Leica iCON gps 100

User Manual
Version 1.0
English

- when it has to be **right**

Leica Geosystems

PART OF HEXAGON

Introduction

Purchase

Congratulations on the purchase of a Leica iCON gps 100 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.

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

Product identification

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

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

Trademarks

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

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to the Leica iCON gps 100 instrument and the Leica CGA100 antenna.

Available documentation

Name	Description/Format		
Leica iCON gps 100 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 100 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 100 documentation/software:

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

myWorld

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.

The availability of services depends on the instrument model.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
mySupport	Create new support requests for your products that will be answered by your local Leica Geosystems Support Team. View the complete history of your support requests and view detailed information on each request in case you want to refer to previous support requests.
myLearning	Welcome to the home of Leica Geosystems online learning! There are numerous online courses – available to all customers with products that have valid CCPs (Customer Care Packages).
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.
mySmartNet	Add and view your HxGN SmartNet subscriptions and user information. HxGN SmartNet delivers high-precision and high-availability GNSS network correction services in real time. The HxGN SmartNet Global family offers Network RTK with RTK bridging and Precise Point Positioning (PPP) services. These services work exclusively with Leica Geosystems GS sensors, providing the highest accuracy. Combined, they ensure HxGN SmartNet coverage everywhere.
myDownloads	Downloads of software, manuals, tools, training material and news for Leica Geosystems products.

Table of Contents

1 Safety Directions

1.1 General Introduction

Description

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

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

About warning messages

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

Warning messages...

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

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

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

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

1.2 Definition of Use

Intended use

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

⚠WARNING

Altered function and safety of the machine

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

Precautions:

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

1.3 Limits of Use

Environment

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

⚠WARNING

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

Life Risk.

Precautions:

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

1.4 Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

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

⚠WARNING

Unqualified installation on building or construction machinery

This may result in personal and material damage.

Precautions:

- ▸ Only an appropriately trained and qualified specialist may install this product on building or construction machinery.

1.5 Hazards of Use

⚠CAUTION

Unsuitable installation location

Installing near mechanically moving machine components may damage the product.

Precautions:

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

NOTICE

Dropping, misusing, modifying, storing the product for long periods or transporting the product

Watch out for erroneous measurement results.

Precautions:

- ▸ Periodically carry out test measurements and perform the field adjustments indicated in the User Manual, particularly after the product has been subjected to abnormal use as well as before and after important measurements.

⚠DANGER

Risk of electrocution

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

Precautions:

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

⚠WARNING

Distraction/loss of attention

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

Precautions:

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

⚠WARNING

Inadequate securing of the working site

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

Precautions:

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

⚠CAUTION

Not properly secured accessories

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

Precautions:

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

⚠WARNING

Lightning strike

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

Precautions:

- Do not use the product in a thunderstorm.

⚠DANGER

Risk of being struck by lightning

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:

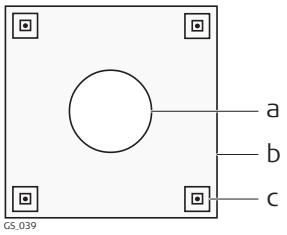
- Do not use the product in a thunderstorm as you can increase the risk of being struck by lightning.
- Be sure to remain at a safe distance from electrical installations. Do not use the product directly under or close to power lines. If it is essential to work in such an environment contact the safety 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:

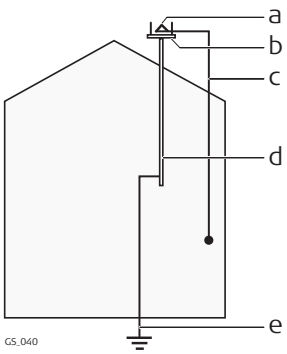
1. On non-metallic structures
   Protection by air terminals is recommended. An air terminal is a pointed solid or tubular rod of conducting material with proper mounting and connection to a conductor. The position of four air terminals can be uniformly distributed around the antenna at a distance equal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

⚠WARNING

Incorrect fastening of the external antenna

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.

⚠CAUTION

Inadequate steering if machine is defective

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

Precautions:

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

⚠WARNING

Missing attention of operators or malfunctions

While steering or navigating the machine accidents may occur due to:

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

Precautions:

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

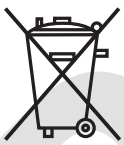
⚠WARNING

Improper disposal

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

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

Precautions:

- ▸ 

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

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

⚠WARNING

Improperly repaired equipment

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

Precautions:

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

1.6 Electromagnetic Compatibility (EMC)

Description

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

⚠CAUTION

Electromagnetic radiation

Electromagnetic radiation can cause disturbances in other equipment.

Precautions:

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

⚠CAUTION

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

This may cause disturbances in other equipment.

Precautions:

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

⚠CAUTION

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

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

Precautions:

- Check the plausibility of results obtained under these conditions.

⚠CAUTION

Electromagnetic radiation due to improper connection of cables

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

Precautions:

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

⚠WARNING

Use of product with radio or digital cellular phone devices

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

Precautions:

- Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment can be disturbed or that humans or animals can be affected.
- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the product with radio or digital cellular phone devices near medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircrafts.
- Do not operate the product with radio or digital cellular phone devices for long periods with the product immediately next to your body.

2 Description of the System

2.1 System Components

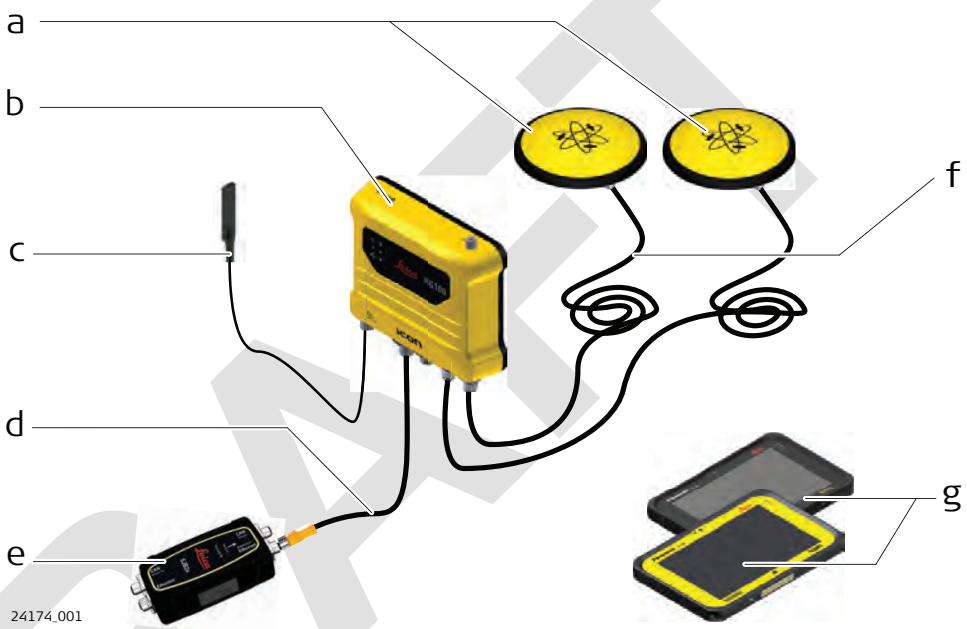
2.1.1 General Information

Description

The Leica iCON gps 100 instrument and the Leica CGA100 GNSS antenna together with dedicated accessories like the Magnetic Mount Kit or a machine computer, offer you highest productivity and flexibility. For example, besides a Dual GNSS configuration the system can also be complemented with a communication unit (CR50) for more flexibility.

Two example configurations are shown in the following paragraphs.

Main components, Dual GNSS configuration with RTK from CC70/CC80 modem

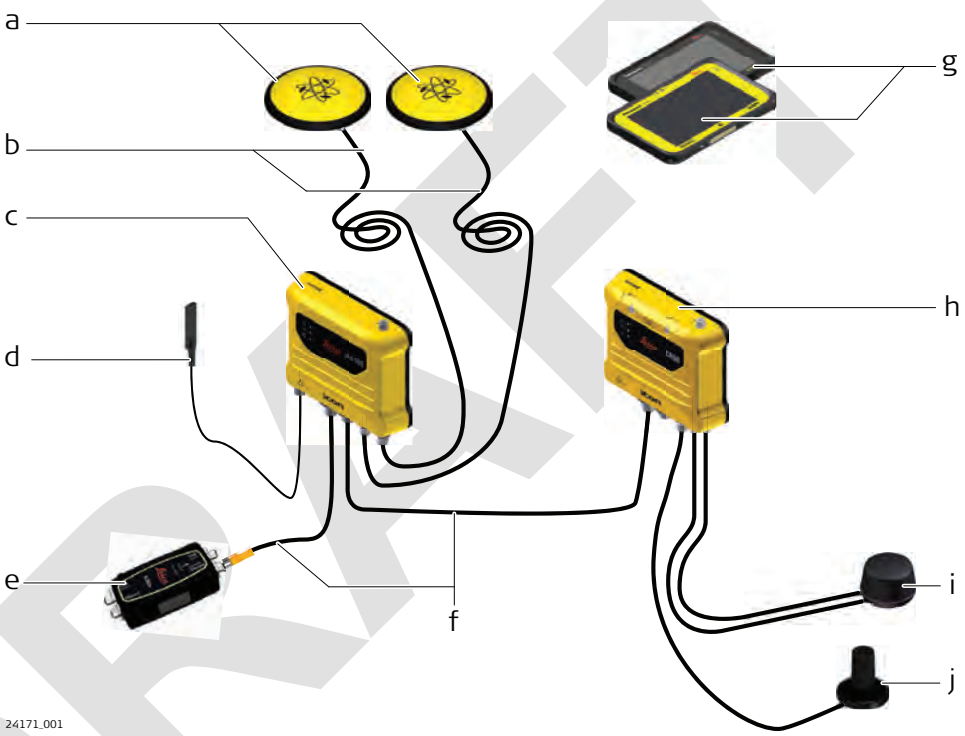


a CGA100 Robust multi-frequency GNSS antenna, 2 x
b iCG100 Instrument
c CA49/CA53 Bluetooth antenna
d Automotive Ethernet cable
e Junction box
f CA16 Antenna cable, 10 m, 2 x
g Machine PC CC70/CC80

Component	Description
iCG100 Instrument	To calculate two positions from the computed ranges to all visible GNSS (**G**lobal **N**avigation **S**atellite **S**ystem) satellites.
CGA100 GNSS Antenna	To receive the signals from the GNSS satellites. This Antenna is specified to the high environmental requirements on mining and construction machines.

Component	Description
Machine PC	To determine the position of the machine using measurement information from the instrument and GNSS antenna and for an automatic adjustment of the machines hydraulic system.
Junction box	The components are connected through the machine junction box.
Bluetooth Antenna	To allow communication with the Machine PC. Antenna is specified to meet the high environmental requirements on mining and construction machines.

Main components, Dual GNSS configuration with RTK from CR50



a CGA100 Robust multi-frequency GNSS antenna, 2 x
b CA16 Antenna cable, 10 m, 2 x
c iCG100 Instrument
d CA49/CA53 Bluetooth antenna
e Junction box
f Automotive Ethernet cable
g Machine PC CC70/CC80
h CR50 Instrument
i CA48 4G diversity modem antenna
j CA12/CA13/CA43 radio antenna and CA22 magnetic mount

Component	Description
iCG100 Instrument	To calculate a position from the computed ranges to all visible GNSS (**G**lobal **N**avigation **S**atellite **S**ystem) satellites.

Component	Description
CGA100 GNSS Antenna	To receive the signals from the GNSS satellites. This Antenna is specified to the high environmental requirements on mining and construction machines.
CR50 Instrument	For RTK data link.
Machine PC	To determine the position of the machine using measurement information from the instrument and GNSS antenna and for an automatic adjustment of the machines hydraulic system.
Junction box	The components are connected through the machine junction box.
Bluetooth Antenna	To allow communication with the Machine PC. Antenna is specified to meet the high environmental requirements on mining and construction machines.

Satellite channels

Depending on the satellite systems and signals configured, a maximum number of 555 channels is allocated.

Instrument	Description
iCG100	GPS, GLONASS, BeiDou and Galileo GNSS receiver, dual-frequency, code and phase, real-time capable

Special features iCON gps 100

iCON gps 100 instruments are equipped with several special features:

- Wide supply voltage range of 9 V to 36 V
- Voltage peak protection and reverse polarity protection
- Can be mounted on a machine vertically and horizontally
- Can be used near the sea
- Magnetic Mount Kit for simple mountings
- Protection caps on connectors
- LEDs for status information
- Versatile connectivity including Automotive Ethernet and Bluetooth
- USB host port for data transfer and firmware upgrade
- Dual GNSS
- Robust, compact aluminium housing

Special features CGA100

CGA100 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, multi-frequency antenna element
- Robust, compact plastic housing

Commands for Remote Config

The iCON gps 100 instrument can be communicated:

- via the Leica Machine Control Net Protocol on the Automotive Ethernet ports and Bluetooth.

Documentation for the communication protocol is available on request from the Leica Geosystems representative.

2.1.2 Power Concept

General

Use the accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

Power options

Power for the instrument is to be supplied externally. External power is supplied coming from the Junction box via the Automotive Ethernet cable.

☞ iCON gps 100 can only be powered using the Automotive Ethernet port.

2.2 Unpacking the Container

Description

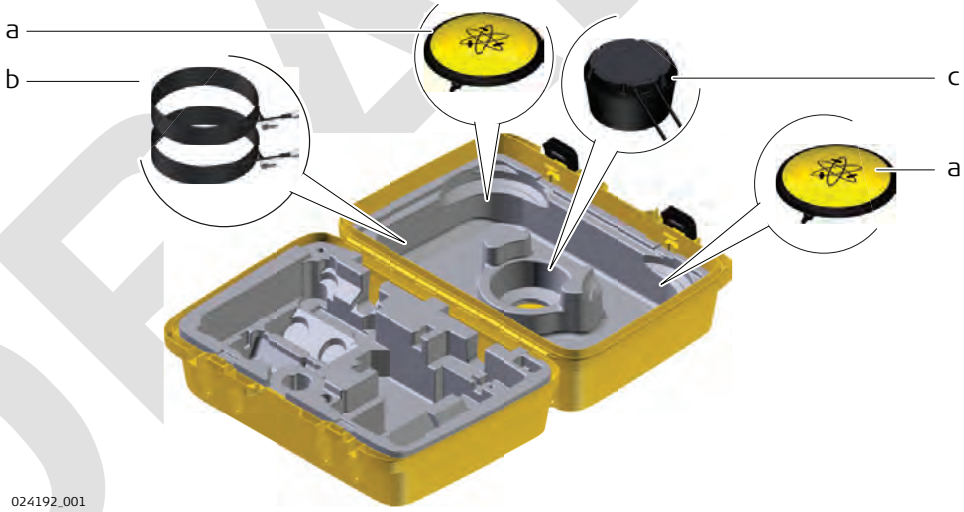
Available delivery packages:

- Delivery box: when a single iCON gps 100 instrument was ordered. Includes the instrument, the printed iCON gps 100 Quick Guide and the USB documentation card.
- A hard-top container comprising all items for a Dual GNSS configuration.

2.2.1 iCON gps 100 Dual GNSS Container

MTC1408 Container upper shell

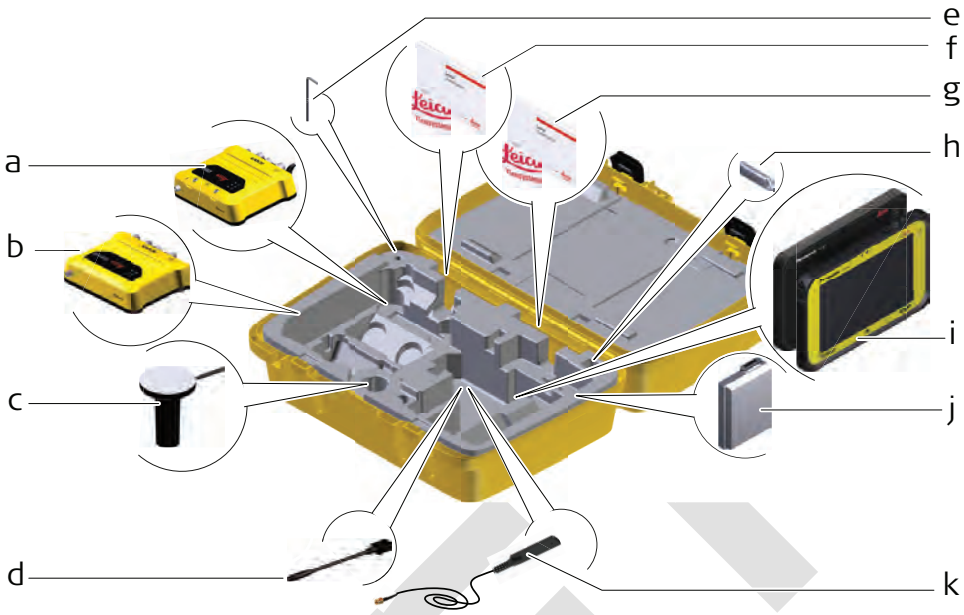
The large-size MTC1408 container comprises all items for a Dual GNSS configuration.



a CGA100 Robust multi-frequency GNSS antenna
b CA16 antenna cable, 10 m, 2 x
c CA48 4G diversity modem antenna

MTC1408 container lower shell

Large-size MTC1408 container configuration with Machine PC.



a CR50 Instrument
b iCON gps 100 Instrument
c CA12/CA13/CA43 radio antenna and CA22 magnetic mount
d USB adapter
e Hex key 2.5 mm
f Quick Guide & USB documentation card CR50
g Quick Guide & USB documentation card iCON gps 100
h Industrial 1 GB USB flash drive
i Machine PC CC70/CC80
j Machine PC spare battery
k CA49/CA53 Bluetooth antenna

2.3 Instrument Components

iCG100 components

a Power and status LED
b Wireless LED
c Tracking status LED
d Grounding screw

e Bluetooth antenna port
f USB port
g Automotive Ethernet Port, Powerin
h Automotive Ethernet Port, Powerout
i Primary external GNSS antenna port
j Secondary external GNSS antenna port

Port	Description
Bluetooth	For connection of an external Bluetooth antenna. Link to machine PC.
USB 2.0	USB A data port (via adapter) for data exchange and software updates.
Automotive Ethernet 1	Power input and data input/output
Automotive Ethernet 2	Power output and data input/output
ANT1, ANT2	GNSS antenna input. ☞ ANT1 is the primary GNSS antenna and ANT2 is the secondary (heading) GNSS antenna.

CGA100 components

a Whitworth thread, 5/8"
b Antenna reference plane
c TNC female connector

3 Using iCON gps 100

3.1 Power Supply

External power supply only

From the Junction box via Automotive Ethernet cable.

☞ In general, all installation works must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

3.2 Using USB Memory Devices

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

☞ Ensure the instrument is placed in its fixed position or place it onto a stable surface.

1. Unscrew the cap from the USB port.
2. Plug in the USB adapter cable.
3. Slide the USB data storage device firmly into the USB host port until it clicks into position.

☞ Take care not to damage the USB data storage device when moving the iCON gps 100 or when handling around the device.

☞ Remove the adaptor cable and close the USB port cover when the USB data storage device is not used any longer.

Preconditions for using USB Memory devices

- USB Memory devices must be formatted in the FAT, FAT32 or exFAT format.
- To import data from a USB Memory device to the iCON gps 100, appropriate folders must be created on the USB device and the files placed in the correct folder.
- Copy coordinate system files to the folder 'CoordinateSystems'. All other files should be copied to the 'System' folder.

3.3 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 7 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.

Installation location

The iCON gps 100 instrument should preferably be installed either inside a compartment just behind the cabin or in the machine cabin itself. If the machine has no space inside a weather proof compartment or cabin, the instrument is to be installed only on components that have no direct connection to the machine tool and/or are positioned separately from the tool or at locations that lie in the safe area of the mechanically moving components. Furthermore, the instrument is to be installed in a way that it is protected from mechanical influences, for example stoning.

Example of a **correctly placed** instrument.

24204_001

☞ 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, the bucket of an excavator, the blade of a dozer, the screed of a paver. Mechanical parts include, for example, the boom and stick of an excavator, the hydraulic cylinder of a dozer or the tow arm of an asphalt paver.
Furthermore, the instrument must not be installed near chassis, chain gear, wheels or on engine components connected to the engine itself. The case stated is intended simply as an example.

Installation direction

- For inside assembly, the iCON gps 100 instrument must be installed either vertically with the connectors pointing upwards/downwards or horizontally on a flat plane. Easy access to the connectors should be guaranteed.
- For outside assembly, it is strongly recommended to install the instrument vertically with the connectors pointing downwards. In case this is not possible, horizontally on a flat plane, but never with the connectors pointing upwards.

Fastening

The iCON gps 100 instrument must be supported by two magnets on opposite sides.

Electrical grounding

The electrical grounds of a Machine may be at different potentials either due to other large current electronic devices on the machine or when different grounds of the machine are isolated in service or welding operations.

Different DC and RF noise may exist at different points in the machine which is out of the control of Leica Geosystems. Such noise may have a negative effect on the satellite tracking performance of the iCON gps 100.

For this reason, it is best that the GNSS antenna(s) are isolated from the machine. This avoids additional ground paths being introduced.

☞ In an ideal installation, with isolated antennas, the connection of the grounding pin on the rear panel of the iCON gps 100 to the machine should not be required.

☞ **It is extremely important to disconnect all cables from the iCON gps 100 before starting any welding operations on the machine. Otherwise the instrument may be damaged beyond repair.**

Installation of GNSS antennas

For best results, it is recommended to mount the two GNSS antennas according to following guidelines:

- separated as far as possible,
- at approximately the same height,
- with the TNC connectors orientated in approximately the same direction
- ensuring an unobstructed view of the sky.

Installation on an excavator:

- Install the two GNSS antennas on the masts in the back of the machine.
- One mast should be placed on each side of the machine. Be aware of heat from the exhaust.

Cable installation

- Ensure that the cables between iCON gps 100 and CGA100 antenna in particular are installed such that they are not bent or stretched.
- It is recommended to use strain relief brackets.
- Route the cable as directly as possible and avoid crossing cables.
- Be sure not to tie the cables onto “hot” hydraulic hoses.

3.4 Antenna Heights

3.4.1 Understanding Antenna Heights

Description

The height of the GNSS antenna above a point consists of three components:

- the vertical or slope height reading,
- the vertical offset,
- the vertical phase centre offset.

For most operations, pre-configured standard settings in the instrument can be used. They automatically take the vertical phase centre offsets into account.

ARP

The antenna accepts vertical height readings to the **A**ntenna **R**eference **P**lane, ARP.

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.

3.4.2 The Antenna Reference Plane, ARP

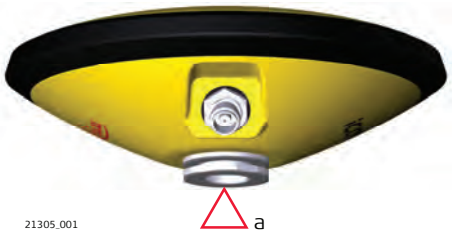
Description

The Antenna Reference Plane:

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

ARP of the antenna

The ARP for the CGA100 antenna is shown in the diagram.



a The Antenna Reference Plane is the underside of the threaded metal insert.

3.4.3 Measuring the Antenna Height for a Mast Setup

Measuring the antenna height - pole setup

Setup Type	Antenna type	The required measurement
Mast	CGA100	vertical distance from the GNSS antenna ARP to a fixed point on the top of the blade (when the blade has both zero long fall and cross fall).

3.5 Dual GNSS Positioning and Heading

General information

When two GNSS antennas are connected to the iCG100 instrument and have a clear view of the sky, the instrument automatically provides a precise GNSS heading relative to True North.

☞ ORP outputs heading relative to grid north instead of true north when a local grid coordinate system is used. The HDT, VTG, XDR messages will always be relative to true north as defined in NMEA-0183 standard.

The iCG100 uses an **Advanced SmartHeading** method of calculating the precise position of the secondary GNSS antenna. This means that precise heading output is available even when the instrument is not receiving corrections from a base station.

The antenna connected to port ANT1 is the primary GNSS antenna while the one on port ANT2 is the secondary (heading) GNSS antenna.

Mounting of GNSS antennas

For best results, it is recommended to mount the two GNSS antennas according to following guidelines:

- separated as far as possible,
- at approximately the same height,
- with the TNC connectors orientated in approximately the same direction, and
- ensuring an unobstructed view of the sky.

Heading Adjustment

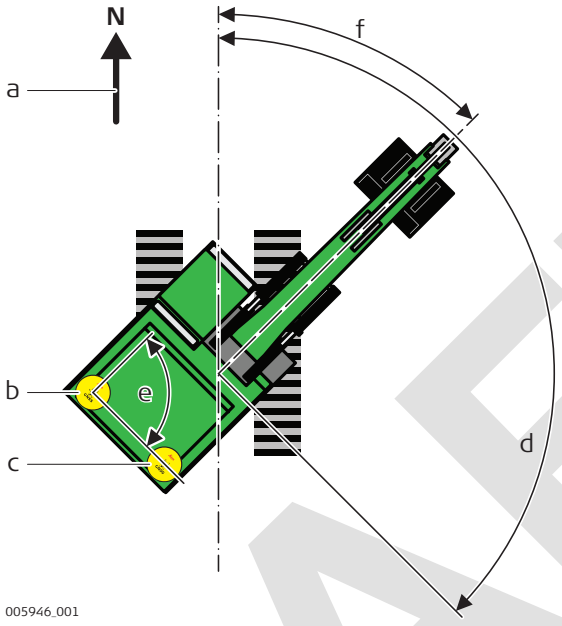
Heading output is the azimuth from GNSS Antenna 1 to GNSS Antenna 2. If it is not possible to mount the antennas parallel to the centreline of the vehicle, then the **known orientation to the centreline** can be entered as a **Heading Adjustment**.

The Heading Adjustment field offers the opportunity to enter an angle correction in order for the heading to be calculated in the exact direction of the machine.

It is important to note that:

- The Heading is the vector from Antenna 1 to Antenna 2 in degrees clockwise from north rather than clockwise from the vehicle reference frame.
- The Heading Adjustment is always applied from a bird's eye view perspective.
- A positive Heading Adjustment is applied clockwise from North while a negative Heading Adjustment is applied anticlockwise from North.

The following picture illustrates that interrelationship.



a North
b GNSS Antenna 1
c GNSS Antenna 2
d Heading (135°)
e Heading Adjustment (-90°)
f Heading output (45°)

Heading output

Heading information is available via the iCON gps 100 Web Interface. Refer to: Home

Heading output can be configured on the **Configuration** page. Refer to: Sensor Configuration

Heading output is available in following message formats:

- Leica ORP
- NMEA HDT
- NMEA VTG
- NMEA XDR

Refer to NMEA Message Formats for further information.

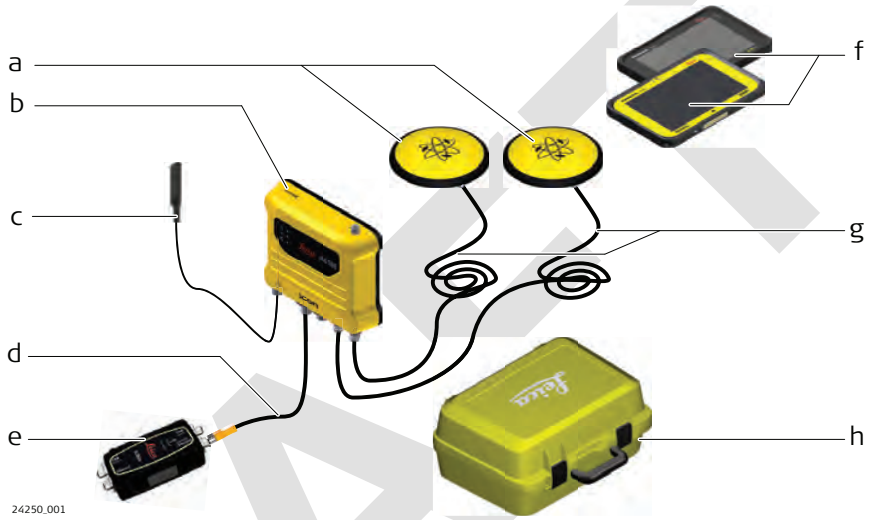
4 Setups with Accessories

☞ 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.

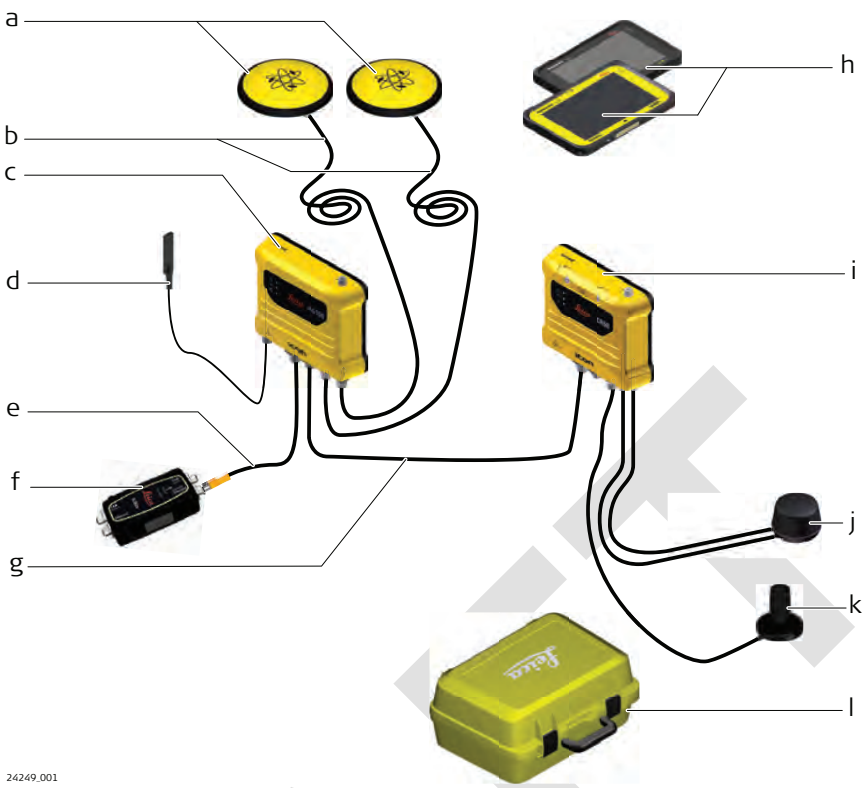
☞ All necessary installation works must be carried out by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

Dual GNSS setup with machine computer modem



a	CGA100 Robust multi-frequency GNSS antenna, 2 x	e	Junction box
b	iCG100 Instrument	f	Machine PC CC70/CC80
c	CA49/CA53 Bluetooth antenna	g	CA16 Antenna cable, 10 m, 2 x
d	Automotive Ethernet cable	h	MTC1408 Carry Case

Dual GNSS setup with radio/modem



a	CGA100 robust multi-frequency GNSS antenna, 2 x	h	Machine PC CC70/CC80
b	CA16 antenna cable, 10 m, 2 x	i	CR50 Instrument
c	iCG100 Instrument	j	CA48 4G diversity modem antenna
d	CA49/CA53 Bluetooth antenna	k	CA12/CA13/CA43 radio antenna and CA22 magnetic mount
e	Automotive Ethernet cable		
f	Junction box	l	MTC1408 Carry Case
g	Automotive Ethernet cable		

Getting connected to the Web Interface

Connection between the sensor and your device is established via Bluetooth.

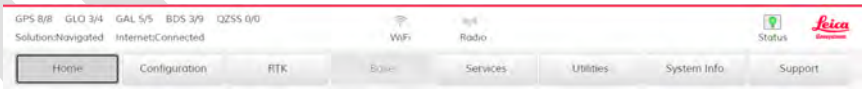
☞ The following instructions are based on using Windows 10.

1. Power on the iCG100.
   ☞ If you intend to use the Web Interface with iCG100 make sure the external Bluetooth antenna is attached.
2. On your computer go to **Start Menu** > **Settings** > **Devices**.
   ☞ Activate Bluetooth if not yet switched on.
3. Click "Add Bluetooth or other devices".
   ☞ Make sure that computer and sensor are in reach for a Bluetooth connection.
4. Click Bluetooth and select the sensor from the list.
   Wait for the connection to be established.
   ☞ The sensor can be identified by its serial number.
5. Go to **Start Menu** > **Settings** > **Network & Internet**.
   Under **Advanced Network Settings** click "Change Adapter Options".
   In the **Network Connections** page double-click on "Bluetooth Network Connection".
   Finally, right-click on the sensor that you have just added and select **Connect using** > **Access Point** from the context menu.
6. Open a browser on your computer and enter the URL:
   http://www.icgsetup.leica-geosystems.com
   User name is "leica", as password enter the serial number of the sensor.
   ☞ Alternatively you can enter the IP address: 172.16.0.1
7. Start configuring the iCG100 using the Web Interface.

☞ For mobile devices it is only required to pair the sensor via Bluetooth.

Web Interface - Frame

The header section contains a status information bar.



The footer includes information on the connected receiver, its serial number and firmware version.

☞ The frame will always be visible independent of which tab you open for further configuration.

Status information bar

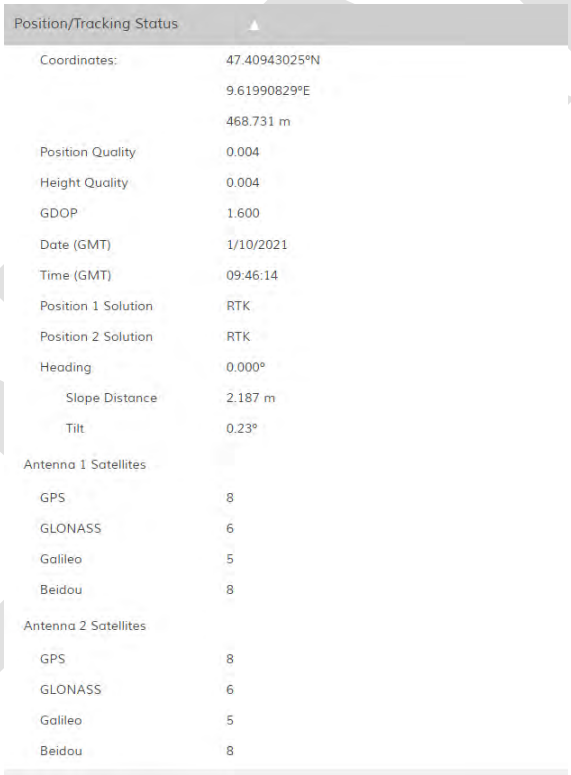
The status bar shows the satellite status, internet connection, antenna configuration and receiver status information.

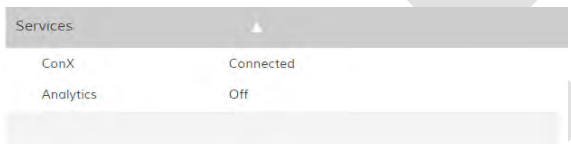
Item	Description
Satellites	Number of satellites currently used/tracked by the receiver. Shows the solution type.
Internet	Indicates whether a connection is established on the sensor or not.
WiFi/Cell/Radio	Indicates the signal strength for each configured communication link.
	Indicates receiver operational status. Green: normal operation Yellow: warning Red: error When you tap the icon, you will be re-directed to the status information page. See also: System Info

Home

The **Home** page is a pure status information page.You will find detailed information on:

- Position/Tracking Status of the connected antennas
- Status of the RTK link
- Status of the communication devices
- ConX and Analytics services

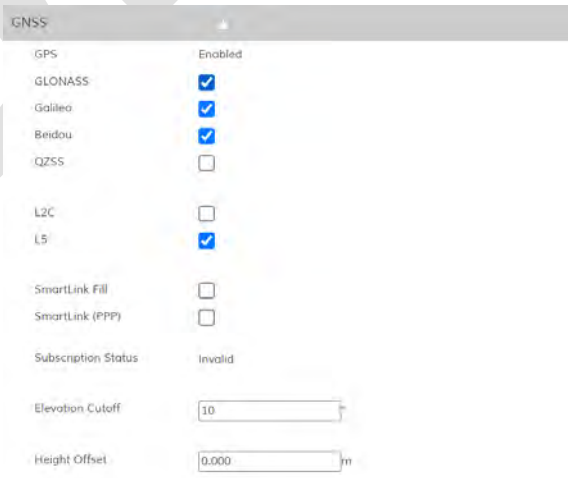
Category	Description
	• Sensor position • Position quality and solution type • Antenna heading information • Tracked satellites for each constellation

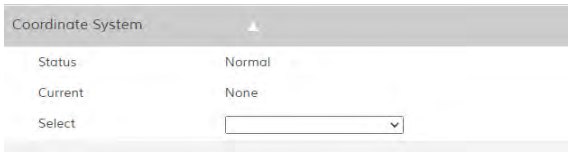
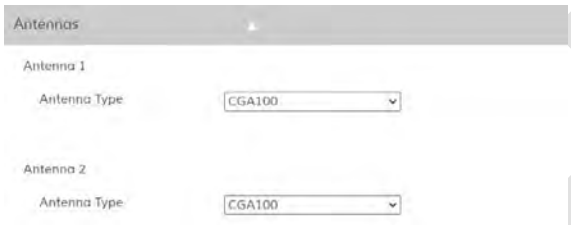
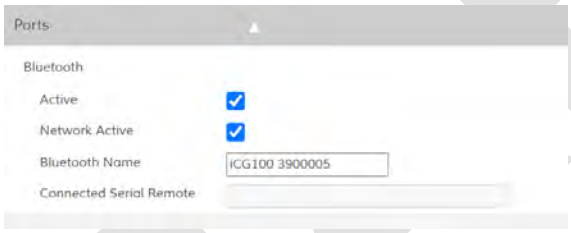
Category	Description
	• Currently configured interface for real-time kinematic correction data status • Data corrections • Automatically detected reference antenna/ receiver • Base details
	Status of communication devices
	Status of ConX and Analytics services

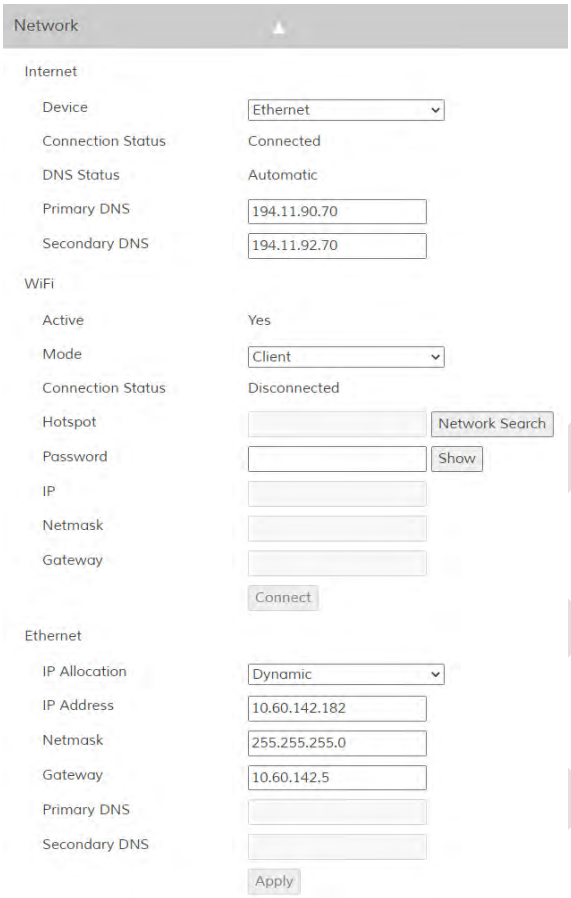
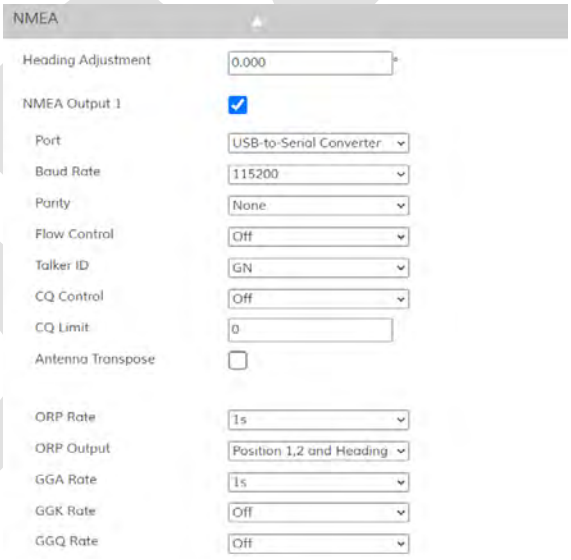
Sensor Configuration

The **Configuration** page allows for configuring device settings such as:

- Tracking settings
- Activation of a coordinate system
- Rover antennae settings
- Bluetooth
- Network settings for the Internet connection via WiFi or Ethernet
- NMEA
- System language

Category	Description
	GPS is always enabled. Additional satellite systems and frequencies can be selected depending on the loaded licenses. Activate or de-activate **SmartLink Fill**. SmartLink Fill is a correction service delivered via satellite to bridge outages of RTK corrections up to 10 minutes. Use SmartLink Fill to increase uptime when facing short outages on the RTK infrastructure.

Category	Description
☞ SmartLink Fill is available for all RTK formats. Activate or de-activate **SmartLink**. SmartLink is a **P**recise **P**oint **P**ositioning service independent of RTK. Being independent from a reference station or a network, it is required that the correct reference frame is selected/generated. Enter the **Elevation Cutoff** to be applied for satellites near the horizon and a **Height Offset**, if required.	
	Select the required coordinate system from the drop-down list.
	Select the antennas that are currently connected to the sensor from the drop-down lists.
	**Bluetooth** is always active. This ensures seamless communication with the web interface. The **Bit Rate** of the CAN protocol can be modified if required.

Category	Description
	**Internet** connection can be established via *Ethernet* or *WiFi* depending on the chosen device. Each of the devices can be configured. Make sure that a connection is possible and the respective antenna is connected to the receiver. ☞ It is possible to configure **WiFi** as **Hotspot** where the internet connection is shared with external devices (provided an internet connection is established on the sensor). Click **Apply** to take over any changes.
	To transmit data using the **NMEA** standard protocol, the instrument must be configured accordingly. ☞ Install the appropriate position rate licences to access all output rates. Two NMEA interfaces can be active in parallel corresponding to **Output 1** and **Output 2**. The NMEA interfaces can be assigned to the serial port, Bluetooth port or TCP Server via Ethernet or cell modem.

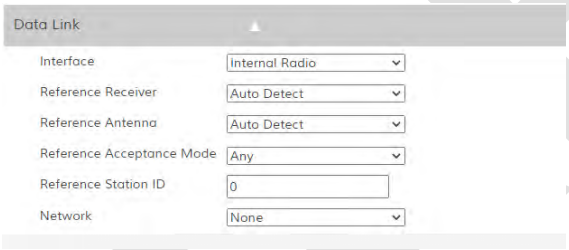
When using a TCP server, configure the **Ports** settings (see above) prior to the NMEA setup.

☞ If a static IP is desired, the DHCP service must be turned off. This allows you to set the IP manually.

Category	Description
	A different **Talker ID** can be manually entered once it is set to *User*. For **CQ Control** choose between *Position only*, *Position & Height* or *Height only*. When CQ Control is active the **CQ Limit** must be defined. **Antenna Transpose** allows for streaming Antenna 1 and Antenna 2 positions on seperate outputs (NMEA Output 1 and NMEA Output 2). Once an NMEA link is configured, each NMEA message can be set to stream at the desired **Rate**. Refer to NMEA Message Formats for more details on NMEA messages. For **ORP**, besides the desired rate, the following output formats are available: *Position* 1, *Position* 1 *&* 2 or *Position* 1, 2 *& Heading*. The Height is set automatically according to the coordinate system used: *Ellipsoidal* for WGS84 and *Orthometric* for Local Grid. Refer to ORP – Orientation and Position for further information on ORP.

RTK Configuration

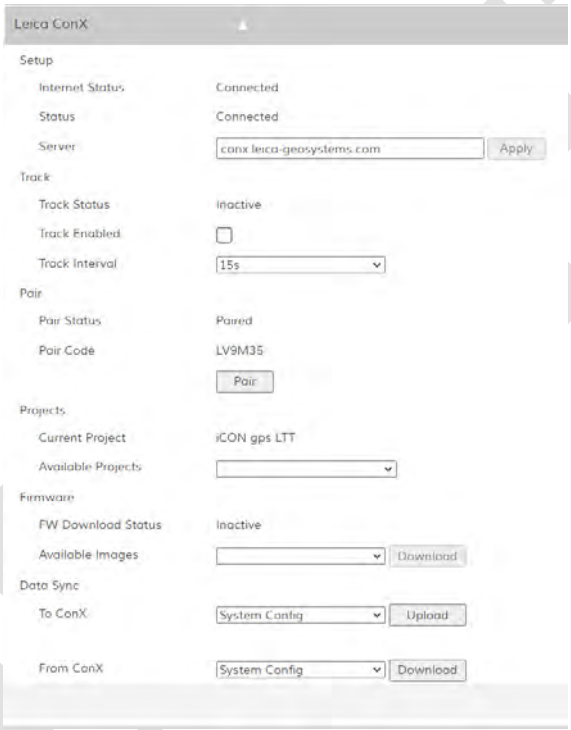
The **RTK** page allows for configuring the real-time kinematic data link.

Category	Description
	From the drop-down list select the **Interface** for the RTK data link. Available options are: *NTRIP* or *TCP*. **Reference Receiver** and **Reference Antenna** allow for manual selection from a drop-down list, if required.
☞ In order to use NTRIP/TCP as data link, an Internet connection is required and the **Network** must be set accordingly (see below). ☞ **TCP interface allows for the selection of the currently connected CR50 instrument under TCP > Address (see below). Once done, a link between the iCON gps 100 and the CR50 instrument will be established successfully.**	
	When NTRIP or TCP is set as **Data Link** (see above), then **Network** settings become enabled. Once a valid **Address** and **Port** are entered and the correct credentials (**Username** and **Password**) are set, you can select a **Mountpoint** from the drop-down list.

Services

The **Services** page allows for active services to be configured.

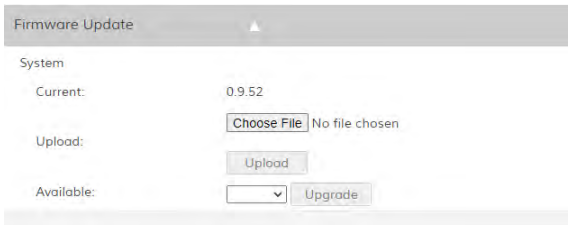
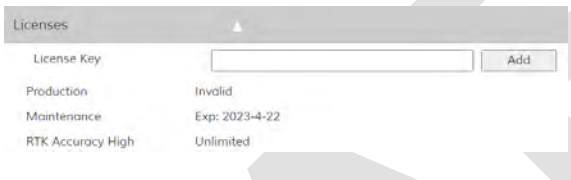
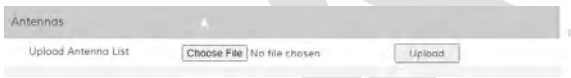
☞ In order to make use of the available services, an internet connection must be established on the sensor. See also: Sensor Configuration

Category	Description
	The iCON Analytics service is enabled by default and active once an internet connection is established on the sensor. If you wish to disable this service or send data anonimously, you can select the respective options from the drop-down list. ☞ Click the **About** button to get detailed information on the scope and implications of using iCON Analytics.
	You can set up and configure a connection to Leica ConX here. Click **Pair** to establish the connection and use the given **Pair Code** to proceed with the setup on the ConX server. • Select **Track Enabled** if you want the sensor position to be sent to ConX at regular intervals. The **Track Interval** can be selected from the drop-down list. • **Available Projects** can be selected from the drop-down list. Select a project from the list if you wish to use a different project. • Select which data shall be synchronised to or from ConX: You can upload *System Config* files, *Coordinate Sytems*, *Log Files* for Support or *User Files*. Select and click the **Upload** button. You can download *System Config* files, *Coordinate Sytems*, *Antenna Lists*, *Licenses* or *User Files*. Select and click the **Download** button. • You can also download **Firmware** from ConX. If Firmware files are available for download, the **Status** turns to "Active" and you can select files from the list of **Available Images**. Select and click the **Download** button.

Utilities

The **Utilities** page allows for firmware updates, adding license keys and uploading antenna lists from the connected device or from a USB flash drive on the sensor.

☞ No internet connection required on the sensor.

Category	Description
	The **Current** firmware version is shown. Click on **Choose File** to select an upgrade file stored locally on the connected device. Then click the **Upload** button to upload the file to the sensor (via Bluetooth). From the drop-down list select the uploaded file and click **Upgrade** to start the firmware upgrade process.
	Individual licenses can be added to the sensor as well as authorisation codes for the **M**easurement **E**ngine. The current status of all licenses is displayed below.
	Click on **Choose File** to select an antenna list stored locally on the connected device. Then click the **Upload** button to upload the file to the sensor (via Bluetooth).
	You can as well import or export files via USB flash drive. Attach the USB flash drive to the sensor. See also: Using USB Memory Devices From the drop-down lists select the files you want to upload to or download from the sensor and click **Import**/**Export**. ☞ On the USB flash drive coordinate systems must be stored in the folder "CoordinateSystems", all other files in the "System" folder.

☞ If a USB flash drive containing firmware files is connected to the sensor, you can directly select the upgrade file from the drop-down list.

Category	Description
	To delete files from the sensor press **Delete All** or select a file from the drop-down list and click **Delete** (only available for coordinate systems). Or Click **Delete All** to delete all **User Files**, all **SSH Public Keys** or all **Coordinate Sytems** stored in the internal memory on the sensor.

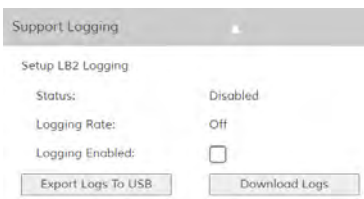
System Info

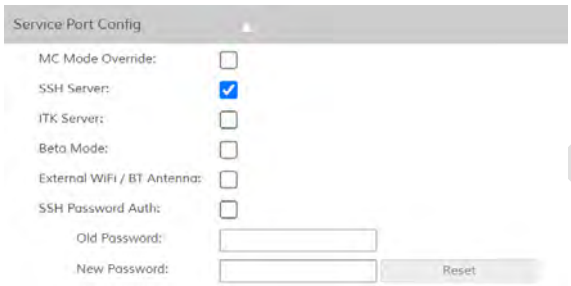
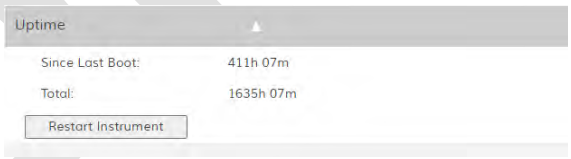
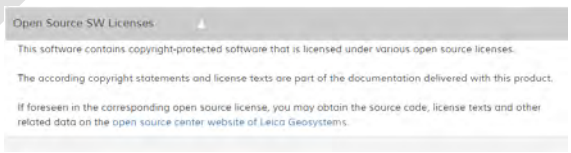
The **System Info** page shows read-only information on the sensor hardware and system status.

Category	Description
	Under **Hardware** you can visualise additional information about the hardware components inside the sensor.
	Under **Status** you can find detailed information on errors and warnings. In case there is an issue the light bulb icon in the Status information bar turns yellow or red. See also: Web Interface - Frame

Support

The **Support** page allows for log files handling service ports and resetting single components.

Category	Description
	Click the **Export Logs To USB** button to export log files inlcuding information on all modules running on the sensor. It is also possible to **Download Logs** directly to the connected device.

Category	Description
☞ A USB flash drive must be connected. See also: Using USB Memory Devices	
In order to include LB2 data in the log files, enable **LB2 Logging**. ☞ LB2 logs contain raw data information from the visible satellite signals and are required for troubleshooting position or tracking performance issues. Roughly 10 min of LB2 logging are usually sufficient. ☞ Log file size grows rapidly over time when LB2 is enabled.	
 Select **MC Mode Override** to pause CAN communication with the machine temporarily for troubleshooting. ☞ MC Mode Override is always disabled while booting the instrument. **Export Logs To USB** allows selection between internal and external antenna. When not selected, internal antenna will be used.	Allows for configuring the **Service Ports** and resetting the SecureShell (SSH) password.
	Allows for resetting single system components.
	Shows the elapsed time since the last system boot as well as the total uptime of the sensor. Tap **Restart Instrument** to reboot the system.
	Software Licence agreement for copyright-protected Open Source Software.

6 Care and Transport

6.1 Transport

Transport in the field

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

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

Transport in a road vehicle

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

For products for which no container is available use the original packaging or its equivalent.

Shipping

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

6.2 Storage

Product

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

6.3 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.

7 Technical Data

7.1 Technical Data iCON gps 100

7.1.1 Tracking Characteristics

Instrument technology

SmartTrack

Satellite reception

Dual frequency

Instrument channels

☞ Depending on the satellite systems and signals configured, a maximum number of 555 channels is allocated.

Supported signals

GPS

L1	L2
Carrier phase, C/A-code	Carrier phase, C code (L2C) and P2-code

GLONASS

L1	L2
Carrier phase, C/A-code	Carrier phase, P2-code

Galileo

E1	E5b
Carrier phase, code	Carrier phase, code

BeiDou

B1	B2
Carrier phase, code	Carrier phase, code

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

Satellites tracked

With each antenna up to 72 satellites simultaneously on two frequencies.

7.1.2 Accuracy

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

The following accuracies, given as **r**oot **m**ean **s**quare, are based on measurements processed using 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 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

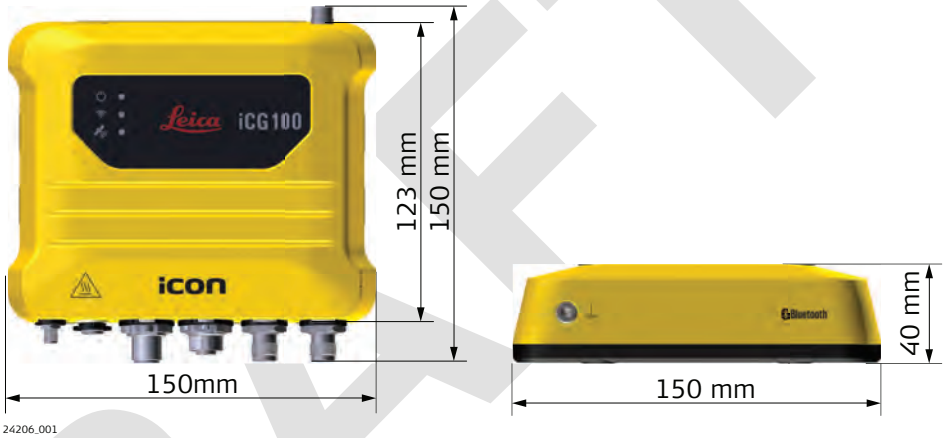
Precise Heading

Heading accuracy with
- 1 m antenna separation: 0.18°
- 2 m antenna separation: 0.09°
- 5 m antenna separation: 0.05°

7.1.3 General Technical Data of the Product

Dimensions

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



Length [mm]	Width [mm]	Thickness [mm]
150.0	150.0	40.0

Weight

Type	Weight [kg]/[lbs]
iCG100	0.83/1.83

Power

Power consumption:	iCON gps 100 Dual GNSS: 7.7 W typically, 24 V @ 320 mA
External supply voltage:	Nominal 24 V DC (⎓), voltage range 9 V to 36 V DC, supplied by the Junction Box via Automotive Ethernet cable.

Electrical data

Type	iCON gps 100
Voltage	Nominal 24 V
Current	Dual GNSS: 7.7 W typically, 24 V @ 320 mA

Type	iCON gps 100
Frequency	GPS L1 1575.42 MHz GPS L2 1227.60 MHz GLONASS L1 1602.5625 MHz - 1611.5 MHz GLONASS L2 1246.4375 MHz - 1254.3 MHz Galileo E1 1575.42 MHz Galileo E5b 1207.14 MHz BeiDou B1 1561.098 MHz BeiDou B2 1207.14 MHz Bluetooth 2400 MHz - 2483.5 MHz
Gain (internal antenna)	Typically -12 dBi
Noise Figure	Typically < 2 dBi

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
Instrument	-40 to +65	-40 to +85

Protection against water, dust and sand

Type	Protection
Instrument	IP6K8/6K9K (ISO 20653) Dust tight Blow rain tight Waterproof to 1 m temporary immersion

Humidity

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

Vibration/Shock

Type	iCON gps 100	CGA100
Vibration	5 - 500 Hz, ± 15 mm, 5 g (IEC 60068-2-6) MIL-STD 810G - 514.6E-1-Cat24	IEC 60068-2-6: 5 - 500 Hz, 15 g, ±15 mm MIL-STD-810G: Fig.514.6E-1: Category 24 (20 - 2000 Hz, 7.7 grms)
Shock	60 g, 6 ms, IEC60068-2-27	IEC 60068-2-27 (special): 60 g, 6 ms IEC 60068-2-27: 100 g, 2 ms

7.2 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
CGA100	GPS, GLONASS, Galileo, BeiDou SmartRack+ antenna with built-in ground plane.	Machine Control, RTK Base Station, RTK Rover and Network RTK applications.

Dimensions

Type	CGA100
Height	60 mm
Diameter	165 mm

Connector

TNC female

Mounting

5/8" Whitworth

Weight

0.4 kg

Electrical data

Type	CGA100
Voltage	3.8 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
GLONASS L3	1207.14 MHz
Galileo E1	1575.42 MHz
Galileo E5a	1176.45 MHz
Galileo E5b	1207.14 MHz
Galileo E6	1278.75 MHz
Galileo AltBOC	1191.795 MHz
BeiDou B1	1561.098 MHz
BeiDou B2	1207.14 MHz
BeiDou B3	1268.52 MHz
QZSS	L1 1575.42 MHz
QZSS	L2 1227.6 MHz
QZSS	L5 1176.45 MHz
QZSS	L6 1278.75 MHz
Gain (typically)	29 dB
Noise Figure (typically)	2 dB

☞ Galileo AltBOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
CGA100	-40 to +85	-55 to +85

Protection against water, dust and sand

Type	Protection
CGA100	IP68, IP69K Dust tight Protected against water jets Waterproof to 1 m temporary immersion

Humidity

Type	Protection
CGA100	IEC60068-2-30 98% r.H. / 25°C 93% r.H. / 55°C The effects of condensation are to be effectively counteracted by periodically drying out the antenna.

Vibration/shock

Type	CGA100
Vibration	IEC 60068-2-6: 5 - 500 Hz, 15 g, ±15 mm MIL-STD-810G: Fig.514.6E-1: Category 24 (20 - 2000 Hz, 7.7 grms)
Shock	IEC 60068-2-27 (special): 60 g, 6 ms IEC 60068-2-27: 100 g, 2 ms

Cable length

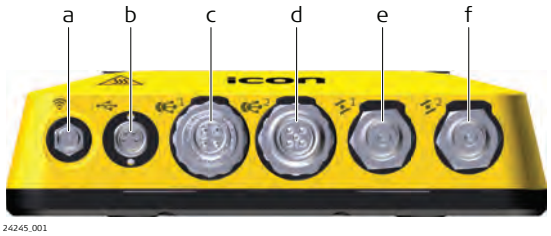
Separation distance from instrument ...	to antenna	Optional cable lengths [m]
iCON gps 100	CGA100	2.8, 5, 10

7.3 Pin Assignments and Sockets

Expert knowledge required

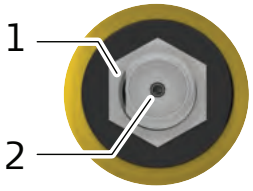
Modification or adaption on base of the pin assignments and socket descriptions need expert knowledge.

Connectors Overview



a Bluetooth antenna port
b USB port
c Automotive Ethernet Port, Power in
d Automotive Ethernet Port, Power out
e Primary external GNSS antenna port
f Secondary external GNSS antenna port

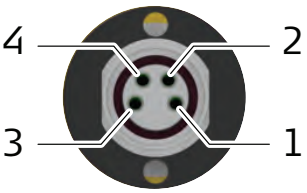
Bluetooth antenna



0024279_001

Pin	Function	Description
1	Shield/GND	Shield/Ground
2	RF+	Antenna signal and antenna power

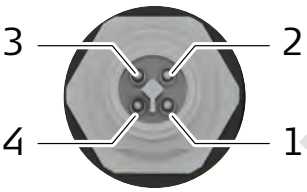
USB M8 connector



024246_001

Pin	Function	Direction
1	+5 V	USB power Out
2	USB P	Bi-directional
3	GND	USB power return
4	USB N -	Bi-directional

Automotive Ethernet, power in

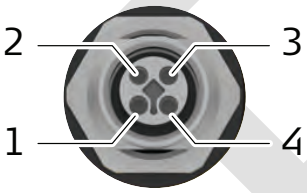


0024247_001

Type: M12 4 Pin

Pin	Name	Function	Direction
1	TRD+	100Base T1-P	Bi-directional
2	TRD-	100Base T1-N	Bi-directional
3	Vin–positive	+VE	Power
4	Vin–negative	-VE	Power

Automotive Ethernet, power out

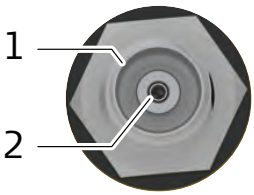


0024248_001

Type: M12 4 Pin

Pin	Name	Function	Direction
1	TRD+	100Base T1-P	Bi-directional
2	TRD-	100Base T1-N	Bi-directional
3	Vout–positive	+VE	Power
4	Vout–negat-ive	-VE	Power

ANT1, ANT2



0024280_001

Type: TNC Female

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

☞ Connecting the wrong antenna to the wrong connector may cause damage to the antennas. In order to minimise the chance of connecting the incorrect external antenna, the two TNC connectors are colour coded. Cables with corresponding colours are available.

7.4 Conformity Declarations

7.4.1 iCON gps 100

Labelling iCON gps 100

Antenna

Type	Antenna type	Connector	Frequency band [MHz]
Bluetooth	External antenna	SMA	2402 - 2480

Frequency band

Type	Frequency band [MHz]
Bluetooth	2402 - 2480

Output power

Type	Output power [mW]
Bluetooth	2.5

Radiation Exposure Statement

The radiated output power of the instrument is below the radio frequency exposure limits. Nevertheless, the instrument should be used in such a manner that the potential for human contact during normal operation is minimised. To avoid the possibility of exceeding the radio frequency exposure limits, keep a distance of at least 20 cm between you (or any other person in the vicinity) and the instrument.

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.

SAR limits

Country	Head	Body	Limb
EU	0.5 W/Kg, 10-gram	0.5 W/Kg, 10-gram	n/a
France	0.5 W/Kg, 10-gram	0.5 W/Kg, 10-gram	0.5 W/Kg, 10-gram

Country	Head	Body	Limb
USA & Canada	1.492 W/Kg, 1-gram	1.6 W/Kg, 1-gram	n/a

EU

CE

Hereby, Leica Geosystems AG declares that the radio equipment type iCON gps 100 is in compliance with Directive 2014/53/EU and other applicable European Directives.
The full text of the EU declaration of conformity is available at the following Internet address: http://www.leica-geosystems.com/ce.

USA

FCC ID: RFD-ICG100
FCC Part 15, 22, 24, 27 and 90

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, it may cause harmful interference to radio communications.

However, there is no guarantee that interference does not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

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

Canada

CAN ICES-003 Class B/NMB-003 Class B
IC: 3177A-ICG100

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

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

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

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

Radio Frequency (RF) Exposure Compliance Statement

The radiated RF output power of the instrument is below the Health Canada's Safety Code 6 exclusion limit for portable devices (radiated element separation distance between the radiating element and user and/or bystander is below 20 cm).

⚠WARNING

This device complies with Industry Canada's licence-exempt RSSs. 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.

China

CCC

CCC acceptance must be able to determine the product category based on the content of the Chinese manual. If the application category does not match the description of the manual, the CCC application will be returned. This was submitted at the application stage CCC.

Product small class	Product name	According to the standard number	Corresponding international standard number
1606	Mobile user terminal	GB19484.1-2013	
		GB4943.1-2011	IEC 60950-1:2005
		GB22450.1-2008	
		YD/T1592.1-2012	
		YD/T1595.1-2012	
		YD/T2583.14-2013	

Japan

- 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).

South Korea

Applicant name: Leica Geosystems AG
Product name: Specific small output wireless device
Model name: 2020-07-09
KC number: R-R-rks-iCG100
Manufacture date: Marked separately
Manufacturer: LEICA GEOSYSTEMS AG/SWITZERLAND

Others

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

7.4.2 CGA100

Labelling CGA100

21296_001

Frequency band

Type	CGA100
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
GLONASS L3	1207.14 MHz
Galileo E1	1575.42 MHz
Galileo E5a	1176.45 MHz
Galileo E5b	1207.14 MHz
Galileo E6	1278.75 MHz
Galileo AltBOC	1191.795 MHz
BeiDou B1	1561.098 MHz
BeiDou B2	1207.14 MHz
BeiDou B3	1268.52 MHz
QZSS	L1 1575.42 MHz
QZSS	L2 1227.6 MHz
QZSS	L5 1176.45 MHz

Type	CGA100
QZSS	L6 1278.75 MHz

Output power

Receive only

EU

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 full text of the EU declaration of conformity is available at the following Internet address:
http://www.leica-geosystems.com/ce.

⚠CAUTION

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

USA

FCC Part 15, 22, 24, 27 and 90

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, it may cause harmful interference to radio communications.

However, there is no guarantee that interference does not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

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

Canada

CAN ICES-003 Class B/NMB-003 Class B

China

CCC

CCC acceptance must be able to determine the product category based on the content of the Chinese manual. If the application category does not match the description of the manual, the CCC application will be returned. This was submitted at the application stage CCC.

Product small class	Product name	According to the standard number	Corresponding international standard number
1606	Mobile user terminal	GB19484.1-2013	
		GB4943.1-2011	IEC 60950-1:2005
		GB22450.1-2008	
		YD/T1592.1-2012	
		YD/T1595.1-2012	
		YD/T2583.14-2013	

Others

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

8 Software Licence Agreement/Warranty

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.

Such agreement is provided together with all products and can also be referred to and downloaded at the Leica Geosystems home page at Hexagon – Legal Documents or collected from your Leica Geosystems distributor.

You must not install or use the software unless you have read and accepted the terms and conditions of the Leica Geosystems Software Licence Agreement. Installation or use of the software or any part thereof, is deemed to be an acceptance of all the terms and conditions of such Licence Agreement. If you do not agree to all or some of the terms of such Licence Agreement, you must not download, install or use the software and you must return the unused software together with its accompanying documentation and the purchase receipt to the distributor from whom you purchased the product within ten (10) days of purchase to obtain a full refund of the purchase price.

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 **M**arine **E**lectronics **A**ssociation is a standard for interfacing marine electronic devices. This chapter describes all NMEA-0183 messages which can be output by the instrument.

Access

Select **Configuration > NMEA** via the Web Interface.

Refer to: Sensor Configuration.

☞

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 **Configuration > NMEA**.

☞

When enabling CQ Control, the coordinate quality is being checked. If the coordinate quality of the position and/or the height component exceeds the defined limit, no NMEA messages are 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	• -- = alphanumeric characters identifying the talker	
		Options:	
		GN = **G**lobal **N**avigation **S**atellite **S**ystem	GNGGA
		GP = GPS only	GPGGA
		GL = GLONASS	GLGGA
		GA = Galileo	GAGGA
		GB = BeiDou	GBGGA
		GQ = QZSS	GQGGA

Symbol	Field	Description	Example
		• ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message.	

Special format fields

Symbol	Field	Description	Example
A	Status	• A = Yes, Data Valid, Warning Flag Clear • V = No, Data Invalid, Warning Flag Set	V
llll.ll	Latitude	• 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
yyyyy.yy	Longitude	• 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	• 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.	115744.00

Symbol	Field	Description	Example
		• Leading zeros are always included for hours, minutes and seconds to maintain fixed length.	
mmddyy	Date	• 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	• 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, yyyyy.yy.	M

Numeric value fields

Symbol	Field	Description	Example
x.x	Variable numbers	• Integer or floating numeric field • Optional 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,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

Description of fields

Field	Description
$--GGA	Header including Talker ID
hhmmss.ss	UTC time of position
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 = Valid fix for GNSS **P**recise **P**ositioning **S**ervice mode, for example WAAS 4 = Real-time position, ambiguities fixed
xx	Number of satellites in use. For $GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
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

Field	Description
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0 and v4.1:

Standard Talker ID = GPS only

$GPGGA,141909.00,4724.5294609,N,00937.0836236,E,1,09,1.0,366.745,M,100.144,M,,*52

Standard Talker ID = GNSS

$GNGGA,142309.00,4724.5296834,N,00937.0832766,E,1,16,0.7,366.740,M,100.144,M,,*4E

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.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn

Field	Description
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0 and v4.1:

Standard Talker ID = GPS only

$GPGGK,142804.00,111414,4724.5292267,N,00937.0832394,E,1,09,2.3,EHT466.919,M*46

Standard Talker ID = GNSS

$GNGGK,142629.00,111414,4724.5295910,N,00937.0831490,E,1,16,1.6,EHT467.089,M*5C

A.5 GGQ - Real-Time Position with CQ

Syntax

$--GGQ,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.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
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 $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>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID = GPS only

$GPGGQ,144419.00,111414,4724.5290370,N,00937.0833037,E,1,10,3.894,366.261,M*01

Standard Talker ID = GNSS

$GNGGQ,144054.00,111414,4724.5294512,N,00937.0834677,E,1,21,3.679,366.584,M*12

$GPGGQ,144054.00,111414,,,,,10,,,*45

$GLGGQ,144054.00,111414,,,,,07,,,*5F

$GBGGQ,144054.00,111414,,,,,04,,,*51

For NMEA v4.1:

Standard Talker ID = GPS only

$GPGGQ,144339.00,111414,4724.5290715,N,00937.0833826,E,1,10,4.060,366.339,M*03

Standard Talker ID = GNSS

$GNGGQ,144224.00,111414,4724.5293821,N,00937.0835717,E,1,22,3.673,366.944,M*12

☞ When more than one GNSS is active only $GNGGQ is output.

A.6 GLL - Geographic Position Latitude/Longitude

Syntax

$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>

Description of fields

Field	Description
$--GLL	Header including talker ID
llll.ll	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

For NMEA v4.0 and v4.1:

Standard Talker ID = GPS only

$GPGLL,4724.5289712,N,00937.0834834,E,144659.00,A,A*68

Standard Talker ID = GNSS

$GNGLL,4724.5294325,N,00937.0836915,E,144839.00,A,A*72

A.7 GNS - GNSS Fix Data

Syntax

$--GNS,hhmmss.ss,llll.ll,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
llll.ll	Latitude (WGS 1984)
a	Hemisphere, **N**orth or **S**outh
yyyyy.yy	Longitude (WGS 1984)
a	**E**ast or **W**est
c--c	Four character mode indicator for each GNSS constellation used in the position where the • First character is for GPS • Second character is for GLONASS • Third character is for Galileo • Fourth character is for BeiDou N = Satellite system not used in position fix or fix not valid P = Precise, for example no deliberate degradation such as SA A = Autonomous; navigation fix, no real-time fix D = Differential; real-time position, ambiguities not fixed R = Real-time kinematic; ambiguities fixed F = Float real-time kinematic
xx	Number of satellites in use. For $GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
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 is exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height is exported.
x.x	Geoidal separation in metres
x.x	Age of differential data

Field	Description
xxxx	Differential base station ID, 0000 to 1023
h	For NMEA v4.1. Navigation Status Indicator S = Safe C = Caution U = Unstable V = Navigation status not valid
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID = GPS only

$GPGNS,150254.00,4724.5290110,N,00937.0837286,E,A,10,0.8,366.282,100.143,,*33GNSS

Standard Talker ID = GNSS

$GNGNS,145309.00,4724.5293077,N,00937.0838953,E,AANA,22,0.5,367.326,100.144,,*64

☞ When more than one GNSS is active only $GNGNS is output.

For NMEA v4.1:

Standard Talker ID = GPS only

$GPGNS,150219.00,4724.5290237,N,00937.0837225,E,A,10,0.8,366.329,100.143,,,V*4FGNSS

Standard Talker ID = GNSS

$GNGNS,145339.00,4724.5292786,N,00937.0838968,E,AANA,22,0.5,367.334,100.143,,,V*19

☞ When more than one GNSS is active only $GNGNS is output.

A.8 GSA - GNSS DOP and Active Satellites

Syntax

$--GSA,a,x,xx,xx,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

Field	Description		
	3 = 3D		
xx	PRN numbers of the satellites used in the solution.		
	For NMEA v4.0:	This field is repeated 12 times.	
	For NMEA v4.1:	This field is repeated 16 times.	
	☞ A new GSA message is sent for each GNSS constellation tracked.		
	For NMEA v4.0 and v4.1:		
	GPS	1 to 32	GPS satellites
		33 to 64	SBAS satellites
		65 to 99	Undefined
	GLONASS	1 to 32	Undefined
		33 to 64	SBAS satellites
		65 to 99	GLONASS satellites
	For NMEA v4.1 also:		
	Galileo	1 to 36	Galileo satellites
		37 to 64	Galileo SBAS
		65 to 99	Undefined
	BeiDou	1 to 37	BeiDou satellites
		38 to 64	BeiDou SBAS
		65 to 99	Undefined
x.x	PDOP		
x.x	HDOP		
x.x	VDOP		
h	For NMEA v4.1. GNSS System ID 1 = GPS 2 = GLONASS 3 = Galileo 4 = BeiDou		
*hh	Checksum		
<CR>	**C**arriage **R**eturn		
<LF>	**L**ine **F**eed		

Examples

For NMEA v4.0:

Standard Talker ID = GPS only

$GPGSA,A,3,01,04,06,09,11,17,20,23,31,,,,1.5,0.8,1.3*31

Standard Talker ID = GNSS

$GNGSA,A,3,01,04,06,09,11,17,20,23,31,,,,1.1,0.5,1.0*25

$GNGSA,A,3,65,71,72,73,74,80,86,87,88,,,,1.1,0.5,1.0*26

For NMEA v4.1:

Standard Talker ID = GPS only

$GPGSA,A,3,01,04,06,09,11,17,20,23,31,,,,,,,1.5,0.8,1.3,1*2C

Standard Talker ID = GNSS

$GNGSA,A,3,01,04,06,09,11,17,20,23,31,,,,,,,1.1,0.5,1.0,1*38

$GNGSA,A,3,65,71,72,73,74,80,86,87,88,,,,,,,1.1,0.5,1.0,2*38

$GNGSA,A,3,05,07,10,11,,,,,,,,,,,,1.1,0.5,1.0,4*33

A.9 GSV - GNSS Satellites in View

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 9		
x	Message number, 1 to 9		
xx	Number of theoretically visible satellites according to the current almanac.		
xx	PRN numbers of the satellites used in the solution.		
	GPS	1 to 32	GPS satellites
		33 to 64	SBAS satellites
		65 to 99	Undefined
	GLONASS	1 to 32	Undefined
		33 to 64	SBAS satellites
		65 to 99	GLONASS satellites
	Galileo	1 to 36	Galileo satellites
		37 to 64	Galileo SBAS
		65 to 99	Undefined
	BeiDou	1 to 37	BeiDou satellites
		38 to 64	BeiDou SBAS
		65 to 99	Undefined
xx	Elevation in degrees, 90 maximum, empty when not tracking		
xxx	Azimuth in degrees true north, 000 to 359, empty when not tracking		
xx	**S**ignal to **N**oise **R**ation 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		
h	For NMEA v4.1. Signal ID		
	GPS	0	All signals
		1	L1 C/A
		2	L1 P(Y)

Field	Description		
		3	L1M
		4	L2 P(Y)
		5	L2C-M
		6	L2C-L
		7	L5-I
		8	L5-Q
		9-F	Reserved
	GLONASS	0	All signals
		1	G1 C/A
		2	G1 P
		3	G2 C/A
		4	GLONASS (M) G2 P
		5-F	Reserved
	Galileo	0	All signals
		1	E5a
		2	E5b
		3	E5a+b
		4	E6-A
		5	E6-BC
		6	L1-A
		7	L1-BC
		8-F	Reserved
	BeiDou	0	All signals
		1-F	Reserved
*hh	Checksum		
<CR>	**C**arriage **R**eturn		
<LF>	**L**ine **F**eed		

☞ 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

For NMEA v4.0:

Standard Talker ID = GPS only

$GPGSV,3,1,09,01,31,151,45,06,37,307,47,09,47,222,49,10,14,279,44*7D

$GPGSV,3,2,09,17,29,246,47,20,69,081,49,23,79,188,51,31,18,040,41*76

$GPGSV,3,3,09,32,23,087,42,,,,,,,,,,,,*49

Standard Talker ID = GNSS

$GPGSV,3,1,09,01,34,150,47,06,34,308,47,09,44,220,48,10,11,277,43*7B
$GPGSV,3,2,09,17,31,248,49,20,71,076,48,23,76,192,50,31,19,042,42*7A
$GPGSV,3,3,09,32,25,085,40,,,,,,,,,,,,*4F
$GLGSV,3,1,09,65,24,271,45,71,37,059,47,72,67,329,49,73,31,074,45*66
$GLGSV,3,2,09,74,17,127,44,80,15,022,41,86,12,190,44,87,49,239,48*66
$GLGSV,3,3,09,88,38,314,46,,,,,,,,,,,,*53
$GBGSV,1,1,04,05,18,123,38,07,23,044,39,10,35,068,45,11,29,224,45*61

For NMEA v4.1:

Standard Talker ID = GPS only

$GPGSV,3,1,09,01,31,151,46,06,36,307,47,09,46,222,49,10,13,278,44,0*64
$GPGSV,3,2,09,17,29,246,48,20,69,080,49,23,79,189,51,31,18,040,42,0*66
$GPGSV,3,3,09,32,23,087,42,,,,,,,,,,,,0*55

Standard Talker ID = GNSS

$GPGSV,3,1,09,01,32,151,46,06,35,308,47,09,45,221,49,10,12,278,42,0*6C
$GPGSV,3,2,09,17,30,247,47,20,70,078,49,23,77,191,51,31,19,041,41,0*6B
$GPGSV,3,3,09,32,24,086,41,,,,,,,,,,,,0*50
$GLGSV,3,1,09,65,25,272,46,71,36,060,47,72,68,333,49,73,31,073,45,0*73
$GLGSV,3,2,09,74,18,126,47,80,15,021,38,86,11,190,45,87,48,238,50,0*71
$GLGSV,3,3,09,88,38,312,46,,,,,,,,,,,,0*49
$GBGSV,1,1,04,05,18,123,38,07,23,044,40,10,35,067,45,11,28,224,46,0*7E

A.10 GST - Position Error Statistics

Syntax

$--GST,hhmmss.ss,x.xxx,x.xxx,x.xxx,xxx.x,x.xxx,x.xxx,x.xxx*hh

Description of fields

Field	Description
$--GST	Message ID; varies depending on the satellite system used for the position solution: • $GPGST: GPS only • $GLGST: GLONASS only • $GN: Combined
hhmmss.ss	UTC of position fix
x.xxx	RMS value of the pseudo-range residuals; includes carrier phase residuals during periods of RTK (float) and RTK (fixed) processing
x.xxx	Error ellipse semi-major axis 1 sigma error, in meters
x.xxx	Error ellipse semi-minor axis 1 sigma error, in meters
xxx.x	Error ellipse orientation, degrees from true north
x.xxx	Latitude 1 sigma error, in meters
x.xxx	Longitude 1 sigma error, in meters
x.xxx	Height 1 sigma error, in meters

Field	Description
*hh	Checksum; data always begins with *

Example

$GPGST,172814.0,0.006,0.023,0.020,273.6,0.023,0.020,0.031*6A

A.11 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>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

$GNHDT,11.4,T, 00*4B

A.12 LLK - Leica Local Position and GDOP

Syntax

$--LLK,hhmmss.ss,mmddyy,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
mmddyy	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

Field	Description
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

For NMEA v4.0:

Standard Talker ID = GPS only

$GPLLK,153254.00,111414,546628.909,M,5250781.888,M,1,09,1.8,366.582,M*15

Standard Talker ID = GNSS

$GNLLK,153819.00,111414,546629.154,M,5250782.866,M,1,20,1.3,367.427,M*05

$GPLLK,153819.00,111414,,,,,09,,,*50

$GLLLK,153819.00,111414,,,,,07,,,*42

$GBLLK,153819.00,111414,,,,,04,,,*4C

For NMEA v4.1:

Standard Talker ID = GPS only

$GPLLK,153254.00,111414,546628.909,M,5250781.888,M,1,09,1.8,366.582,M*15

Standard Talker ID = GNSS

$GNLLK,153504.00,111414,546629.055,M,5250782.977,M,1,20,1.3,367.607,M*05

☞ When more than one GNSS is active only $GNLLK is output.

A.13 LLQ - Leica Local Position and Quality

Syntax

$--LLQ,hhmmss.ss,mmddyy,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
mmddyy	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

Field	Description
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

For NMEA v4.0:

Standard Talker ID = GPS only

$GPLLQ,154324.00,111414,546629.232,M,5250781.577,M,1,09,3.876,366.549,M*05

Standard Talker ID = GNSS

$GNLLQ,154119.00,111414,546629.181,M,5250782.747,M,1,20,3.890,367.393,M*1D

$GPLLQ,154119.00,111414,,,,,,09,,,*44

$GLLLQ,154119.00,111414,,,,,,07,,,*56

$GBLLQ,154119.00,111414,,,,,,04,,,*58

For NMEA v4.1:

Standard Talker ID = GPS only

$GPLLQ,154324.00,111414,546629.232,M,5250781.577,M,1,09,3.876,366.549,M*05

Standard Talker ID = GNSS

$GNLLQ,154149.00,111414,546629.191,M,5250782.727,M,1,20,3.880,367.387,M*1B

☞ When more than one GNSS is active only $GNLLQ is output.

A.14 RMC - Recommended Minimum Specific GNSS Data

Syntax

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxxxx,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
llll.ll	Latitude (WGS 1984)
a	Hemisphere, North or South
yyyyy.yy	Longitude (WGS 1984)
a	East or West
x.x	Speed over ground in knots
x.x	Course over ground in degrees
xxxxxx	Date: ddmmyy
x.x	Magnetic variation in degrees
a	East or West
*hh	Mode Indicator
	A = Autonomous mode
	D = Differential mode
	N = Data not valid
<CR>	Carriage Return
<LF>	Line Feed

Examples

For NMEA v4.0 and v4.1:

Standard Talker ID = GPS only and GNSS

$GNRMC,154706.00,A,4724.5288205,N,00937.0842621,E,0.01,144.09,141114,0.00,E,A*10

A.15 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

Field	Description
	A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0 and v4.1:

Standard Talker ID = GPS only

$GPVTG,152.3924,T,152.3924,M,0.018,N,0.034,K,A*2D

Standard Talker ID = GNSS

$GNVTG,188.6002,T,188.6002,M,0.009,N,0.016,K,A*33

A.16 XDR – Transducer Measurements

Syntax

$--XDR,A,x.x,D,PITCH,A,x.x,A,YAW*hh<CR><LF>

Description of fields

Field	Description
$--XDR	Header including talker ID
A	Transducer type: angular displacement
x.x	Pitch Measurement data
D	Units of measure is Degrees
PITCH	Transducer #1 ID: PITCH
A	Transducer type: angular displacement
x.x	Yaw Measurement data
D	Units of measure is Degrees
YAW	Transducer #2 ID: YAW
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

$GPXDR,A,0.071,D,PITCH,A,228.132,D,YAW*5E

A.17 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

Field	Description
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>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

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

Examples

For NMEA v4.0 and v4.1:

Standard Talker ID = GPS only and GNSS

$GPZDA,155404.05,14,11,2014,01,00*61

A.18 PJK - Local Coordinate Position Output

Syntax

$PTNL,PJK,hhmmss.ss,mmddyy,nnnnnn.nnn,N,eeeeee.ee,E,
xx,xx,x.x,-HTxx.xxx,M*hh

☞ The PTNL,PJK message is longer than the NMEA-0183 standard of 80 characters.

Description of fields

Field	Description
$PTNL,PJK	Message ID $PTNL,PJK
hhmmss.ss	UTC of position fix
mmddyy	Date
nnnnnn.nnn	Northing, in metres
N	Direction of Northing is always N (North)
eeeeee.ee	Easting, in metres
E	Direction of Easting is always E (East)

Field	Description
xx	GPS quality indicator 0 = Fix not available or invalid 1 = Autonomous GPS fix 2 = RTK float solution 3 = RTK fix solution 4 = Differential, code phase only solution (DGPS) 5 = SBAS solution 6 = RTK Float 3D network solution 7 = RTK Fixed 3D network solution 8 = RTK Float 2D network solution 9 = RTK Fixed 2D network solution 10 = OmniSTAR HP/XP solution 11 = OminSTAR VBS solution 12 = Location RTK 13 = Beacon DGPS
xx	Number of satellites in fix
x.x	DOP of fix
-HTxx.xxx	Height of Antenna Phase Center **G**HT: If a user-defined geoid model or an inclined plane is loaded into the receiver, the NMEA PJK string always reports the orthometric height **E**HT: If the latitude/longitude of the receiver is outside the user-defined geoid model bounds, the height is shown as ellipsoidal height
M	M = height is measured in metres
*hh	Checksum; data always begins with *

☞ If the receiver does not have a coordinate system loaded, this string returns nothing in fields **nnnnnn.nn,N,eeeeee.ee,E** and **-HTxx.xxx**.

Examples

- $PTNL,PJK,202831.50,011112,+805083.350,N,
  +388997.346,E,10,09,1.5,GHT+25.478,M*77
- $PTNL,PJK,010717.00,081796,+732646.511,N,
  +1731051.091,E,1,05,2.7,EHT+28.345,M*7C

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.

Access

Select **Configuration > NMEA** via the Web Interface.

Refer to: Sensor Configuration.

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)
	yyyyy.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** = **2** (Dual GNSS)	

Message type	Format	Description
	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)
	yyyyy.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>	**C**arriage **R**eturn
	<LF>	**L**ine **F**eed

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,3,1,2,084709.25,310713,50,0.006,0.005,0.016,1.847,5,7,5250781.241,546672.161,371.528,1,254,084709.25,310713,100,0.005,0.004,0.012,5250781.277,546671.390,371.497,1,084709.25,310713,100,272.683,0.592*23

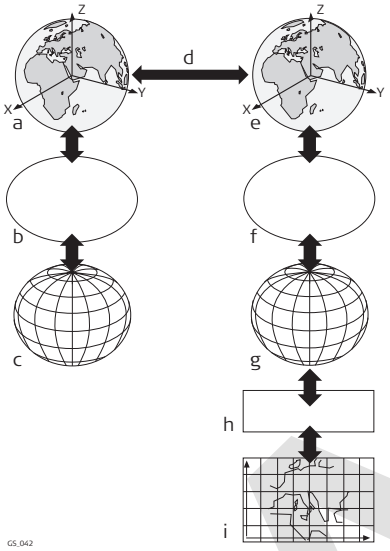
Appendix C Glossary

C.1 C

Coordinate system - elements

The five elements which define a coordinate system are:

- a transformation
- a projection
- an ellipsoid
- a geoid model
- a **C**ountry **S**pecific **C**oordinate **S**ystem 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 (*.ccg)

Description

Country **S**pecific **C**oordinate **S**ystem 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	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	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. 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 model excludes the use of a transformation in a coordinate system.

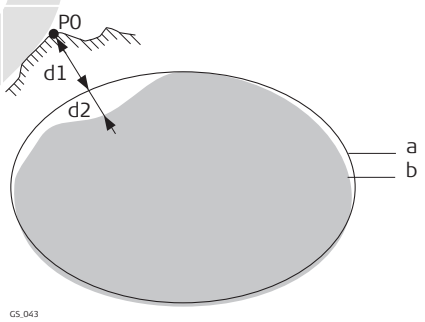
C.2 G

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

C.3 W

WGS84

WGS84 is the global geocentric datum to which all GNSS positioning information is referred to.

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