ll</code>	Latitude (WGS 1984)
<code>a</code>	Hemisphere, N orth or S outh
<code>yyyy.yy</code>	Longitude (WGS 1984)
<code>a</code>	E ast or W est
<code>x</code>	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Valid fix for GNSS P recise P ositioning S ervice mode, for example WAAS 4 = Real-time position, ambiguities fixed
<code>xx</code>	Number of satellites in use. For <code>\$GNGGA</code> messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.

Field	Description
x.x	HDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
M	Units of altitude as fixed text M
x.x	Geoidal separation in metres. The Geoidal separation is the difference between the WGS 1984 earth ellipsoid surface and mean sea level.
M	Units of geoidal separation as fixed text M
x.x	Age of differential GNSS data, empty when DGPS not used
xxxx	Differential base station ID, 0000 to 1023
*hh	Checksum
< CR >	Carriage Return
< LF >	Line Feed

Examples

User-defined Talker ID = GN

```
$GNGGA,113805.50,4724.5248541,N,00937.1063044,E,4,13,0.7,1171.281,M,-
703.398,
M,0.26,0000*42
```

A.4

GGK - Real-Time Position with DOP

Syntax

```
$--GGK,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.yy,a,x,xx,x.x,EHTx.x,M*hh< CR >< LF >
```

Description of fields

Field	Description
\$--GGK	Header including Talker ID
hhmmss.ss	UTC time of position
mmddyy	UTC date
llll.ll	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For \$GNGGK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	GDOP
EHT	Ellipsoidal height
x.x	Altitude of position marker as local ellipsoidal height. If the local ellipsoidal height is not available, the WGS 1984 ellipsoidal height will be exported.

Field	Description
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

\$GNGGK,113616.00,041006,4724.5248557,N,00937.1063064,E,3,12,1.7,EHT1171.742,M*6D

User-defined Talker ID = GN

\$GNGGK,113806.00,041006,4724.5248557,N,00937.1063064,E,3,13,1.4,EHT1171.746,M*66

A.5

GGQ - Real-Time Position with CQ

Syntax

\$--GGQ,hhmmss.ss,mmddy,lll.l,a,yyyy.yy,a,x,xx,x.x,x.x,M*hh<CR><LF>

Description of fields

Field	Description
\$--GGQ	Header including talker ID
hhmmss.ss	UTC time of position
mmddy	UTC date
lll.l	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyy.yy	Longitude (WGS 1984)
a	E ast or W est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For \$GNGGQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	Coordinate quality in metres
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

```
$GNGGQ,113615.50,041006,4724.5248556,N,00937.1063059,E,3,12,0.009,1171.281,M*22
```

```
$GPGGQ,113615.50,041006,,,,08,,*67
```

```
$GLGGQ,113615.50,041006,,,,04,,*77
```

User-defined Talker ID = GN

```
$GNGGQ,113805.50,041006,4724.5248541,N,00937.1063044,E,3,13,0.010,1171.281,M*2E
```

A.6

GLL - Geographic Position Latitude/Longitude

Syntax

```
$--GLL,IIII.II,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>
```

Description of fields

Field	Description
\$--GLL	Header including talker ID
IIII.II	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
hhmmss.ss	UTC time of position
A	Status A = Data valid V = Data not valid
a	Mode indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed



The Mode indicator field supplements the Status field. The Status field is set to A for the Mode indicators A and D. The Status field is set to V for the Mode indicator N.

Examples

Standard Talker ID

```
$GNGLL,4724.5248556,N,00937.1063059,E,113615.50,A,D*7B
```

User-defined Talker ID = GN

```
$GNGLL,4724.5248541,N,00937.1063044,E,113805.50,A,D*7E
```

Syntax

```
$--GNS,hhmmss.ss,lll.l, a,yyyyy.yy,a,c--c,xx,x.x,x.x,x.x,x.x,xxxx,h*hh<CR><LF>
```

Description of fields

Field	Description
\$--GNS	Header including talker ID
hhmmss.ss	UTC time of position
lll.l	Latitude (WGS 1984)
a	Hemisphere, N orth or S outh
yyyyy.yy	Longitude (WGS 1984)
a	E ast or W est
c--c	Mode indicator N = Satellite system not used in position fix or fix not valid A = Autonomous; navigation fix, no real-time fix D = Differential; real-time position, ambiguities not fixed R = Real-time kinematic; ambiguities fixed
xx	Number of satellites in use, 00 to 99
x.x	HDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
x.x	Geoidal separation in metres
x.x	Age of differential data
xxxx	Differential base station ID, 0000 to 1023
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed

Examples

Standard Talker ID

```
$GNGNS,113616.00,4724.5248557,N,00937.1063064,E,RR,12,0.9,1171.279,-703.398,0.76,0000*6C
```

```
$GPGNS,113616.00,,,,,08,,,,*69
```

```
$GLGNS,113616.00,,,,,04,,,,*79
```

User-defined Talker ID = GN

```
$GNGNS,113806.00,4724.5248547,N,00937.1063032,E,R,13,0.7,1171.283,-703.398,0.76,0000*39
```

Syntax

```
$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,h*hh<CR><LF>
```

Description of fields

Field	Description
\$--GSA	Header including talker ID
a	Mode M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to change automatically between 2D and 3D
x	Mode 1 = Fix not available 2 = 2D 3 = 3D
xx	Numbers of the satellites used in the solution. This field is repeated 12 times. 1 to 32 = PRN numbers of GPS satellites 33 to 64 = Numbers of WAAS and WAAS like satellites 65 to 96 = Slot numbers of GLONASS satellites
x.x	PDOP
x.x	HDOP
x.x	VDOP
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples**Standard Talker ID**

```
$GNGSA,A,3,01,11,14,17,19,20,24,28,,,,,1.5,0.9,1.2*26
```

```
$GNGSA,A,3,65,66,67,81,,,,,,,,,1.5,0.9,1.2*29
```

User-defined Talker ID = GN

```
$GNGSA,A,3,01,11,14,17,19,20,23,24,28,,,65,66,67,81,,,,,,,,,1.2,0.7,1.0*27
```

Syntax

```
$--GSV,x,x,xx,xx,xx,xxx,xx,.....,h*hh<CR><LF>
```

Description of fields

Field	Description
\$--GSV	Header including talker ID
x	Total number of messages, 1 to 4
x	Message number, 1 to 4
xx	Number of theoretically visible satellites according to the current almanac.
xx	PRN (GPS) / Slot (GLONASS) number of satellite
xx	Elevation in degrees, 90 maximum, empty when not tracking
xxx	Azimuth in degrees true north, 000 to 359, empty when not tracking
xx	Signal to Noise Ration C/No in dB, 00 to 99 of L1 signal, null field when not tracking.
...	Repeat set PRN / Slot number, elevation, azimuth and SNR up to four times
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed



Satellite information can require the transmission of multiple messages, specified by the total number of messages and the message number.



The fields for the PRN / Slot number, Elevation, Azimuth and SNR form one set. A variable number of these sets are allowed up to a maximum of four sets per message.

Examples

Standard Talker ID

```
$GPGSV,3,1,11,01,55,102,51,11,85,270,50,14,31,049,47,17,21,316,46*7A
```

```
$GPGSV,3,2,11,19,31,172,48,20,51,249,50,22,00,061,,23,11,190,42*7E
```

```
$GPGSV,3,3,11,24,11,292,43,25,08,114,,28,14,275,44,,,,*45
```

```
$GLGSV,2,1,06,65,16,055,42,66,64,025,48,67,46,262,42,68,01,245,*64
```

```
$GLGSV,2,2,06,81,52,197,47,83,07,335,,,,,,,,*68
```

User-defined Talker ID = GN

```
$GNGSV,3,1,10,01,55,100,51,11,86,263,50,14,31,049,47,17,22,316,46*65
```

```
$GNGSV,3,2,10,19,30,172,48,20,52,249,51,23,12,190,42,24,12,292,42*6C
```

```
$GNGSV,3,3,10,25,09,114,,28,14,274,44,,,,,,,,*62
```


A.10

HDT - Heading, True

Syntax

\$--HDT,x.x,T*hh<CR><LF>

Description of fields

Field	Description
\$--HDT	Header including talker ID
x.x	Heading, degrees True
T	Fixed text T for true north
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

\$GNHDT,11.4,T,00*4B

A.11

LLK - Leica Local Position and GDOP

Syntax

\$--LLK,hhmmss.ss,mmddy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh<CR><LF>

Description of fields

Field	Description
\$--LLK	Header including talker ID
hhmmss.ss	UTC time of position
mmddy	UTC date
eeeeee.eee	Grid Easting in metres
M	Units of grid Easting as fixed text M
nnnnnn.nnn	Grid Northing in metres
M	Units of grid Northing as fixed text M
x	Position quality 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For \$GNLLK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	GDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

```
$GNLLK,113616.00,041006,764413.024,M,252946.774,M,3,12,1.7,1171.279,M*0F  
$GPLLK,113616.00,041006,,,,,08,,, *57  
$GLLLK,113616.00,041006,,,,,04,,, *47
```

User-defined Talker ID = GN

```
$GNLLK,113806.00,041006,764413.021,M,252946.772,M,3,13,1.4,1171.283,M*04
```

A.12

LLQ - Leica Local Position and Quality

Syntax

```
$--LLQ,hhmmss.ss,mmddy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh<CR><LF>
```

Description of fields

Field	Description
\$--LLQ	Header including talker ID
hhmmss.ss	UTC time of position
mmddy	UTC date
eeeeee.eee	Grid Easting in metres
M	Units of grid Easting as fixed text M
nnnnnn.nnn	Grid Northing in metres
M	Units of grid Northing as fixed text M
x	Position quality 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For \$GNLLQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	Coordinate quality in metres
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	C arriage R eturn
<LF>	L ine F eed

Examples

Standard Talker ID

```
$GNLLQ,113616.00,041006,764413.024,M,252946.774,M,3,12,0.010,1171.279,M*  
12  
$GPLLQ,113616.00,041006,,,,,08,,, *4D  
$GLLLQ,113616.00,041006,,,,,04,,, *5D
```

User-defined Talker ID = GN

```
$GNLLQ,113806.00,041006,764413.021,M,252946.772,M,3,13,0.010,1171.283,M*  
1A
```

Syntax

```
$--RMC,hhmmss.ss,A,IIII.II,a,yyyy.yy,a,x.x,x.x,xxxxx,x.x,a,a*hh<CR><LF>
```

Description of fields

Field	Description
\$--RMC	Header including talker ID
hhmmss.ss	UTC time of position fix
A	Status A = Data valid V = Navigation instrument warning
IIII.II	Latitude (WGS 1984)
a	Hemisphere, North or South
yyyy.yy	Longitude (WGS 1984)
a	East or West
x.x	Speed over ground in knots
x.x	Course over ground in degrees
xxxxx	Date: ddmmyy
x.x	Magnetic variation in degrees
a	East or West
a*hh	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
<CR>	Carriage Return
<LF>	Line Feed

Examples**Standard Talker ID**

```
$GNRMC,113616.00,A,4724.5248557,N,00937.1063064,E,0.01,11.43,100406,11.43,E,D*1C
```

User-defined Talker ID = GN

```
$GNRMC,113806.00,A,4724.5248547,N,00937.1063032,E,0.00,287.73,100406,287.73,E,D*10
```

A.14

VTG - Course Over Ground and Ground Speed

Syntax

\$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

Description of fields

Field	Description
\$--VTG	Header including talker ID
x.x	Course over ground in degrees true north, 0.0 to 359.9
T	Fixed text T for true north
x.x	Course over ground in degrees magnetic North, 0.0 to 359.9
M	Fixed text M for magnetic North
x.x	Speed over ground in knots
N	Fixed text N for knots
x.x	Speed over ground in km/h
K	Fixed text K for km/h
a	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

\$GNVTG,11.4285,T,11.4285,M,0.007,N,0.013,K,D*3D

User-defined Talker ID = GN

\$GNVTG,287.7273,T,287.7273,M,0.002,N,0.004,K,D*3E

A.15

ZDA - Time and Date

Syntax

\$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>

Description of fields

Field	Description
\$--ZDA	Header including talker ID
hhmmss.ss	UTC time
xx	UTC day, 01 to 31
xx	UTC month, 01 to 12
xxxx	UTC year
xx	Local zone description in hours, 00 to ±13
xx	Local zone description in minutes, 00 to +59
*hh	Checksum
<CR>	Carriage Return
<LF>	Line Feed



This message is given high priority and is output as soon as it is created. Latency is therefore reduced to a minimum.

Examples

Standard Talker ID


\$GPZDA,091039.00,01,10,2003,-02,00*4B

User-defined Talker ID = GN

\$GNZDA,113806.00,10,04,2006,02,00*76

Appendix B ORP – Orientation and Position

Description This proprietary Leica message provides the current Position and Quality in either Geodetic or Grid coordinates for one or two antennas plus the resulting orientation.

 Information regarding the second antenna is not applicable for the iCON gps 60 SmartAntenna.

Access Select **Settings** > **Tools** > **NMEA Output**. Toggle to **Edit** for **NMEA Out 1** or **NMEA Out 2**. ORP is available on the second page of the wizard

Description of fields

Message type	Format	Description
RESPONSE:	\$PLEIR,	Header, message sent from instrument
Position and Quality	ORP,	Message Identifier
	xxxx,	ControlType ¹
	x,	Coordinate System ²
	The following block is available if Control Type = 1 or = 2 (Single or Dual GNSS)	
	x,	Position Status Flag - 1st Antenna ³
	If Position Status Flag - 1st Antenna != "0" (not computed yet) and != 4 (not used)	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency ⁴ [milliseconds]
	xx.xx,	Quality Latitude/Northing [metres]
xx.xx,	Quality Longitude/Easting [metres]	
xx.xx,	Quality Height [metres]	
xx.xx,	GDOP – Value for first Antenna	
x,	Number of Satellites used in Computation (GPS)	
x,	Number of Satellites used in Computation (GG)	
If Coordinate System = 0 (Geodetic) the following block is present:		
llll.ll,	Latitude (+: North -: South)	
yyyy.yy,	Longitude (+: East -: West)	
xxxx.xxxx,	Altitude of position marker ⁵ [metres]	
If Coordinate System = 1 (Grid) the following block is present:		
xxxx.xxxx,	Grid Northing [metres]	
xxxx.xxxx,	Grid Easting [metres]	
xxxx.xxxx,	Altitude of position marker [metres]	
x,	Height type ⁶	

Message type	Format	Description
	The following block is only available if Control Type = 2 (Dual GNSS)	
	X,	Position Status Flag - 2nd antenna ³
	If Position Status Flag - 2nd Antenna != "0" (not computed yet) and != 4 (not used)	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency ⁴ [milliseconds]
	xx.xx,	Quality Latitude/Northing [metres]
	xx.xx,	Quality Longitude/Easting [metres]
	xx.xx,	Quality Height [metres]
	If Coordinate System = 0 (Geodetic) the following block is present:	
	llll.ll,	Latitude (+: North -: South)
	yyyy.yy,	Longitude (+: East -: West)
	xxxx.xxxx,	Altitude of position marker ⁵ [metres]
	If Coordinate System = 1 (Grid) the following block is present:	
	xxxx.xxxx,	Grid Northing [metres]
	xxxx.xxxx,	Grid Easting [metres]
	xxxx.xxxx,	Altitude of position marker [metres]
	x,	Height type ⁶
	The following block is only available if Control Type = 3	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency ⁴ [milliseconds]
	xxxx.xxxx,	Orientation Angle ⁷ [degrees], 0.0° to 359.9°
	xx.xx,	Quality of calculated Orientation [degrees]
	*hh	Checksum
	<CR>	Carriage Return
	<LF>	Line Feed

1 Control Type

- 1: Antenna1 Position Information
- 2: Antenna1 and Antenna2 Information
- 3: Antenna1 and Antenna2 Information + Orientation

2 Coordinate System

- 0: WGS Geodetic
- 1: Local Grid

3 Position Status

- 0: Computed Position not yet available
- 1: Differential code Position
- 2: Differential phase Position
- 3: Non-differential Position
- 4: xRTK

- 4 Latency given is defined as the difference in time between the UTC of the measurements used in the computation and the UTC of the first Message byte sent out the instrument port.
- 5 Ellipsoidal height is forced for Geodetic coordinates.
Orthometric height is forced for Grid coordinates.
- 6 **Height**
0: Ellipsoidal height
1: Orthometric height
- 7 Orientation is available for Local Grid and WGS84.

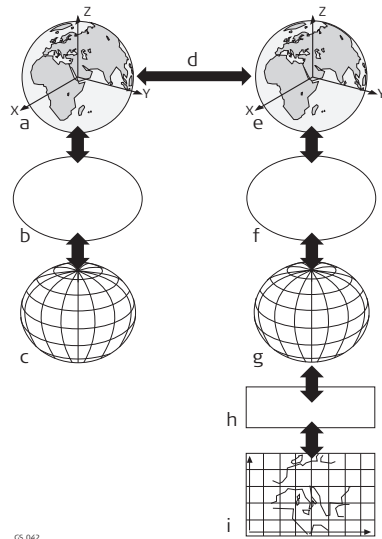
Example

\$PLEIR,ORP,3,1,2,084709.25,310713,50,0.006,0.005,0.016,1.847,5,7,5250781.241
,546672.161,371.528,1,254,084709.25,310713,100,0.005,0.004,0.012,5250781.2
77,546671.390,371.497,1,084709.25,310713,100,272.683,0.592*23

Coordinate system - elements

The five elements which define a coordinate system are:

- a transformation
- a projection
- an ellipsoid
- a geoid model
- a **Country Specific Coordinate System** model



- a) WGS 1984 cartesian: X, Y, Z
- b) WGS 1984 ellipsoid
- c) WGS 1984 geodetic: Latitude, longitude, ellipsoidal height
- d) 7 parameter transformation: dX, dY, dZ, rx, ry, rz, scale
- e) Local cartesian: X, Y, Z
- f) Local ellipsoid
- g) Local geodetic: Latitude, longitude, ellipsoidal height
- h) Local projection
- i) Local grid: Easting, Northing, orthometric height

All these elements can be specified when creating a coordinate system.

CSCS model (*.csg)

Description


Country Specific Coordinate System models

- are tables of correction values to convert coordinates directly from WGS 1984 to local grid without the need of transformation parameters.
- take the distortions of the mapping system into account.
- are an addition to an already defined coordinate system.

Types of CSCS models

The correction values of a CSCS model can be applied at different stages in the coordinate conversion process. Depending on this stage, a CSCS model works differently. Three types of CSCS models are supported. Their conversion process is as explained in the following table. Any suitable geoid model can be combined with a geodetic CSCS model.

Type	Description
Grid	<ol style="list-style-type: none"> 1 Determination of preliminary grid coordinates by applying the specified transformation, ellipsoid and map projection. 2 Determination of the final local grid coordinates by applying a shift in Easting and Northing interpolated in the grid file of the CSCS model.
Cartesian	<ol style="list-style-type: none"> 1 Performing the specified transformation. 2 Determination of local cartesian coordinates by applying a 3D shift interpolated in the grid file of the CSCS model.

Type	Description
	3 Determination of the final local grid coordinates by applying the specified local ellipsoid and map projection.
Geodetic	1 Determination of local geodetic coordinates by applying a correction in latitude and longitude interpolated from the file of the CSCS model. 2 Determination of the final local grid coordinates by applying the local map projection.  Using a geodetic CSCS system excludes the use of a transformation in a coordinate system.

C.2

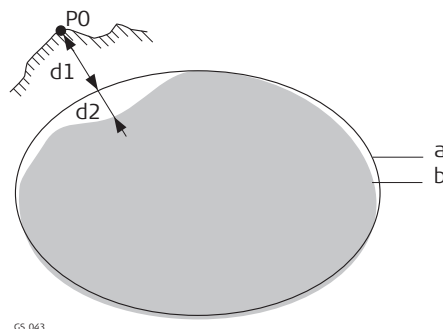
G

Geoid model

Description

GPS operates on the WGS 1984 ellipsoid and all heights obtained by measuring baselines are ellipsoidal heights. Existing heights are usually orthometric heights, also called height above the geoid, height above mean sea level or levelled height. The mean sea level corresponds to a surface known as the geoid. The relation between ellipsoidal height and orthometric height is

Orthometric Height = Ellipsoidal Height - Geoid Separation N



- a WGS 1984 ellipsoid
- b Geoid

- P0 Measured point
- d1 Ellipsoidal height
- d2 Geoid separation N, is negative when the geoid is below the ellipsoid

N value and geoid model

The geoid separation (N value) is the distance between the geoid and the reference ellipsoid. It can refer to the WGS 1984 or to the local ellipsoid. It is not a constant except over maybe small flat areas such as 5 km x 5 km. Therefore it is necessary to model the N value to obtain accurate orthometric heights. The modelled N values form a geoid model for an area. With a geoid model attached to a coordinate system, N values for the measured points can be determined. Ellipsoidal heights can be converted to orthometric heights and back.

Geoid models are an approximation of the N value. In terms of accuracy, they can vary considerably and global models in particular should be used with caution. If the accuracy of the geoid model is not known, it can be safer to use local control points with orthometric heights and apply a transformation to approximate the local geoid.

Geoid field file

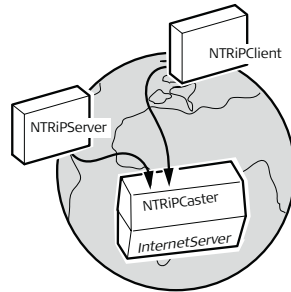
The geoid separations in a geoid field file can be used in the field to change between ellipsoidal and orthometric heights.

Creation: Export onto a USB Memory device or the internal memory of the instrument.
 Extension: *.grd

Ntrip**Networked Transport of RTCM via Internet Protocol**

- is a protocol streaming real-time corrections over the Internet.
- is a generic protocol based on the Hypertext Transfer Protocol HTTP/1.1.
- is used to send differential correction data or other kinds of streaming data to stationary or mobile users over the Internet. This process allows simultaneous computer, laptop, PDA, or instrument connections to a broadcasting host.
- supports wireless Internet access through mobile IP networks like digital cellular phones or modems.

The Ntrip Server could be the GPS instrument itself. This setup means the GPS instrument is both the Ntrip Source generating the real-time data and also the NTRIP Server transferring this data to the Ntrip Caster.



GS_044

Ntrip and its role in the Internet

Ntrip Caster**The Ntrip Caster**

- is an Internet server handling various data streams to and from the Ntrip Servers and Ntrip Clients.
- checks the requests from Ntrip Clients and Ntrip Servers to see if they are registered to receive or provide real-time corrections.
- decides whether there is streaming data to be sent or to be received.

Ntrip Client

The Ntrip Client receives data streams. This setup could be, for example a real-time rover receiving real-time corrections.

In order to receive real-time corrections, the Ntrip Client must first send

- a user ID
- a password
- an identification name, the so-called Mountpoint, from which real-time corrections are to be received

to the Ntrip Caster.

Ntrip Server

The Ntrip Server transfers data streams.

In order to send real-time corrections, the Ntrip Server must first send

- a password
- an identification name, the so-called Mountpoint, where the real-time corrections come from

to the Ntrip Caster.

Before sending real-time corrections to the Ntrip Caster for the first time, a registration form must be completed. This form is available from the Ntrip Caster administration centre. Refer to the website of the Ntrip Caster administration centre.

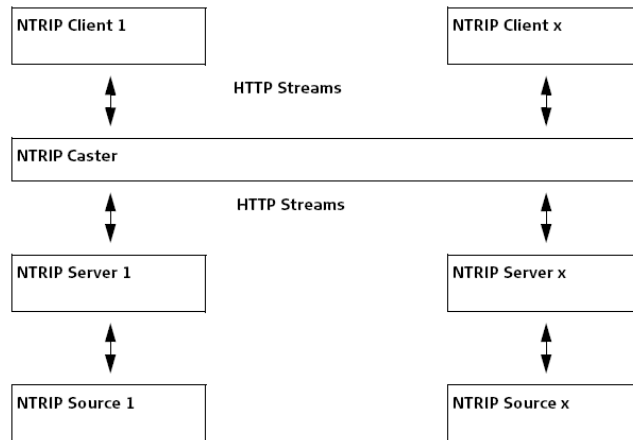
Ntrip Source

The Ntrip Source generates data streams. This setup could be base sending out real-time corrections.

Ntrip system components

Ntrip consists of three system components:

- Ntrip Clients
- Ntrip Servers
- Ntrip Caster



C.4

W

WGS 1984

WGS 1984 is the global geocentric datum to which all GNSS positioning information is referred to.

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