Leica iCON gps 80
User Manual

Version 2.7
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a Leica iCON gps 80 system.

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

Product Identification

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

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 80 instrument and the Leica CGA60 antenna.

Available documentation

Name	Description/Format		
Leica iCON gps 80 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 80 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 80 documentation/software:

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

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

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

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

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In this manual

1 Safety Directions

1.1 General Introduction

Description

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

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

About Warning Messages

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

Warning messages...

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

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

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

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

1.2 Definition of Use

Intended use

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

Reasonably foreseeable misuse

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

WARNING

Unauthorised modification of building and constructions machines by mounting or installing the product may alter the function and safety of the machine.
Precautions:
Follow the instructions of the machine manufacturer. If no appropriate instruction is available, ask machine manufacturer for instructions before mounting or installing the product.

1.3 Limits of Use

Environment

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

DANGER

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

1.4 Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To ensure that it is used in accordance with the instructions.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.

- To ensure that the national laws, regulations and conditions for the operation of e.g. radio transmitters or lasers are respected.
- To ensure that the radio modem is not operated without the permission of the local authorities on frequencies and/or output power levels other than those specifically reserved and intended for use without a specific permit.
  The internal and external radio modems have been designed to operate on frequency ranges and output power ranges, the exact use of which differs from one region and/or country to another.

WARNING

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

1.5 Hazards of Use

CAUTION

Installing near mechanically moving machine components may damage the product.
Precautions:
Deflect the mechanically moving machine components as far as possible and define a safe installation zone.

CAUTION

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.
Precautions:
Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use as well as before and after important measurements.

DANGER

Because of the risk of electrocution, it is dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.
Precautions:
Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

WARNING

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.
Precautions:
The person responsible for the product must make all users fully aware of the existing dangers.

WARNING

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites and at industrial installations.
Precautions:
Always ensure that the working site is adequately secured. Adhere to the regulations governing safety, accident prevention and road traffic.

CAUTION

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

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

WARNING

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.
Precautions:
Do not use the product in a thunderstorm.

DANGER

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

Lightning conductors

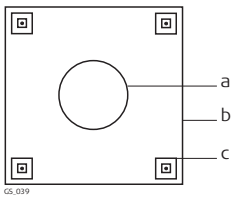
Suggestion for design of a lightning conductor for a GNSS system:
1) On non-metallic structures

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

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

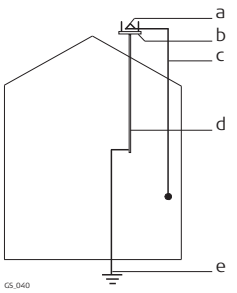
   Protection is as described for non-metallic structures, but the air terminals can be connected directly to the conducting structure without the need for down conductors.

Air terminal arrangement, plan view



a) Antenna
b) Support structure
c) Air terminal

Grounding the instrument/antenna



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

CAUTION

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

Precautions:

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

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

WARNING

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.

Precautions:

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

WARNING

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

Precautions:

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

WARNING

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

Precautions:

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

CAUTION

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

Precautions:

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

WARNING

While steering or navigating the machine accidents can occur due to **a)** the operator not paying attention to the surroundings (persons, ditches, traffic, etc.), or **b)** malfunctions (... of a system component, interference, etc.).

Precautions:

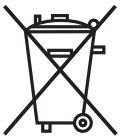
The operator assures that the machine is operated, guided and monitored by a qualified user (e.g. driver). The user has to be able to take emergency measures, for example an emergency stop.

WARNING

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

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

Precautions:



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

Product-specific treatment and waste management information can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/treatment or received from your Leica Geosystems distributor.

WARNING

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

1.6 Electromagnetic Compatibility EMC

Description

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

WARNING

Electromagnetic radiation can cause disturbances in other equipment.

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

CAUTION

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

Precautions:

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

CAUTION

Disturbances caused by electromagnetic radiation can result in erroneous measurements.
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.
Precautions:
Check the plausibility of results obtained under these conditions.

CAUTION

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.
Precautions:
While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

Radios or Digital Cellular Phones

WARNING

Use of product with radio or digital cellular phone devices:

Electromagnetic fields can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.
Precautions:
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment can be disturbed or that humans or animals can be affected.

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

1.7 FCC Statement, Applicable in U.S.

The greyed paragraph below is only applicable for products without radio, digital cellular phone devices.

WARNING

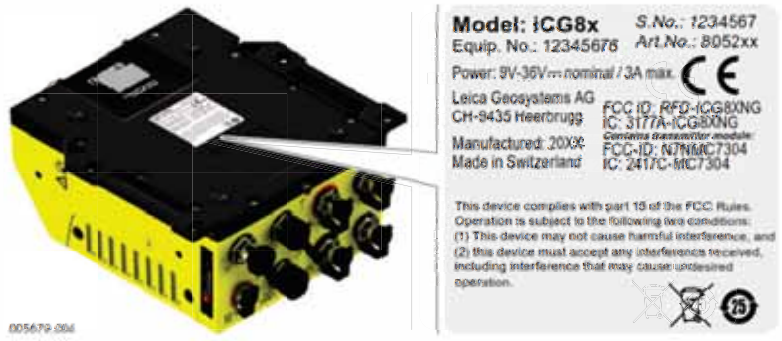
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

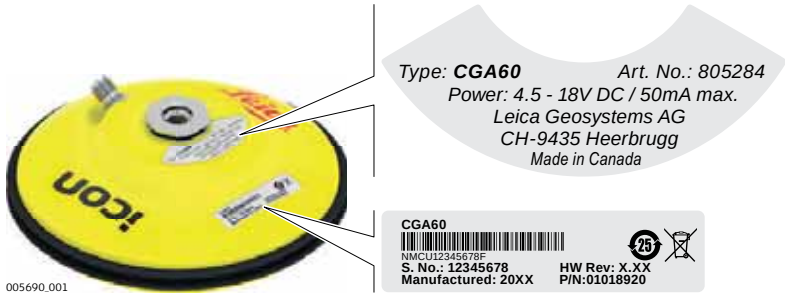
WARNING

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

Labelling iCON gps 80



Labelling CGA60



2 Description of the System

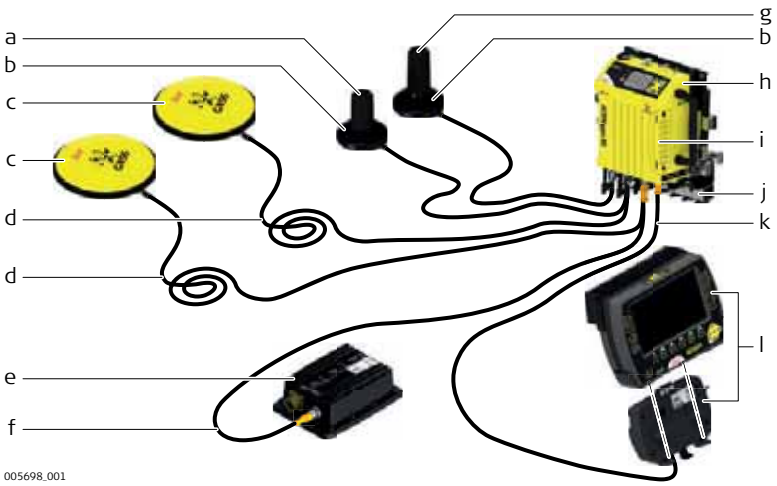
2.1 System Components

2.1.1 General Information

Description

The Leica iCON gps 80 instrument and the Leica CGA60 GNSS antenna together with dedicated accessories like the Quick Release Machine Bracket CMB6, a machine computer, or an external radio offers you highest productivity and flexibility. For example, Single GNSS configuration as well as Dual GNSS configuration is possible, but the system also can be used in a Base Station configuration.
Two example configurations are shown in the following paragraphs.

Main components, Dual GNSS configuration with internal modem

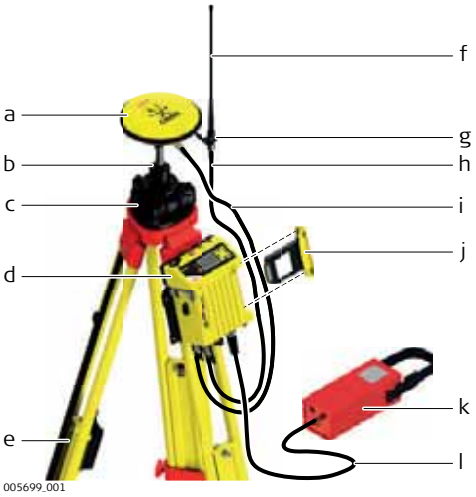


a) Modem antenna CA26
b) CA22 Magnetic radio antenna mount, 2 x
c) CGA60 Robust triple frequency GNSS antenna, 2 x
d) CA16 Antenna cable, 10 m, 2 x
e) CAN junction box
f) CAN cable
g) Radio antenna CA12
h) iCG82 Instrument
i) Internal modem
j) Quick Release Machine Bracket CMB6
k) Cable for cradle 5Pin M12/open end, 5 m
l) Machine PC

Component	Description
iCG82 Instrument	To calculate two positions from the computed ranges to all visible GNSS (**G**lobal **N**avigation **S**atellite **S**ystem) satellites.
CGA60 GNSS Antenna	To receive the satellite signals from the GNSS satellites. This Antenna is specified to the high environmental requirements on mining and construction machines.
Internal modem	For correction data transfer radios/modems are used.
Quick Release Machine Bracket CMB6	The special Quick Release Machine Bracket CMB6 can be used for a fast withdrawal of the iCON gps 80 instrument. iCON gps 80 needs to be pre-assembled with the left and right clamping rail of the CMB6, while the Quick Release Base Bracket must be installed on the machine.
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 machine's hydraulic system.

Component	Description
CAN junction box	The components are connected directly to the standard machine junction box and communication cables are connected via the machine's own CAN bus.

Main components, Base Station configuration



a) CGA60 Robust triple frequency GNSS antenna
b) GRT246 Carrier
c) CTB102 Tribrach
d) iCG81 Instrument
e) Tripod
f) GAT1 Gainflex radio antenna
g) GAD33 Arm 15 cm
h) GEV120 Antenna cable, 2.8 m
i) GEV120 Antenna cable, 2.8 m
j) Satel Radio CCD14
k) External battery GEB371
l) MSC1259 Power cable

Component	Description
iCG81 Instrument	To calculate a position from the computed ranges to all visible GNSS (**G**lobal **N**avigation **S**atellite **S**ystem) satellites.
CGA60 GNSS Antenna	To receive the satellite signals from the GNSS satellites. This Antenna is specified to the high environmental requirements on mining and construction machines.
Satel radio CCD14	For long-range data transmission.
Tripod, tribrach, carrier	To setup the instrument and GNSS antenna as a Base Station.

Satellite channels

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

Instrument	Description
iCG81/iCG82	GPS, GLONASS, BeiDou and Galileo GNSS receiver, triple frequency, code and phase, real-time capable

Special features iCON gps 80

iCON gps 80 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 in both the vertical and horizontal orientations
- Can be used near the sea
- Brackets for simple mountings
- Protection caps on connectors
- Display and keys for status and configuration
- Versatile connectivity including CAN, Serial RS232, Ethernet and Bluetooth
- USB host port for data transfer and firmware upgrade
- Integrated high speed LTE (4G) / HSPA (3.5G) / GPRS (2G) modem for countries without 4G/3G
- Integrated radio options
- Single and dual GNSS variants
- Backwards compatibility: supports external GFU communication devices for cost effective upgrade from legacy Leica systems
- Robust, compact aluminium housing

Special features CGA60

CGA60 antennas are equipped with several special features:

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

Commands for Remote Config

The iCON gps 80 instrument can be communicated:

- via the MPI protocol on the serial port P1 and Bluetooth.
- via the Leica Machine Control CAN Protocol on the CAN ports.
- via the Leica Machine Control Net Protocol on the Ethernet port, Serial P1 and Bluetooth.

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

2.1.2 Power Concept

General

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

Power options

Power for the instrument is to be supplied externally. Up to two external power supplies can be connected.
External power can be supplied by:

- 9 V to 36 V DC power supply (machine or vehicle) via a converter cable supplied by Leica Geosystems.
- GEB371 battery connected via a cable.
- 110 V/240 V AC to 12 V DC power supply unit, supplied by Leica Geosystems.

☞ iCON gps 80 can be powered using the CAN ports as well as the serial port P1.
☞ iCON gps 80 can accept different voltages on the CAN and serial ports, for example one main supply 24 V and one backup supply 12 V. However, the instrument should never be connected with two different CAN input voltages, as this may cause the instrument to power down and can potentially cause damage to the internal electronics.

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

2.2 Unpacking the Container

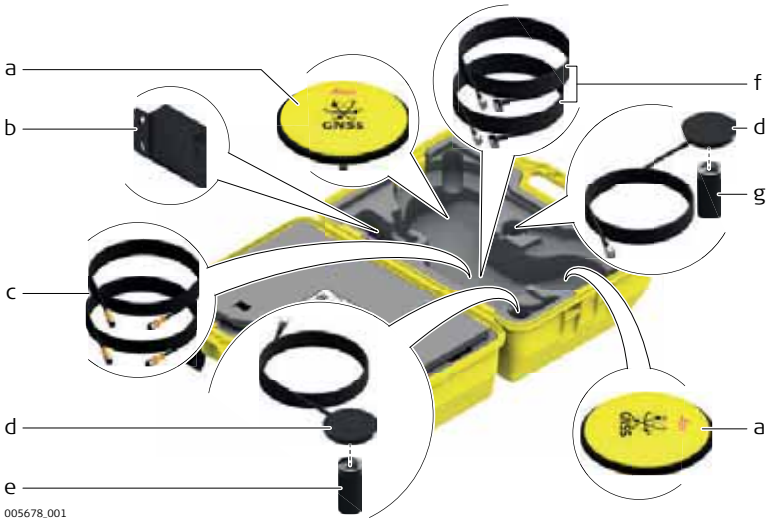
Description

Available delivery packages:

- Delivery box: when a single iCON gps 80 instrument was ordered. Includes the instrument, the printed iCON gps 80 Quick Guide and the USB documentation card.
- A hard-top container comprising all items for a Single or Dual GNSS configuration.
- A hard-top container comprising all items for a Base Station setup.

CTC4 Container upper shell

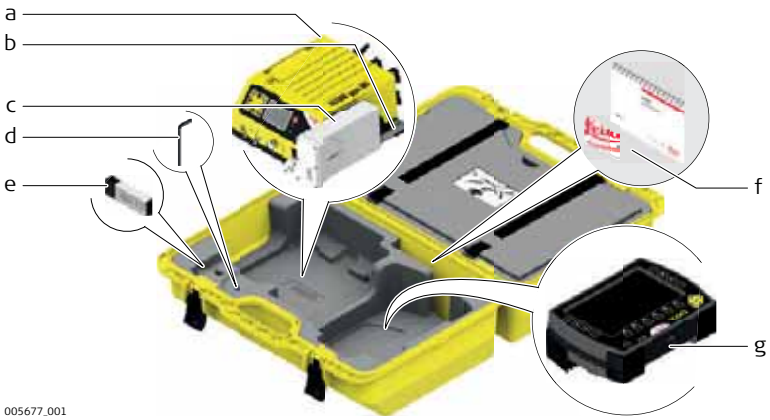
The large-size CTC4 container comprises all items for the Single and Dual GNSS configurations.



a) CGA60 Robust triple frequency GNSS antenna, 2 x
b) Slope Sensor
c) CAN cable, 2 x
d) CA22 Magnetic radio antenna mount, 2 x
e) Radio antenna CA12
f) CA16 Robust antenna cable, 2 x
g) Modem antenna CA26

CTC4 container lower shell

Large-size CTC4 container configuration with Machine PC.



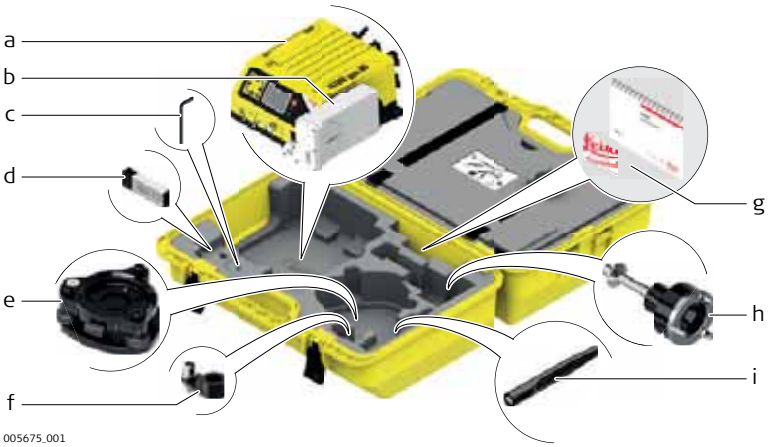
a) iCON gps 80 Instrument
b) Left and right clamping rail of the Quick Release Machine Bracket CMB6
c) GFU27 Radio modem
d) Allen key 2.5 mm
e) MS1 Industrial 1 GB USB memory stick
f) Manuals & USB documentation card
g) Machine PC

CCTC3 Container upper shell

The large-size CCTC3 container comprises all items for the Base Station setup.

a) CGA60 Robust triple frequency GNSS antenna
b) GAD32 Telescopic rod
c) GAT1 Radio antenna
d) CA15 Antenna cable, 5 m
e) MSC1259 Power cable
f) GAD33 Arm 15 cm
g) GHT36 Base for telescopic rod
h) GSZ4-1 Height hook

CCTC3 container lower shell



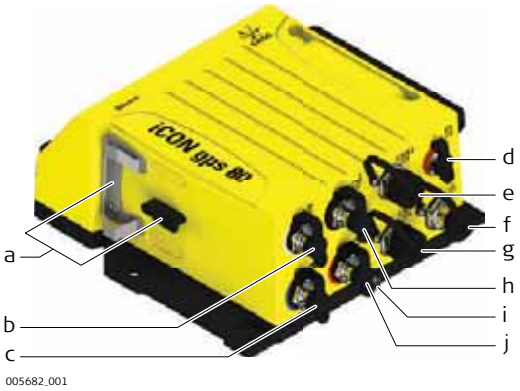
a) iCON gps 80 Instrument
b) GFU27 Radio modem
c) Allen key 2.5 mm
d) MS1 Industrial 1 GB USB memory stick
e) CTB102 Tribrach
f) GAD34 Adapter antenna to extension
g) Manuals & USB documentation card
h) GRT246 Carrier
i) GAT18 Multiband GSM/UMTS antenna

iCG81/iCG82 components

Front view:

a) RS232 port P2
b) Power and status LED, Ambient light sensor
c) ON/OFF button
d) Display
e) Keyboard
f) Tripod fastening clip
g) Cover for USB port
h) Mounting holes
i) Carrying handle, optional accessory
j) Radio cover, SIM card and slot-in-device compartment

Rear view:



a) Support for GFU device
b) External radio antenna port
c) Primary External GNSS antenna port
d) P1 Data/Power port
e) CAN1 Data/Power port
f) Ethernet port
g) CAN2 Data/Power port
h) External Modem antenna port
i) Grounding screw
j) Secondary external GNSS antenna port, iCG82 only

Port	Description
USB 2.0	USB A data port, for data exchange, software updates.
P1 (8-pin LEMO 1, female)	Power input, serial interface for data input/output, and PPS.
P2 (8-pin LEMO 1, female)	RS232 for connection of an external radio device.
RADIO	For connection of an external radio antenna.
CAN1, CAN2	Power input and data input/output. CAN ports are connected internally so connection order is not important.
ANT1, ANT2	GNSS antenna input. ANT1 is always the primary GNSS antenna and ANT2 is always the secondary (heading) GNSS antenna.
MODEM	For connection of an external antenna for the internal 4G modem.

CGA60 components

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

CMB6 components

a) Feed through for Padlock
b) Locking bolt
c) Mounting screws, for vehicle mounting
d) Guiding rail
e) Carrying handle, optional accessory for iCON gps 80
f) Clamping rail
g) Dummy plugs for cable storage
h) Quick Release Base Bracket
i) Locking bolt for Padlock

3 Using iCON gps 80

3.1 Power Supply

External power supply only

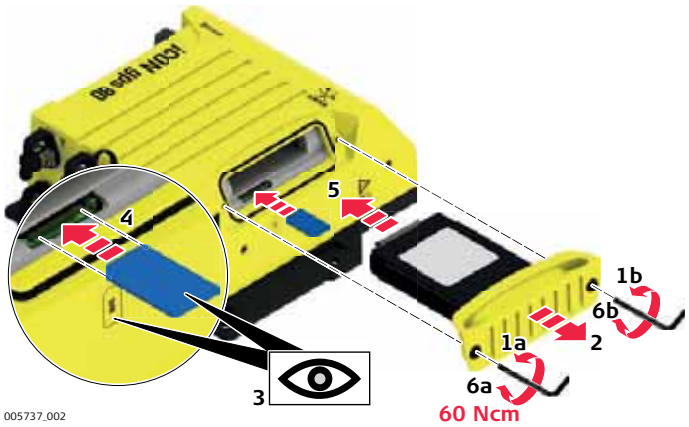
- 9 V to 36 V DC power supply (machine or vehicle) via a converter cable supplied by Leica Geosystems.
- The iCON gps 80 instrument can be powered via the **CAN** ports as well as **Port 1**.
- A GEB371 battery can also be connected via cable.

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

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

3.2 Installing a SIM Card

Insert and remove the SIM card step-by-step



Step	Description
☞	Ensure the instrument is placed in it's fixed position or place it onto a stable surface.
1.	Loosen the screws of the Radio cover with the supplied Allen key.
2.	Remove the Radio cover. ☞ The indents on the Radio cover allow to grip and pull for removal.
3.	Orientate the SIM card as illustrated.
4.	Insert the SIM card into the card slot and push it in until it locks into place.
5.	Place the Radio cover back into position.
6.	Tighten the screws of the Radio cover, with maximum 60 Ncm. ☞ Secure the screws with Loctite 243 or a similar product to ensure that the instrument is waterproof.

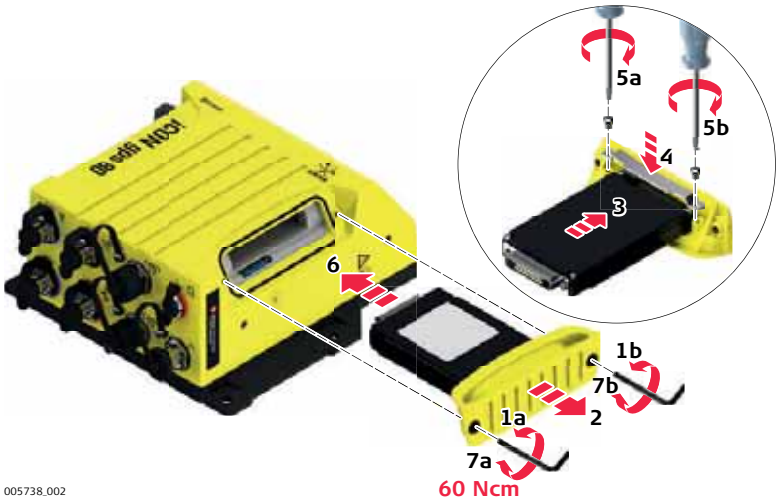
☞ To remove the SIM card push the card in again, then it pops out and can be removed.

Internal radios

Following internal radios can be used with the instrument:

Radio	Device
Satel TA13	CCD7
Intuicom 900SLR	CCD8

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



Step	Description
☞	Ensure the instrument is placed in it's fixed position or place it onto a stable surface.
1.	Loosen the screws of the Radio cover with the supplied Allen key.
2.	Remove the Radio cover. ☞ The indents on the Radio cover allow to grip and pull for removal.
3.	Place the slot-in-device into position to the Radio cover.
4.	Place the mounting bracket into position.
5.	Tighten the screws.
6.	Place the Radio cover back into position.
7.	Tighten the screws of the Radio cover, with maximum 60 Ncm. ☞ Secure the screws with Loctite 243 or a similar product to ensure that the instrument is waterproof.
☞	For the equipment setup as real-time base station with radio, it's recommended to use an external radio antenna mounted on a second tripod. This increases the height of the radio antenna and therefore maximises radio coverage. Please contact the local selling unit or dealer for further information.

Devices fitting into a clip-on-housing

Radios fitting into a clip-on-housing

Radio	Clip-on-housing
Intuicom 1200DL, transceive	1200DL
Pacific Crest PDL, receive	GFU15
Satelline 3AS, transceive	GFU14
Satelline M3-TR1, transceive	GFU27
TFR-300L, receive	no GFU number

Pacific Crest radio modems

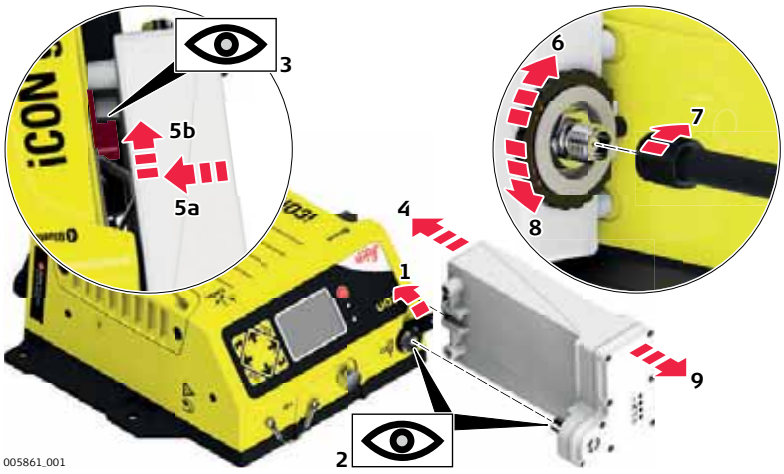
Pacific Crest radio modems must be ordered directly from your local Pacific Crest Office or Representative.

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

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

☞ Pacific Crest ADL, transceive, can be used but is not available in a clip-on-housing.

Attach and detach a clip-on-housing step-by-step



Step	Description
☞	Ensure the instrument is placed in it's fixed position or place it onto a stable surface.
1.	Flip the protection cap of port P2 aside.
2.	Ensure that the connector on the clip-on-housing fits to port P2 on the instrument front panel.
3.	Place the clip-on-housing into position such that the guide rails for the clip-on-housing on the instrument and the guide rails on the clip-on-housing are aligned.
4.	Slide the clip-on-housing towards the instrument front panel to the guide rails on the instrument.
5.	Apply slight pressure to the clip-on-housing towards the instrument side and slide the clip-on-housing towards the instrument front panel until the connector is plugged into port P2.

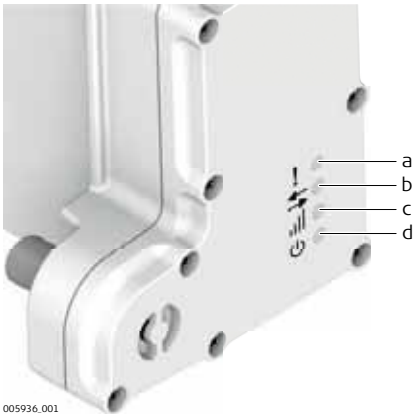
Step	Description
6.	On the top side of the clip-on-housing, turn the screw clockwise, as shown by the symbols on the screw, to lock the clip-on-housing to the instrument.
7.	Screw the radio antenna or a radio antenna cable onto the clip-on-housing.
8.	To detach the clip-on-housing, turn the screw anticlockwise on the top side of the clip-on-housing, as shown by the symbols on the screw, to unlock the clip-on-housing from the instrument.
9.	Slide the clip-on-housing away from the instrument front panel until the connector is unplugged from port P2 and the guide rails are released.
10.	Place the protection cap on port P2 again.

LED indicators

Description

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

Diagram



a) Mode LED, available for Satelline 3AS and M3-TR1
b) Data transfer LED
c) Signal strength LED
d) Power LED

Description of the LEDs

IF the	on	is	THEN
Mode LED	GFU14 with Satelline 3AS, GFU27 with Satelline M3-TR1	red	the device is in the programming mode controlled from the PC via cable.
Data transfer LED	any device	off	data is not being transferred.
		green or flashing green	data is being transferred.
Signal strength LED	GFU15 with Pacific Crest PDL	red or flashing red	the communication link, **D**ata **C**arrier **D**etection, is okay on the roving instrument.
		off	the DCD is not okay.
	GFU14 with Satelline 3AS, GFU27 with Satelline M3-TR1	red or flashing red	the communication link, **D**ata **C**arrier **D**etection, is okay on the roving instrument.
		off	the DCD is not okay.
Power LED	any device	off	power is off.
		green	power is okay.

3.5 Using USB Memory Devices

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

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Step	Description
☞	Ensure the instrument is placed in it's fixed position or place it onto a stable surface.
1.	Loosen the knurled screw of the USB port cover.
2.	Flip the cover aside.
3.	Slide the USB Memory device firmly into the USB host port until it clicks into position.
☞	Take care not to damage the USB Memory device when moving the iCON gps 80 or when handling around the device.
☞	It's recommended to close the USB port cover when no USB Memory device is used.

Preconditions for using USB Memory devices

- USB Memory devices must be formatted in the FAT or FAT32 format.
- To import data from a USB Memory device to the iCON gps 80 appropriate folders must be created on the USB device and the files placed in the correct folder. Refer to "6.6 Import, Export, or Delete Data" for further information.

3.6 Quick Release Machine Bracket CMB6

Installation information

Installation of the Quick Release Machine Bracket CMB6 should be carried out in a way to respect following aspects:

- Stable mounting construction, in a position without interfering the operators work space.
- The Quick Release Base Bracket as part of the CMB6 must be installed on the machine or the desired installation spot accordingly, either using the Magnetic Mount or bolted.
- Easy and secure access to attach and detach the iCON gps 80 instrument.
- Easy and secure access to all connected cables.
- Easy access to the iCON gps 80 keys and a clear view on the display.

☞ Like all other installation works, the installation of the CMB6 must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

Attach and detach the iCON gps 80 step-by-step

Attach the iCON gps 80

Step	Description
☞	iCON gps 80 needs to be pre-assembled with the left and right clamping rail of the Quick Release Machine Bracket CMB6. The Quick Release Base Bracket must be pre-installed on the machine or the desired installation spot accordingly, either using the Magnetic Mount or bolted.
1.	Insert the iCON gps 80 into position on the "fixed jaw" side of the Quick Release Machine Bracket CMB6.
2.	Lower the instrument on the "spring jaw" side of the CMB6, until the locking bolt snaps into place.
3.	If applicable, attach a padlock to the feed through and lock up.
4.	Connect all cables needed for the current configuration to the corresponding connectors. Cables and connectors are colour coded, for easy assignment.
☞	Ensure to connect all cables to the corresponding connector, to protect the instruments from damage.
5.	When the cables have been stored on a dummy plug before, close the dummy plug with its protection cap.

Detach the iCON gps 80

Step	Description
☞	Before detaching the iCON gps 80, ensure the instrument is properly shut down and power switched off.
1.	To detach the iCON gps 80, first detach the connected cables one by one and store them onto a proper dummy plug. Connector positions and dummy plugs are symbol coded, for easy assignment.
2.	If applicable, unlock and detach the padlock.
3.	Withdraw the locking bolt from its locking position and arrest it in open position by rotating.
4.	Slide the instrument on the guiding rails of the Quick Release Machine Bracket CMB6 out of the guides and remove the instrument. Take care not to cant the upper and lower part of the CMB6.
5.	Refit the protection caps of the iCON gps 80 plugs.
☞	The plugs of the iCON gps 80 and the CMB6 should always be covered using the corresponding protection cap, when no cable is plugged in.

3.7 Installation on a Machine

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

☞ Before installation:

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

Installation location

The iCON gps 80 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. Further, the instrument is to be installed so that it is protected from mechanical influences, for example stoning.

Examples of a **correctly placed** instrument.

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

Installation direction

- For inside assembly, the iCON gps 80 instrument must be installed either vertically with the connectors pointing upwards/downwards or horizontally on a flat plane. Easy access to the keys and a clear view on the display 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 80 instrument must have supports beneath all mounting holes and should be fastened with four M6 bolts (or equivalent).
- The Quick Release Machine Bracket CMB6 is easy to handle and forms a secure mounting option for the instrument. The Quick Release Base Bracket as part of the CMB6 must be installed on the machine, either using the Magnetic Mount or bolted.

Quick Release Machine Bracket

The special Quick Release Machine Bracket CMB6 can be used for a fast withdrawal of the iCON gps 80 instrument.

☞ The CMB6 should be be installed in a location that allows easy releasing and simple removing of the iCON gps 80 instrument. Refer to "3.6 Quick Release Machine Bracket CMB6" for further information.

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 80.
For this reason, it is best that all external antennas connected to the iCON gps 80, including the GNSS antenna(s), radio antenna and modem antenna, 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 80 to the machine should not be required.

☞ **It is extremely important to disconnect all cables from the iCON gps 80 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, and
- 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.

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Installation on a grader/dozer:

- Install the GNSS antenna on the mast on the blade. Be aware of heat from the exhaust.

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Installation of external radio

In case the external GFU radio cannot be mounted directly on the iCON gps 80 due to space limitations, then a special bracket for proper mounting can be used.
GFU bracket: MMB1250, GFU Bracket on Machine

Installation of antennas for internal/external radios and modems

- External antennas with a magnetic mount can be used and installed on the roof of the cabin.
- This will increase the radio signal and therefore the reception of correction signals from a base station or when using a NTRIP solution.

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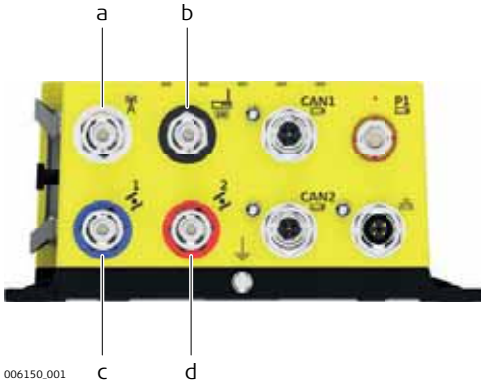
Cable installation

- Ensure that the cables between iCON gps 80 and CGA60 antenna in particular are installed so as to prevent them from becoming bent and stretched.
- It is strongly recommended to use strain relief brackets.
- Route the cable as directly as possible and avoid crossing cables.
- Be sure not to tie the cables into "hot" hydraulic hoses.

☞ 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 four TNC connectors are colour coded. Cables with corresponding colours are available.

The colour coding is as follows:



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a) White: Radio
b) Black: Modem
c) Blue: GNSS Antenna 1
d) Red: GNSS Antenna 2

3.8 Antenna Heights

3.8.1 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.

MRP

The antenna accepts vertical height readings to the **M**echanical **R**eference **P**lane, MRP.

Vertical phase centre variations

These are handled automatically in the standard antenna records. The antenna calibrations to determine the phase centre variations were executed by Geo++® GmbH.

☞ **Pillar setup**. For other than the GRT146 carrier, the dimensions must be determined and the vertical offset must be adapted.

☞ **Tripod setup**. For height measurement devices other than the height hook, the dimensions must be determined and the vertical offset must be adapted.

☞ **Mast setup**. The dimensions of the mast must be determined.

3.8.2 The Mechanical Reference Plane, MRP

Description

The **M**echanical **R**eference **P**lane:

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

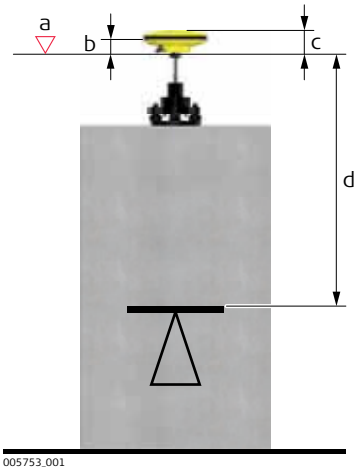
MRP of the antenna

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

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

Measuring the antenna height - pillar setup

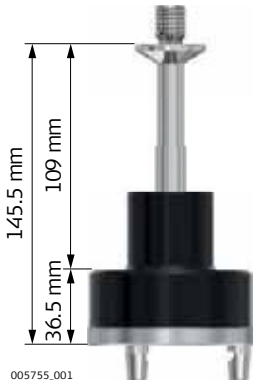
Setup type	Antenna name	The required measurement
Pillar	CGA60	the vertical height reading to the MRP.



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

No vertical offset.

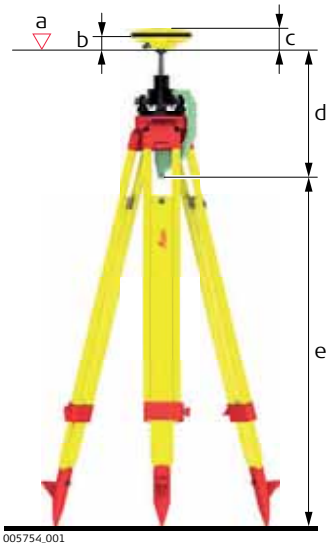
Determining the antenna height with the GRT146 carrier step-by-step

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

3.8.4 Measuring the Antenna Height for a Tripod Setup

Measuring the antenna height - tripod setup

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



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

Vertical offset = 0.36

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

Step	Description
1.	The vertical height reading = vertical height reading from the height hook. • The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. • The vertical offset of 0.36 m is automatically stored in the antenna setup record for a tripod setup and will automatically be taken into account. It does not need to be entered.

3.8.5 Measuring the Antenna Height for a Mast Setup

Measuring the antenna height - pole setup

Setup Type	Antenna type	The required measurement
Mast	CGA60	vertical distance from the GNSS antenna MRP to a fixed point on the top of the blade (when the blade has both zero long fall and cross fall).

General information

When two GNSS antennas are connected to the iCG82 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 iCG82 uses a **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 always the primary GNSS antenna while the one on port ANT2 is always 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

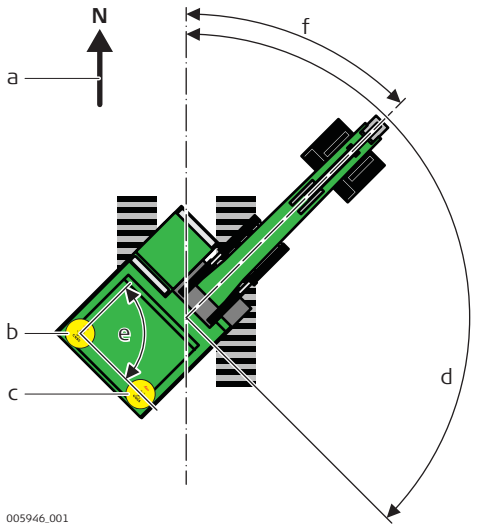
Heading output is the azimuth from GNSS Antenna 1 to GNSS Antenna 2. If it is not possible to mount the antennas parallel to the centreline of the vehicle, then the **known orientation to the centreline** can be entered as a **Heading Adjustment**.

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 anti-clockwise 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 in the **Position** sub menu on the display.
Heading output can be configured on either of the serial ports (P1 or P2) using the **NMEA Output** wizard.

Heading output is available in following message formats:

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

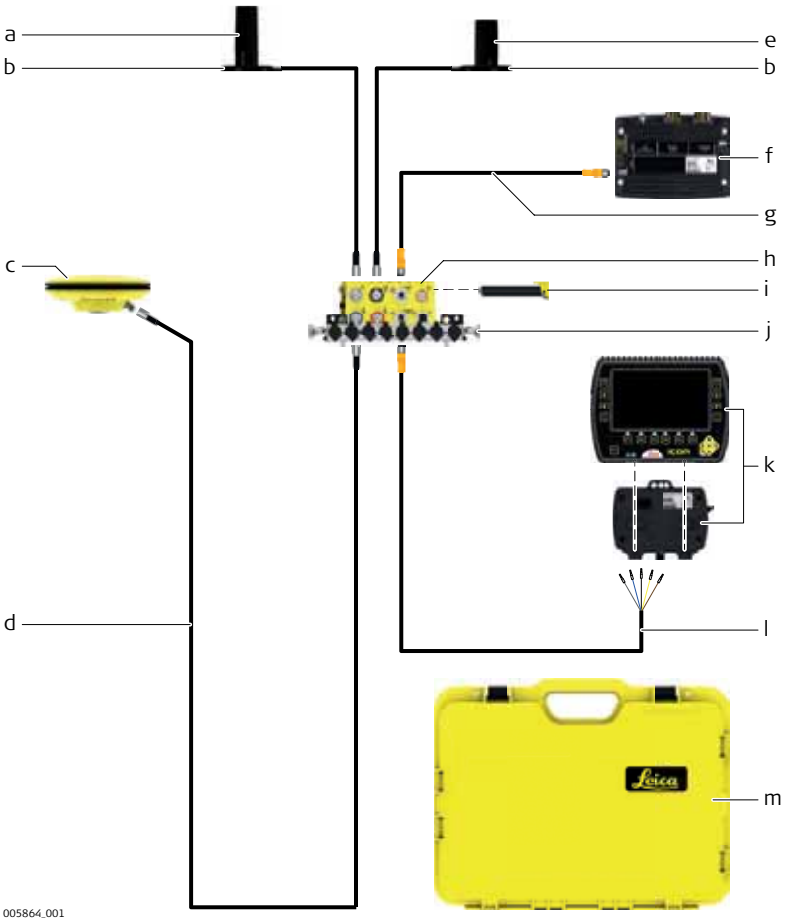
Refer to "6.3 ORP and NMEA Output" for further information.

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.

4.1 Single GNSS Setup, with Internal Radio

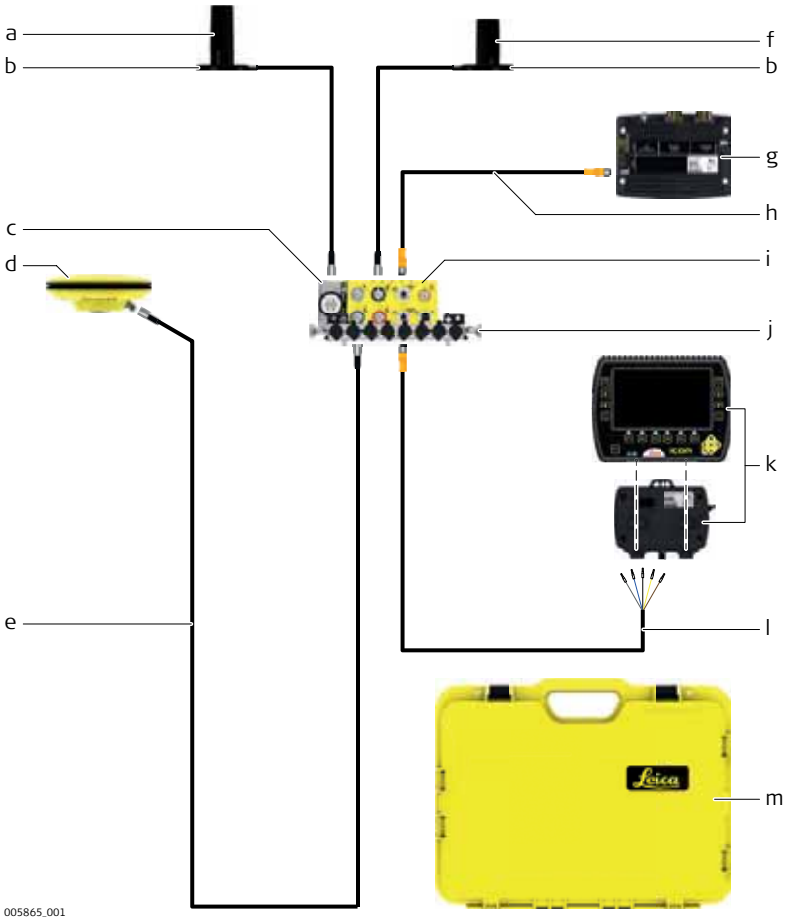
Single GNSS setup with internal radio modem



a) Radio antenna CA12
b) CA22 Magnetic radio antenna mount, 2 x
c) CGA60 Robust triple frequency GNSS antenna
d) CA16 Antenna cable, 10 m
e) Modem antenna CA26
f) Junction box / Machine Power Supply
g) CAN cable
h) iCG81 Instrument
i) Satel radio CCD14
j) Quick Release Machine Bracket CMB6
k) Machine PC
l) Cable for cradle 5Pin M12/open end, 5 m
m) CTC4 Carry Case

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

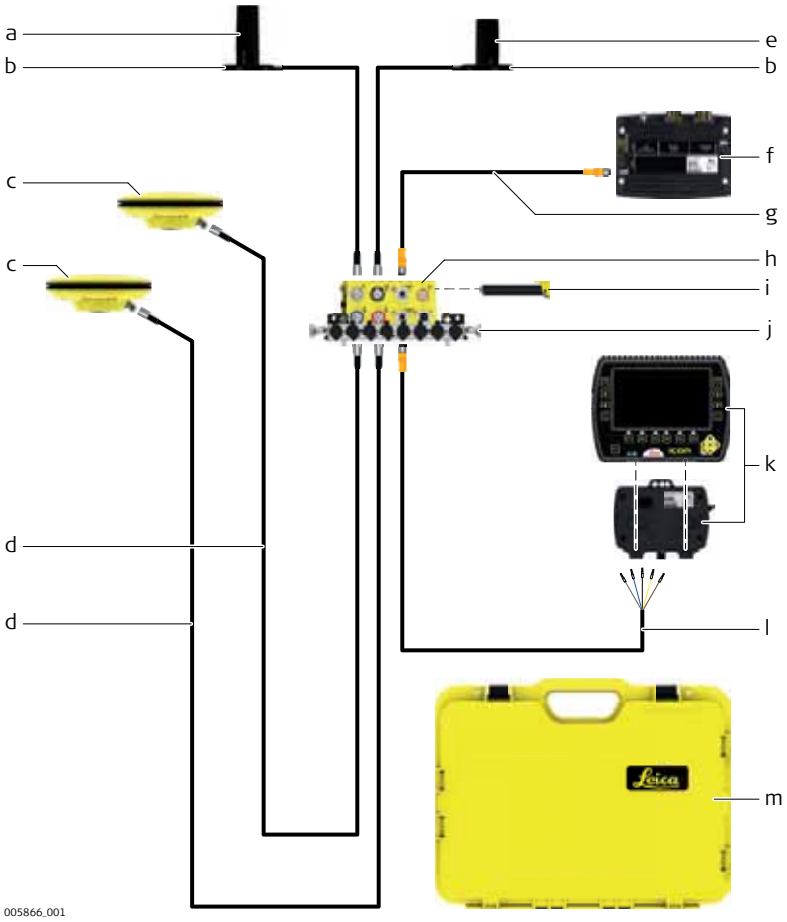
Single GNSS setup with external radio modem



a) Radio antenna CA12
b) CA22 Magnetic radio antenna mount, 2 x
c) External radio modem GFU27
d) CGA60 Robust triple frequency GNSS antenna
e) CA16 Antenna cable, 10 m
f) Modem antenna CA26
g) Junction box / Machine Power Supply
h) CAN cable
i) iCG81 Instrument
j) Quick Release Machine Bracket CMB6
k) Machine PC
l) Cable for cradle 5Pin M12/open end, 5 m
m) CTC4 Carry Case

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

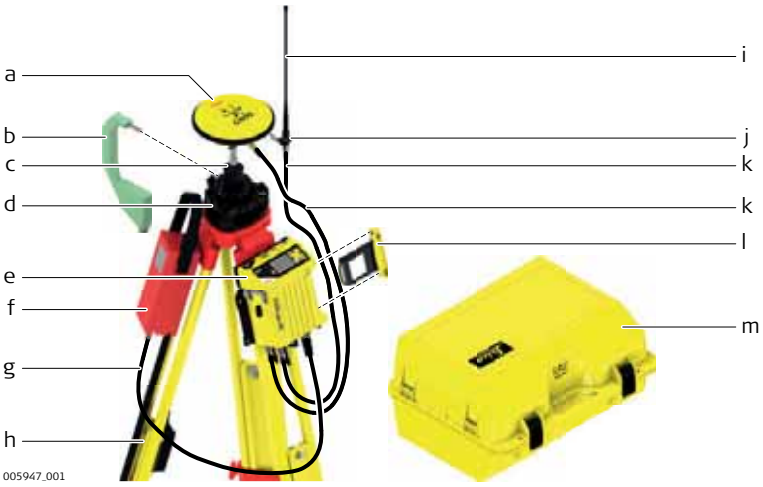
Dual GNSS setup with internal radio modem



a) Radio antenna CA12
b) CA22 Magnetic radio antenna mount, 2 x
c) CGA60 Robust triple frequency GNSS antenna, 2 x
d) CA16 Antenna cable, 10 m, 2 x
e) Modem antenna CA26
f) Junction box / Machine Power Supply
g) CAN cable
h) iCG82 Instrument
i) Satel radio CCD14
j) Quick Release Machine Bracket CMB6
k) Machine PC
l) Cable for cradle 5Pin M12/open end, 5 m
m) CTC4 Carry Case

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

Local Base Station setup, on Tripod

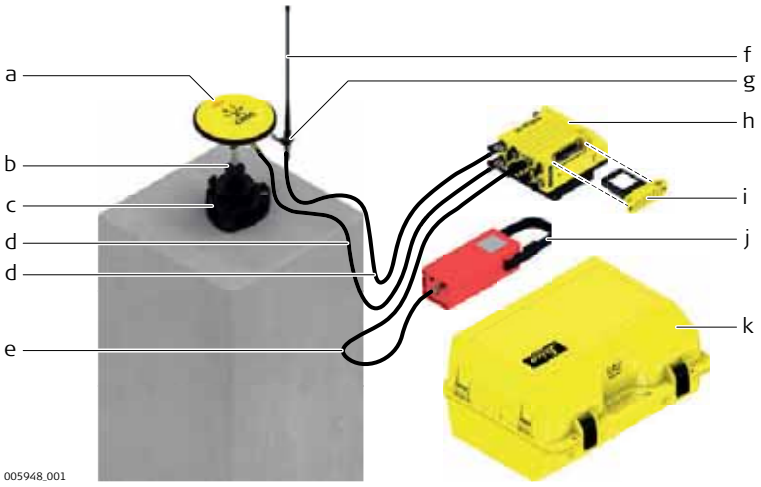


a) CGA60 Robust triple frequency GNSS antenna
b) GSZ4-1 Height hook
c) Carrier GRT246
d) CTB102 Tribrach, with optical plummet
e) iCG81 Instrument
f) External battery GEB371
g) MSC1259 Cable instrument to external battery, 1.8 m
h) Wooden tripod GST05
i) Gainflex radio antenna
j) GAD33 Arm 15 cm long, attaches to GNSS antenna
k) Antenna cable, 2.8 m, 2 x
l) Satel radio CCD14
m) CCTC3 Carry Case

Local Base Station setup, on Tripod step-by-step

Step	Description
☞	Ensure Satel Radio CCD14 is correctly installed and configured.
1.	**Setting Up the Equipment**
	• Set up the tripod, mount and level the CTB102 tribrach onto the tripod.
	• Check that the tribrach is correctly centred over the marker.
	• Place and lock the GRT246 carrier into the tribrach.
	• Screw the CGA60 GNSS antenna onto the carrier.
	• Attach the GAD33 arm to the base of the CGA60 GNSS antenna.
	• Attach the Gainflex radio antenna to the GAD33 arm.
☞	The GAD32 telescopic rod can be used to increase the antenna height. This will increase the radio signal and therefore the reception of correction signals from a base station or when using a NTRIP solution.
	• Check that the tribrach is still correctly positioned and levelled.
	• Hang the iCG81 instrument onto a tripod leg.
	• Hang the external battery GEB371 onto a tripod leg.
	• Use the Antenna cable to connect the GNSS antenna to port ANT1 on the iCG81.
	• Use the second Antenna cable to connect the GAD33 arm to the RADIO port on the iCG81.
	• Use the MSC1259 cable to connect the external battery to the P1 port on the iCG81.
	• Turn on the instrument.
☞	GSZ4-1 Height hook is needed to measure the Antenna Height later on.
2.	**Perform a Base Station setup on the iCG81.**
	Refer to "6.1 Base Setup" for further information.

Local Base Station setup, on Pillar

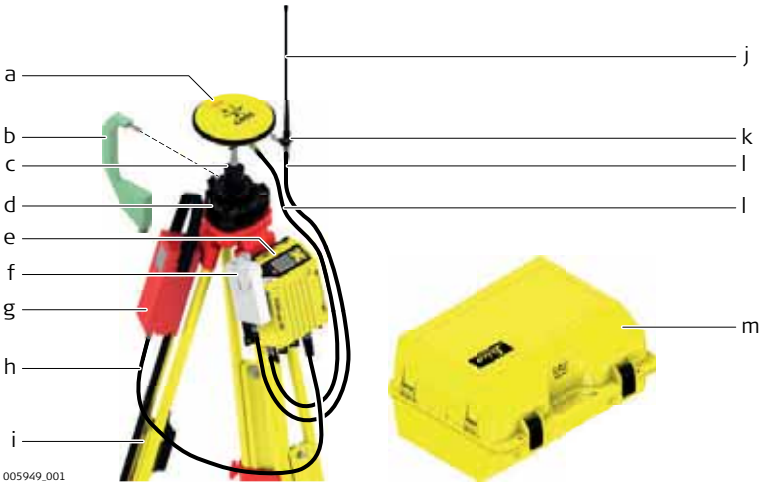


a) CGA60 Robust triple frequency GNSS antenna
b) Carrier GRT246
c) CTB102 Tribrach, with optical plummet
d) Antenna cable, 2.8 m, 2 x
e) MSC1259 Cable instrument to external battery, 1.8 m
f) Gainflex radio antenna
g) GAD33 Arm 15 cm long, attaches to GNSS antenna
h) iCG81 Instrument
i) Satel radio CCD14
j) External battery GEB371
k) CCTC3 Carry Case

Local Base Station setup, on Pillar step-by-step

Step	Description
☞	Ensure Satel Radio CCD14 is correctly installed and configured.
☞	The pillar must be prepared to mount the CTB102 tribrach to.
1.	**Setting Up the Equipment**
	• Mount and level the CTB102 tribrach onto the pillar.
	• Place and lock the GRT246 carrier into the tribrach.
	• Screw the CGA60 GNSS antenna onto the carrier.
	• Place the iCG81 onto the pillar or any other suitable location.
	• Place the external battery GEB371 onto the pillar or any other suitable location.
	• Attach the GAD33 arm to the base of the CGA60 GNSS antenna.
	• Attach the Gainflex radio antenna to the GAD33 arm.
	• Use the Antenna cable to connect the GNSS antenna to port ANT1 on the iCG81.
	• Use the second Antenna cable to connect the GAD33 arm to the RADIO port on the iCG81.
	• Use the MSC1259 cable to connect the external battery to the P1 port on the iCG81.
	• Turn on the instrument.
2.	**Perform a Base Station setup on the iCG81.**
	Refer to "6.1 Base Setup" for further information.

Local Base Station setup, with external radio

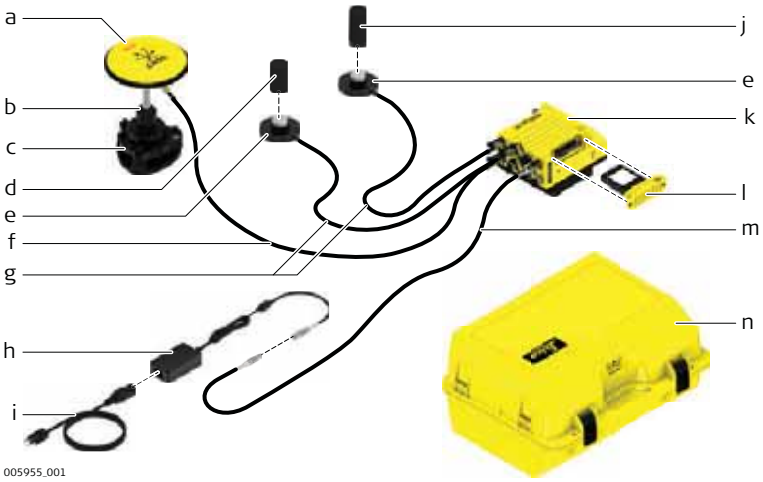


a) CGA60 Robust triple frequency GNSS antenna
b) GSZ4-1 Height hook
c) Carrier GRT246
d) CTB102 Tribrach, with optical plummet
e) iCG81 Instrument
f) Radio modem GFU device
g) External battery GEB371
h) MSC1259 Cable instrument to external battery, 1.8 m
i) Wooden tripod GST05
j) Gainflex radio antenna
k) GAD33 Arm 15 cm long, attaches to GNSS antenna
l) Antenna cable, 2.8 m, 2 x
m) CCTC3 Carry Case

Local Base Station setup, with external radio step-by-step

Step	Description
☞	Ensure the external Radio modem GFU device is correctly installed and configured.
1.	**Setting Up the Equipment**
	• Set up the tripod, mount and level the CTB102 tribrach onto the tripod.
	• Check that the tribrach is correctly centred over the marker.
	• Place and lock the GRT246 carrier into the tribrach.
	• Screw the CGA60 GNSS antenna onto the carrier.
	• Attach the GAD33 arm to the base of the CGA60 GNSS antenna.
	• Attach the Gainflex radio antenna to the GAD33 arm.
	• Check that the tribrach is still correctly positioned and levelled.
	• Hang the iCG81 instrument onto a tripod leg.
	• Hang the external battery GEB371 onto a tripod leg.
	• Attach the external Radio modem GFU device to the P2 port on the iCG81 instrument.
	• Use the Antenna cable to connect the GNSS antenna to port ANT1 on the iCG81.
	• Use the second Antenna cable to connect the GAD33 arm to the GFU device.
	• Use the MSC1259 cable to connect the external battery to the P1 port on the iCG81.
	• Turn on the instrument.
☞	GSZ4-1 Height hook is needed to measure the Antenna Height later on.
2.	**Perform a Base Station setup on the iCG81.**
	Refer to "6.1 Base Setup" for further information.

Local Base Station setup - Permanent



a) CGA60 Robust triple frequency GNSS antenna
b) Carrier GRT246
c) CTB102 Tribrach, with optical plummet
d) Modem antenna CA26
e) CA22 Magnetic radio antenna mount, 2 x
f) CA16 Antenna cable, 10 m
g) Antenna cable, 2 x
h) Power supply unit GEV208
i) AC power cable, country specific
j) Radio antenna CA12
k) iCG81 Instrument
l) Satel radio CCD14
m) GEV219 Cable Lemo 8 pin to Lemo 5 pin
n) CCTC3 Carry Case

Local Base Station setup, Permanent step-by-step

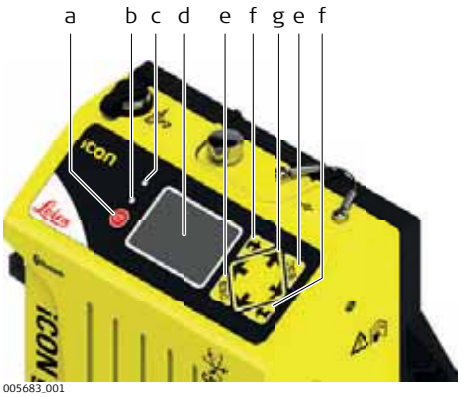
Step	Description
☞	Ensure Satel Radio CCD14 is correctly installed and configured.
☞	The site/office/container must be prepared to mount the CTB102 tribrach to, in a way, to ensure a clear view of the sky for the GNSS antenna.
1.	**Setting Up the Equipment**
	• Mount and level the CTB102 tribrach onto the site/office/container.
	• Place and lock the GRT246 carrier into the tribrach.
	• Screw the CGA60 GNSS antenna onto the carrier.
	• Attach the CA22 magnetic radio antenna mount together with the CA12 radio antenna to the site/office/container.
	• Attach the second CA22 magnetic radio antenna mount together with the CA26 modem antenna to the site/office/container.
☞	The higher the radio antennas are mounted, the better the radio transmission range.
	• Place the iCG81 instrument onto a prepared suitable location.
	• Use the Antenna cable to connect the CA12 radio antenna to the RADIO port of the iCG81 instrument.
	• Use the second Antenna cable to connect the CA26 modem antenna to port P2 of the iCG81 instrument.
	• Use the CA16 Antenna cable to connect the GNSS antenna to port ANT1 of the iCG81 instrument.
	• Use the GEV219 power cable to connect the Power supply unit to port P1 of the iCG81 instrument.

Step	Description
	• Connect the AC power cable to the Power supply unit GEV208 and plug it into the power outlet.
	• Turn on the instrument.
2.	**Perform a Base Station setup on the iCG81.**
	Refer to "6.1 Base Setup" for further information.

5 iCON gps 80 User Interface

5.1 User Interface Description

User Interface overview



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

User Interface elements

The instrument can be controlled via the user interface elements.

Element		Function
Navigation keys 		4-way navigation in the menus via left, right, up and down key.
Enter key 		• To activate editing. • To accept changes. • To enter a menu or submenu.
ESC key 		• To cancel operations. • To leave a menu or submenu.
ON/OFF key 		Gives access to startup and shutdown: press for three seconds.
Display		Displays status information and software functions.
Ambient light sensor		Energy saving ambient light sensor. ☞ When the display **Backlight** is set to **Auto**, the Backlight intensity is automatically adjusted on the ambient light sensor input.
Power LED	off	Instrument is switched off.
	continuously green	• Normal operation mode. • Position acquired.
	continuously red	• During start-up of the instrument. • For various errors occuring. The current status information is shown on the display.

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

☞ Use the  key to enter a submenu and confirm settings.

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

Display orientation

To enable a proper view on the display for various mounting options the iCON gps 80 allows to flip the screen, providing a up-side-down use of the display.

1) Access the wizard via **Settings** › **System Configuration** › **Screen Settings**.
2) Choose the **Flip Screen** setting to meet your needs:
   No: for the default display orientation.
   Yes: to rotate the display orientation by 180°.
3) Press to confirm your setting. The display orientation is changed immediately.

5.2 Main Menu

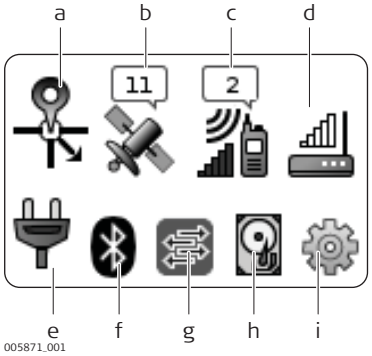
Description

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

Main Menu content

The Main Menu features a matrix set of menu icons.

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



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

Additional icon information

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

Icon		Description
Position		Instrument has not obtained a position.
		• Navigated position has been obtained. • Error ≤ 10 m.
		• Float position has been obtained. • Error ≤ 0.5 m.
		• xRTK position has been obtained. • Error < 0.05 to 0.10 m.
		• High accuracy position has been obtained. • Error ≤ 0.05 m.
		Navigated position plus high accuracy heading have been obtained.
		Float position plus high accuracy heading have been obtained.
		xRTK position plus high accuracy heading have been obtained.
		High accuracy position plus high accuracy heading have been obtained.
		No GNSS antenna is connected to the instrument.

Icon		Description
		**iCON gps 80** is operating as a **base**.
		**BasePilot** setup in progress.
		**BasePilot** setup failed.

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

Icon		Description
Radio		Radio not in use.
		• Radio set to receive correction data in **rover** mode. • Active radio channel is displayed. • Waves flash when correction data is received.
		• Radio set to transmit correction data in **base** mode. • Active radio channel is displayed. • Waves flash when correction data is transmitted.
		Radio frequency set manually.
		Radio error.
		Sensor is receiving corrections over SmartLink due to an interrupted or broken radio link.

Icon		Description
Modem		Modem not in use.
		Modem connected to a cell phone network.
		• Modem set to receive correction data in **rover** mode. • Waves flash when correction data is received.
		• Modem set to transmit correction data in **base** mode. • Waves flash when correction data is transmitted.
		Modem error.
		Sensor is receiving corrections over SmartLink due to an interrupted or broken modem link.

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

Icon		Description
Power		External power is used.
		External power is used, low voltage warning.

Icon		Description
iCON Telematics/Port Summary		**iCON Telematics** is not configured or is configured but idle.
		New iCON gps 80 firmware is available for download from **iCON Telematics**.
		View function enabled in **iCON Telematics**.
		Flashing arrows in the icon: Track function enabled in **iCON Telematics**.
		**iCON Telematics** error.
		Port Summary: View the current status for the NMEA output, Remote (MPI), CAN, and PPS.
		Ethernet Status: View the current Ethernet status.

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

Icon		Description
Settings		Settings icon.

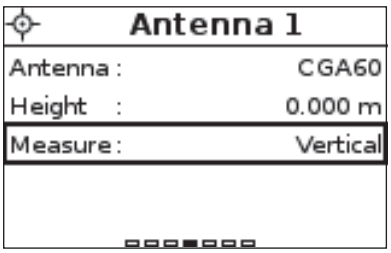
5.3 Submenus

5.3.1 Navigation in Submenus

How to navigate in submenus

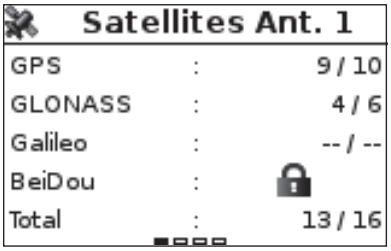
- Use the ↑ and ↓ navigation keys to select a submenu entry.
- To enter a submenu, highlight the menu entry of interest and press ↵.
- Use the ← and → navigation keys to navigate through a submenu with multiple pages.

Example of a submenu



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

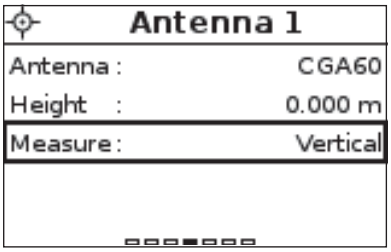
Locked Submenus



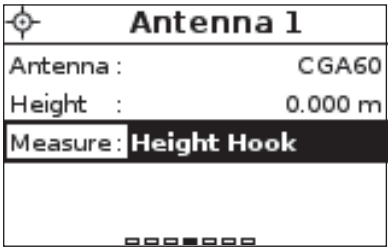
Features that are not active due to a missing licence are marked with a **lock** symbol ( ).

5.3.2 How to Change Settings and Edit Values

How to change settings

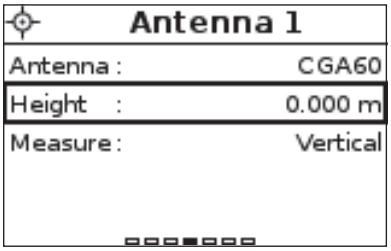


- Enter the desired submenu as described before, for example **Antenna 1** settings.
- The first editable value is automatically selected, indicated by a frame around the entry.
- Use the ↑ and ↓ navigation keys, to select the desired option, for example **Measure**.

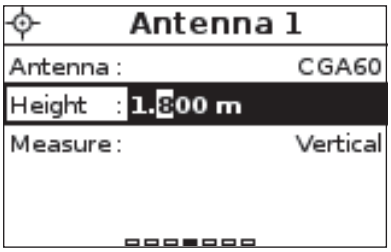


- Press ↵ to enter the list of available options.
- Use the ← and → navigation keys to scroll through the list of options.
- Press ↵ to confirm the selection, or
- press ESC to discard the setting and cancel the operation.

Select and edit values



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

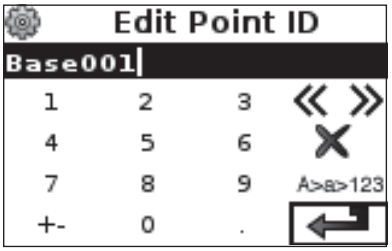


- Press ↵ to enter the input field.
- Use the ↑ and ↓ navigation keys, to change the value of a digit.
- Use the ← and → navigation keys to change to another digit.
- Press ↵ to confirm the setting, or
- press ESC to discard the setting and cancel the operation.

Enter numbers or text

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

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



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

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

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

Position Menu

Informs about:

- **Position Quality**:
  - **Position Quality**
  - **Height Quality**
  - **GDOP**: Geometric Dilution Of Precision. The smaller the number, the higher the possible precision.
  - **Solution**: **Navigated**, **Float**, **Fixed (XRTK)** or **Fixed**
- **Position Antenna**:
  - The coordinate system used: **WGS84**, **Via Network** or any loaded coordinate system files.
  - Position Coordinates
  - Position Height
- **Heading**:
  - **Heading**: is the vector from GNSS Antenna 1 to GNSS Antenna 2, applied from a bird's eye view perspective, in degrees clockwise from north. Refer to "3.9 Dual GNSS Positioning and Heading" for further information.
  - **Slope Distance**
  - **Tilt**
  - **Solution**
- **Antenna 1** (and **2**):
  - The active GNSS antenna
  - Height of the active antenna
  - Measurement mode of antenna height: **Vertical**, **Sloped to Mark**, or **Height Hook**
- **RTK Mode**:
  - The active **RTK Mode**
  - BasePilot: Used or Not Used
- Current **Date & Time**

Configurable values (if external antenna is connected):

- Antenna (1 and 2) type
- Antenna (1) height
- Measurement mode of Antenna (1) height

☞ Information about **Antenna 2** as well as **Heading** is only valid for the iCG82 instrument with installed **Dual positioning and Heading** licence, when both GNSS antennas are connected and have a clear view of the sky.

Satellite Menu

Informs about:

- **Satellites Antenna1** (and **2**):
  - The number of tracked satellites and available satellites, if no position is given (no base correction data received).
  - The number of used satellites and available satellites, when position is available (with base correction data).
  - **Cut-Off Angle**: below this defined angle satellites will not be taken into account for calculations.
- **Reference Satellites**:
  - The number of reference satellites, in rover mode only.

Configurable value:

- **Cut-Off Angle**, for iCG82 applied to both antennas.

Radio Menu

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

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

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

Modem Menu

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

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

Power Menu

Informs about:
- The port used for external power supply
- The input voltage

Configurable values:
- None

Bluetooth Menu

Informs about:
- Bluetooth connection details and status

Configurable value:
- Activate/deactivate Bluetooth

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iCON Telematics and Port Summary Menu

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

Configurable values:
- Activate/deactivate **Share screen**

Storage Menu

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

Configurable values:
- None

Settings Menu

Contains following submenus:
- **Tools**
- **System Information**
- **System Configuration**
- **Service**
- **Copyrights**

Settings Menu: Tools

Functions	Description
Base Setup	Execute a Base Station setup. Refer to "6.1 Base Setup" for further information.
Rover Setup	Execute a Rover setup. Refer to "6.2 Rover Setup" for further information.
NMEA Output	Attend the NMEA Output settings. Refer to "6.3 ORP and NMEA Output" for further information. ☞ The appropriate license must be installed to access the NMEA Output wizard.
Raw Data Logging	• Setup/Start Raw Data Logging. Refer to "6.4 Raw Data Logging" for further information. • View the Log file list. • Export Log files to a connected USB memory device. • Delete all Log files.
iCON Telematics	• View the current **iCON Telematics Status**. • **iCON Sync Download**: download data from the iCON telematics web page. • **iCON Sync Upload**: upload data to the iCON telematics web page. • **iCON Telematics Firmware**: search for and execute available instrument firmware updates from the iCON telematics web page. • Perform a **iCON Telematics Setup**. ☞ Refer to "6.5 iCON Telematics" for further information on the different functions.

Functions	Description
Import / Export / Delete	• Import data from a connected USB memory device. • Export data to a connected USB memory device. • Delete data stored on the instrument. Available options to delete: **Base point list**, **Welcome screen**, **Support logs**, and **Coordinate systems**.
Licenses	• **View** active **licenses**. • **Upload license file** from a connected USB memory device. • **Enter license key**. • **Delete all licenses** stored on the instrument.

Settings Menu: System Information

Functions	Description
System Information	• **Instrument Type** and Serial Number. • Active firmware version. • Information about the Measurement Engine(s), the Internal Radio, and the Internal Cell Modem.

Settings Menu: System Configuration

Functions	Description
Upload Firmware	Single Firmware file selectable to upgrade the instrument's firmware. Firmware file must be placed in a folder called **system** on a USB memory device.
GNSS Settings	• Configure GNSS tracking settings GPS L2C, GPS, GLONASS, Galileo & BeiDou. • To activate or deactivate xRTK. ☞ xRTK is a slightly less accurate RTK position type, typically 5 to 10 cm, automatically providing more availability for phase fixed positions with a reliability of 99%. Recommended when working in heavy canopy environments. For NMEA messages, positions measured with the xRTK mode are flagged as fixed. • Set the Heading Adjustment. • To activate or deactivate **SmartLink**. – SmartLink is available for all RTK formats and independently from the xRTK configuration. – SmartLink is a correction service delivered via Satellite to bridge RTK corrections outages for long periods of time, for example 10 minutes. Use SmartLink to work for longer without the consistent usage of the RTK infrastructure. ☞ GPS L5, Galileo E5a/E5b/AltBOC and BeiDou B2 satellite signals are unavailable in SmartLink mode. ☞ The configurations in Satellite Tracking Settings are not changed. ☞ The SmartLink functionality is licenced.
Coordinate systems	To set the Coordinate system used. Choose from **WGS84**, **Via Network** or any loaded coordinate system files.
PPS Output	Set the PPS Output parameters: **Rate** and **Polarity**. Further information can be found below.

Functions	Description
Reset Options	Reset options are available for the Memory, the External Port Configurations, the Instrument, Almanac, and the Antenna list. ☞ The Almanac is a set of data that every GNSS satellite transmits, and it includes information about the state of the entire satellite constellation, and coarse data on every satellite's orbit. When the iCON gps 80 instrument has current almanac data in memory, it can acquire satellite signals and determine initial position more quickly.
Choose Language	Change system language.
Screen Settings	• Set display **Backlight** options: – **Auto**: Ambient light sensor is used to automatically adjust screen backlight for best display. – **Full**: Screen backlight is set to full brightness. – **Off**: Backlight is turned off. • Set display **Power Saver** options: – **Off**: Screen backlight will not turn off. – **5 s**, **30 s**, **1 min.**, ...: Screen backlight remains on for the time period set following the last key press. • **Flip** the **Screen**: to activate/deactivate up-side-down use of the display.
Startup & Shutdown	• When **Start on Pulse to Port** is set to **On**: The instrument will automatically start up after receiving a pulse signal on port **P1**. • When **Start on Power to Port** is set to **On**: The instrument will automatically start up when power is available on port **P1**, **CAN1** or **CAN2**.
Date & Time	Define **Time Zone** and **D**aylight **S**aving **T**ime.
Units & Formats	• Set the Unit used for **Distance**. • Define **Date** and **Time** format.
Upload ME Firmware	Single ME (Measurement Engine) files selectable to upgrade the ME(s). ME file must be placed in a folder called **system** on a USB memory device.
Network Settings	• Select the Internet device: **Modem** or **Ethernet**. • Define **Modem Settings**. • Define **Ethernet Settings**.
Remote Config	Configure the instrument for remote control using the Leica Machine Control Net Protocol. It is possible to access this protocol via net ports (using Ethernet or Modem), Serial P1 or Bluetooth. When the net ports are used, both **TCP** and **UDP** protocols are available in either Server or Client modes. • Define the settings for **TCP**. If settings were done previously, switch on/off or select as needed. • Define the settings for **UDP**. If settings were done previously, switch on/off or select as needed. • Define the settings for **Serial**. If settings were done previously, switch on/off or select as needed.
CAN Settings	Set the CAN Bus rate. Options are 125 kbits/s or 250 kbits/s. Default is 250 kbits/s.

Functions	Description
User Defined Antennas	Create or edit up to 50 user defined antennas. • Give the antenna a user defined **Name**. • Enter values for **Hz offset**, **Vrt offset**, and the phase centre offset values **L1 ph.off.** and **L2 ph.off.**. • Enter the **IGS name** and a **Serial nr.**. IGS stands for International GNSS Service. It is possible to register antennas and receivers at IGS, and these items are then kept in an official list. All input fields, but the **Serial nr.**, must be completed. Therefore a list showing these values for the user defined antenna should be present. ☞ **Copy add. corr.** allows to copy an existing additive constant. User defined antennas are available in the antenna fields for selection, for example in wizards or sub-menus. When a user defined antenna was used for a Base Station setup it is also shown in the Base Point List.
iCON Analytics	• Use **Usage Report** to enable/disable this feature. • Use **About iCON Analytics** to view detailed information about the matters and capacity of this feature. Further information can be found below.

PPS Output - Description

- PPS stands for **P**ulse **P**er **S**econd. If configured, iCON gps 80 sends out an electric pulse at a specified interval time. For example, this could be used to activate another device.
- PPS output is possible using the Data/Power port P1 on the iCON gps 80.
- The PPS output source is a 0 V to +5.0 V signal referenced to Vin negative.

PPS Output - Parameters to set

- **Rate**: Defines the interval at which the pulses are output.
- **Polarity**: Defines if the pulses are output at the negative or positive edge of the pulse.

iCON Analytics - detailed information

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

Settings Menu: Service

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

Settings Menu: Copyrights

Functions	Description
Copyrights	Includes Open Source Software License information.

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

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

And/Or

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

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

5.4 iCON gps 80 Screen in Machine Control Mode

☞ When the iCON gps 80 is installed into the Leica Machine Control CAN bus as part of a complete 3D Leica Machine Control solution, certain operations on the iCON gps 80 are limited in order to optimise performance and avoid mismatched settings between the GNSS instrument and the 3D panel.

Connected to iCON 3D, but not in RUN mode

When the iCON gps 80 is

- connected to a 3D panel via a CAN cable,
- and the 3D panel is **not** in **RUN** mode,
- and traffic on the CAN bus is detected,

the iCON gps 80 enters **Machine Control** mode and following information is shown:

MC mode is active! Not all settings are available in this mode.

☞ Press **OK** to confirm the information and return to the last active menu.

Following restrictions are applied:

- All menus of the iCON gps 80 are selectable, except the **Tools** menu.
- No changes to the current configuration are possible.
- **Upload Firmware**, **Reset almanac**, and "User Interface only" settings, like **Choose Language**, and **Flip Screen** are available in full functionality.

Following Machine Control default settings are applied:

- Satellite cut-off angle: Automatic
- Position output: 20 Hz
- Antenna height: 0 m
- Heading offset: 0°
- Start on Pulse to Port: ON

Connected to iCON 3D, and in RUN mode

When the iCON gps 80 is

- connected to a 3D panel via a CAN cable,
- and the 3D panel is in **RUN** mode,
- and traffic on the CAN bus is detected,

the iCON gps 80 enters **Machine Control Run** mode and following information is shown:

MC run mode is active! Only status information is available in this mode.

☞ Press **OK** to confirm the information and return to the last active menu.

Following restrictions are applied:
- The iCON gps 80 display can be used for status information only.
- No changes to the current configuration are possible.

Following Machine Control default settings are applied:
- Satellite cut-off angle: Automatic
- Position output: 20 Hz
- Antenna height: 0 m
- Heading offset: 0°
- Start on Pulse to Port: ON

☞ When the iCON gps 80 is in **Machine Control Run** mode, all non-essential functions for machine control including NMEA output and RINEX logging are disabled in order to optimise instrument performance.

6 Software Tools

6.1 Base Setup

6.1.1 Base Setup Description

Setup iCON gps 80 as Base Station

iCON gps 80 can be setup and used as Base Station. Measured Base Points can be recorded in the instrument and a Base Point list can be imported and used for future Base Setups.

There are different options to setup the iCON gps 80 as Base Station:

- **Manual Base Setup**:
  - When no Base Setup has been performed and recorded before to the iCON gps 80 and no Base Point List has been imported, it is necessary to perform a manual Base Setup.
  - Manual Base Setup is always possible, also with a imported Base Point List or a previously recorded Base Setup.
- **Base Setup using BasePilot**:
  - iCON gps 80 features a tool for automatic Base Setup called BasePilot.
  - BasePilot is enabled automatically when the iCON gps 80 is powered up on an existing base point. BasePilot recognises that the instrument is in base mode, is over a known point and automatically loads the previously stored base configuration.

Using the Base Point List

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

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

No stored positions nearby

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

There are no existing Base Points nearby!

If this information appears:

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

6.1.2 Manual Base Setup

Base Setup

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

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

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

Smart Get here step-by-step

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

Step	Description
1.	According to your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via **Settings** › **Tools** › **Base Setup**.
3.	In the **Position** screen highlight **Modify** and press .
4.	Select **Smart Get here** and press to confirm.
5.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Select **Continue** and press to confirm. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
6.	In the **Measure Setup** screen select, set the **Meas. Time** according to your needs and press to confirm.
7.	• If needed, select **Corr. Source** and press to confirm. Continue with 12. • When ready to determine the current position, select **Measure** and press to confirm.
8.	The instrument measures the current position. Subsequently it searches the Base Point List for stored base points in the vicinity. • If necessary, select **Remeasure** and press to confirm. • When measurement is okay, select **OK** and press to confirm.
9.	If there is already a point within a 40 m radius of the measured point stored in the instrument a message is displayed: • Select **Overwrite** to use the newly measured position, or • select **Use existing** to use the known point. – In case the existing point has been chosen, a second warning message is displayed where you can choose between **Saved setup** to use the saved Base point setup, including Antenna and Communication settings, or **Current** to use the currently loaded configuration. If no point is found within a 40 m radius of the measured position the instrument returns to the **Position** screen.
10.	Back in the **Position** screen select **Modify** and **Edit** and press to confirm, in case the Point ID and/or coordinates want to be adapted. Otherwise select **Continue** and press to confirm.
11.	In the **Edit Position** screen: • Select **Pt. ID** and press to confirm. • Enter a Point ID and press to confirm. • If needed, position and height values can be changed. • When finished, select **Continue** and press to confirm. New Point ID, position and height values are stored and instrument returns to the **Position** screen.

Step	Description
12.	Use the ➔ navigation key to proceed to the **Communication** setup screen, to configure a rover. Select between Internal radio, External radio and Network. • To configure the settings for **Internal Radio** continue with 13. • To configure the settings for **External Radio P2** continue with 14. • To configure the settings for **Network** continue with 15. • Otherwise continue with 44.
13.	For the **Internal Radio** select **On**, **Off** or **Edit** and press ↵ to confirm. When **Edit** was selected: • In the **Internal Radio (1)** the **Model** is displayed. • In the **Internal Radio (2)** screen select the **Channel**, **Frequency**, and **Bandwidth**. **Protocol** and **FEC** can be defined under **Advanced Settings**. Please note that **Protocol** and **FEC** is only available for the internal Satel radio TA13. For the Intuicom 900SLR only **Channel** can be selected. ☞ For an internal Satelline radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed. ☞ If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well. • In the **RTK Settings** screen select the **Corr.Format**: – **Leica**: The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. – **Leica 4G**: The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments. – **CMR**: CMR and CMR+ are compacted formats used to broadcast data for third-party instruments. – **RTCM 3.1**, **RTCM 3.2 MSM3**, **RTCM 3.2 MSM5**: Use RTCM when rover units from a different manufacturer are to be used. Use to decode the standard **RTCM v3** and the **RTCM v3 (MSM)** messages from the base. Message according to RTCM version 3. A new standard format for transmission of **G**lobal **N**avigation **S**atellite **S**ystem correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. • Still in the **RTK Settings** screen define the time interval and the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.

Step	Description
14.	For the **External Radio P2** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **External Radio (1)** screen select the **Model**: – For generic radio setting (**Generic RS232**), where no device is auto-detected, select **Baud rate**, **Parity**, and **Flow contr.**. – For external radios which are automatically detected, the **Model** is also selected automatically. In the **External Radio (2)** screen select the **Channel**. **Protocol** and **FEC** can be defined under **Advanced Settings**. – For external radios which are not automatically detected, select the **Model** in the **External Radio (1)** screen and in the **External Radio (2)** screen select the **Channel** and the **Protocol**. ☞ **Protocol** and **FEC** are available and the frequency can be set manually just for the external GFU27 radio, when radio firmware version 06.17.3.61 or higher is installed. ☞ If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well. • In the **RTK Settings** screen select the **Corr.Format** from **Leica**, **Leica *4G***, **CMR**, **RTCM 3.1**, **RTCM 3.2 MSM3**, **RTCM 3.2 MSM5**. Refer to step 13. for details. • Still in the **RTK Settings** screen define the time interval and the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.
15.	For the **Network** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **Internet conn.** screen select **Modem** or **Ethernet** as device. • To configure the settings for **Modem** continue with 16. • To configure the settings for **Ethernet** continue with 39.
16.	In the **Int. Modem** screen select **NTRIP Base**, **NTRIP Source**, **TCP Server**, or **Dialup** as **Mode**. • To configure the settings for **NTRIP Base** continue with 17. • To configure the settings for **NTRIP Source** continue with 24. • To configure the settings for **TCP Server** continue with 29. • To configure the settings for **Dialup** continue with 36.
17.	In the **Int. Modem** screen select **NTRIP Base** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
18.	Use the ➔ navigation key to proceed to the next step.
19.	• In the **DynDNS Settings** (for Dynamic Domain Name System) screen select the **Provider** and enter **Host**, **Username** and **Password**. • When using a SIM card with a fixed IP set **DynDNS** to **Off**. ☞ The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
20.	Use the ➔ navigation key to proceed to the next step.
21.	In the **NTRIP Settings** screen enter **Port** number, **Username** and **Password**. ☞ The port number entered must be accessible from outside your local cell network.
22.	Use the ➔ navigation key to proceed to the next step.

Step	Description
23.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 13. for details. Use the ➔ navigation key to save the settings and enable the device.
24.	In the **Int. Modem** screen select **NTRIP Source** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
25.	Use the ➔ navigation key to proceed to the next step.
26.	In the **Caster Settings** screen select the **Mode** and enter **Address**, **Port**, **Mnt.Pt.** (mount point) and **Password**. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
27.	Use the ➔ navigation key to proceed to the next step.
28.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 13. for details. Use the ➔ navigation key to save the settings and enable the device.
29.	In the **Int. Modem** screen select **TCP Server** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
30.	Use the ➔ navigation key to proceed to the next step.
31.	• In the **DynDNS Settings** (for Dynamic Domain Name System) screen select the **Provider** and enter **Host**, **Username** and **Password**. • When using a SIM card with a fixed IP set **DynDNS** to **Off**. ☞ The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
32.	Use the ➔ navigation key to proceed to the next step.
33.	In the **TCP Server** screen enter **Port** number and a number for **Max. clients**. ☞ The port number entered must be accessible from outside your local cell network.
34.	Use the ➔ navigation key to proceed to the next step.
35.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 13. for details. Use the ➔ navigation key to save the settings and enable the device.
36.	In the **Int. Modem** screen select **Dialup** as **Mode**, and enter **PIN**.
37.	Use the ➔ navigation key to proceed to the next step.
38.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 13. for details. Use the ➔ navigation key to save the settings and enable the device.

Step	Description
39.	In the **Ethernet** screen select the **Mode** from **NTRIP Base**, **NTRIP Source**, and **TCP Server**. Set **DHCP** to: • **On** to use the DHCP (Dynamic Host Configuration Protocol) to automatically get IP address and networking parameters requested from a DHCP server. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen use the **Renew DHCP Lease** functionality if necessary. • **Off** to manually enter IP address and networking parameters. Use the ➔ navigation key to proceed to the next step. In the **DNS Servers** screen enter the primary and, if needed, the secondary DNS server parameters.
40.	Use the ➔ navigation key to proceed to the next step.
41.	• When **NTRIP Base** was selected: In the **NTRIP Settings** screen enter **Port** number, **Username** and **Password**. ☞ The port number entered must be accessible from outside your local cell network. • When **NTRIP Source** was selected: In the **Caster Settings** screen select the **Mode** and enter **Address**, **Port**, **Mnt.Pt.** (mount point) and **Password**. – Address mode WWW allows the entry of a web address. – Address mode IP allows the entry of an IP address. • When **TCP Server** was selected: In the **TCP Server** screen enter **Port** number and a number for **Max. clients**. ☞ The port number entered must be accessible from outside your local cell network.
42.	Use the ➔ navigation key to proceed to the next step.
43.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 13. for details. Use the ➔ navigation key to save the settings and enable the device.
44.	Use the ➔ navigation key to proceed to the **Antenna 1** screen. The active **Antenna**, the **Height** of the active antenna, the **Measure** mode of antenna height and the **Ref.Stn.ID** (Reference Station Identification) might be changed again. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
45.	Use the ➔ navigation key to proceed to the final step. • To save and apply the new Base Station settings select **Save** and press ↵ to confirm. • To discard the new Base Station settings select **Undo** and press ↵. To actually discard the settings confirm the following Warning by pressing ↵ on **OK**.

Find nearest step-by-step

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

Step	Description
1.	According your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via **Settings** › **Tools** › **Base Setup**.

Step	Description
3.	In the **Position** screen highlight **Modify** and press  .
4.	Select **Find nearest** and press  to confirm.
5.	The instrument searches for base points within a 20 m radius, which are stored in the Base Point List. The closest base point is selected automatically.
6.	If a Base Point is found within a 20 m radius of the current position: • Select **Saved setup** to use the saved Base point setup, including Antenna and Communication settings, or • select **Current** to use the currently used Base point setup. • Press  to confirm the selection. If no Base Point is found within a 20 m radius an according information message is displayed. In this case the **Smart Get here** or **Edit** function is needed to setup a base station.
7.	Back in the **Position** screen, re-check the selected base point information.
8.	Use the ➔ navigation key to proceed to the **Communication** setup screen, for example to establish a connection via radio. ☞ It is possible to use three communication devices running in parallel. • To configure the settings for **Internal Radio** continue with 9. • To configure the settings for **External Radio P2** continue with 10. • To configure the settings for **Network** continue with 11. • Otherwise continue with 40.

Step	Description
9.	For the **Internal Radio** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **Internal Radio (1)** the **Model** is displayed. • In the **Internal Radio (2)** screen select the **Channel**, **Frequency**, and **Bandwidth**. **Protocol** and **FEC** can be defined under **Advanced Settings**. Please note that **Protocol** and **FEC** is only available for the internal Satel radio TA13. For the Intuicom 900SLR only **Channel** can be selected. ☞ For an internal Satelline radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed. ☞ If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well. • In the **RTK Settings** screen select the **Corr.Format**: – **Leica**: The proprietary Leica real-time GPS data format supporting GPS L1/L2 and GLONASS L1/ L2. – **Leica 4G**: The proprietary Leica real-time GNSS data format supporting GPS L1/ L2/ L5, GLONASS L1/ L2, Galileo E1/E5a/E5b/AltBOC and BeiDou B1/B2. This format is recommended when working exclusively with Leica instruments. – **CMR**: CMR and CMR+ are compacted formats used to broadcast data for third-party instruments. – **RTCM 3.1**, **RTCM 3.2 MSM3**, **RTCM 3.2 MSM5**: Use RTCM when rover units from a different manufacturer are to be used. Use to decode the standard **RTCM v3** and the **RTCM v3 (MSM)** messages from the base. Message according to RTCM version 3. A new standard format for transmission of **G**lobal **N**avigation **S**atellite **S**ystem correction information. Higher efficiency than RTCM v2.x. Supports real-time services with significantly reduced bandwidth. • Still in the **RTK Settings** screen define the time interval and the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.

Step	Description
10.	For the **External Radio P2** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **External Radio (1)** screen select the **Model**: – For generic radio setting (**Generic RS232**), where no device is auto-detected, select **Baud rate** and **Flow contr.**. – For external radios which are automatically detected, the **Model** is also selected automatically. In the **External Radio (2)** screen select the **Channel**. **Protocol** and **FEC** can be defined under **Advanced Settings**. – For external radios which are not automatically detected, select the **Model** in the **External Radio (1)** screen and in the **External Radio (2)** screen select the **Channel** and the **Protocol**. ☞ **Protocol** and **FEC** are available and the frequency can be set manually just for the external GFU27 radio, when radio firmware version 06.17.3.61 or higher is installed. ☞ If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well. • In the **RTK Settings** screen select the **Corr.Format** from **Leica**, **Leica 4G**, **CMR**, **RTCM 3.1**, **RTCM 3.2 MSM3**, **RTCM 3.2 MSM5**. Refer to step 9. for details. • Still in the **RTK Settings** screen define the time interval and the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.
11.	For the **Network** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **Internet conn.** screen select **Modem** or **Ethernet** as device. • To configure the settings for **Modem** continue with 12. • To configure the settings for **Ethernet** continue with 35.
12.	In the **Int. Modem** screen select **NTRIP Base**, **NTRIP Source**, **TCP Server**, or **Dialup** as **Mode**. • To configure the settings for **NTRIP Base** continue with 13. • To configure the settings for **NTRIP Source** continue with 20. • To configure the settings for **TCP Server** continue with 25. • To configure the settings for **Dialup** continue with 32.
13.	In the **Int. Modem** screen select **NTRIP Base** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
14.	Use the ➔ navigation key to proceed to the next step.
15.	• In the **DynDNS Settings** (for Dynamic Domain Name System) screen select the **Provider** and enter **Host**, **Username** and **Password**. • When using a SIM card with a fixed IP set **DynDNS** to **Off**. ☞ The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
16.	Use the ➔ navigation key to proceed to the next step.
17.	In the **NTRIP Settings** screen enter **Port** number, **Username** and **Password**. ☞ The port number entered must be accessible from outside your local cell network.
18.	Use the ➔ navigation key to proceed to the next step.

Step	Description
19.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 9. for details. Use the ➔ navigation key to save the settings and enable the device.
20.	In the **Int. Modem** screen select **NTRIP Source** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
21.	Use the ➔ navigation key to proceed to the next step.
22.	In the **Caster Settings** screen select the **Mode** and enter **Address**, **Port**, **Mnt.Pt.** (mount point) and **Password**. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
23.	Use the ➔ navigation key to proceed to the next step.
24.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 9. for details. Use the ➔ navigation key to save the settings and enable the device.
25.	In the **Int. Modem** screen select **TCP Server** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
26.	Use the ➔ navigation key to proceed to the next step.
27.	• In the **DynDNS Settings** (for Dynamic Domain Name System) screen select the **Provider** and enter **Host**, **Username** and **Password**. • When using a SIM card with a fixed IP set **DynDNS** to **Off**. ☞ The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
28.	Use the ➔ navigation key to proceed to the next step.
29.	In the **TCP Server** screen enter **Port** number and a number for **Max. clients**. ☞ The port number entered must be accessible from outside your local cell network.
30.	Use the ➔ navigation key to proceed to the next step.
31.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 9. for details. Use the ➔ navigation key to save the settings and enable the device.
32.	In the **Int. Modem** screen select **Dialup** as **Mode**, and enter **PIN**.
33.	Use the ➔ navigation key to proceed to the next step.
34.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 9. for details. Use the ➔ navigation key to save the settings and enable the device.

Step	Description
35.	In the **Ethernet** screen select the **Mode** from **NTRIP Base**, **NTRIP Source**, and **TCP Server**. Set **DHCP** to: • **On** to use the DHCP (Dynamic Host Configuration Protocol) to automatically get IP address and networking parameters requested from a DHCP server. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen use the **Renew DHCP Lease** functionality if necessary. • **Off** to manually enter IP address and networking parameters. Use the ➔ navigation key to proceed to the next step. In the **DNS Servers** screen enter the primary and, if needed, the secondary DNS server parameters.
36.	Use the ➔ navigation key to proceed to the next step.
37.	• When **NTRIP Base** was selected: In the **NTRIP Settings** screen enter **Port** number, **Username** and **Password**. ☞ The port number entered must be accessible from outside your local cell network. • When **NTRIP Source** was selected: In the **Caster Settings** screen select the **Mode** and enter **Address**, **Port**, **Mnt.Pt.** (mount point) and **Password**. – Address mode WWW allows the entry of a web address. – Address mode IP allows the entry of an IP address. • When **TCP Server** was selected: In the **TCP Server** screen enter **Port** number and a number for **Max. clients**. ☞ The port number entered must be accessible from outside your local cell network.
38.	Use the ➔ navigation key to proceed to the next step.
39.	In the **Save Settings** screen select the **Corr.Format** (Correction Format). Refer to step 9. for details. Use the ➔ navigation key to save the settings and enable the device.
40.	Use the ➔ navigation key to proceed to the **Antenna 1** screen. The active **Antenna**, the **Height** of the active antenna, the **Measure** mode of antenna height and the **Ref.Stn.ID** (Reference Station Identification) might be changed. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
41.	Use the ➔ navigation key to proceed to the final step. • To save and apply the new Base Station settings select **Save** and press ↵ to confirm. • To discard the new Base Station settings select **Undo** and press ↵. To actually discard the settings confirm the following Warning by pressing ↵ on **OK**.

Edit step-by-step

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

Step	Description
1.	According your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via **Settings** › **Tools** › **Base Setup**.

Step	Description
3.	In the **Position** screen highlight **Modify** and press .
4.	Select **Edit** and press to confirm.
5.	In the **Edit Position** screen enter a Point ID, a set of coordinates and the height of the desired Base Station. Select **Continue** and press to confirm.
6.	The instrument searches for base points in the vicinity, which are stored in the Base Point List.
7.	If there is already a Base Point within a 40 m radius of the measured point stored in the instrument a message is displayed: • Select **Overwrite** to use the newly measured position, or • select **Use existing** to use the known point. – In case the existing point has been chosen, a second warning message is displayed where you can choose between **Saved setup** to use the saved Base point setup, including Antenna and Communication settings, or **Current** to use the currently used Base point setup. If no Base Point is found within a 40 m radius an according information message is displayed and the newly entered information is stored as Base Point.

6.1.3 Base Setup using BasePilot

BasePilot setup

BasePilot is a feature which configures and starts the iCON gps 80 running as a Base when the instrument (antenna) is setup over a known base point. Predefined base configurations are automatically loaded.

Step	Description
1.	According to your needs, setup the hardware needed over a known base point. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	• If iCON gps 80 is in **Base** mode: – **BasePilot** starts up automatically. • If iCON gps 80 is in **Rover** mode: – Go to **Settings** › **Tools** › **Base Setup** and choose **Find nearest**. – Press to confirm. Refer to "6.1.2 Manual Base Setup" for further information.
3.	While **BasePilot** is setting up: The position icon is displayed.
4.	After the **BasePilot** has been completed: The position icon is displayed. **The radio/modem now starts transmitting corrections!** ☞ On **RTK Mode** page, in the **Position** submenu the line **BasePilot** shows: **Successful**.

☞ When using BasePilot, always check in the **Position** submenu that the iCON gps 80 has selected the correct base point! **Using the wrong base point can lead to an error of more than 20 m for a rover!**

6.2 Rover Setup

Rover setup description

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

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen press and select the communication device using the ← and → navigation keys: • **Int. Radio**: Select this option to use the internal radio. A slot-in-radio must be inserted in its slot. Refer to "3.3 Slot-in-Device" for further information. • **Ext. Radio P2**: Select this option to use an external radio connected to Port P2. • **NTRIP Bridge P2**: Select this option to use a NTRIP Bridge connected to Port P2. ☞ A NTRIP Bridge may also be known as UMTS-CDMA router. • **Int. Modem**: Select this option to use the internal modem. A SIM card must be inserted in the card slot. Refer to "3.2 Installing a SIM Card" for further information. • **Ethernet**: Select this option to use Ethernet.
3.	Press to confirm your selection and use the → navigation key to proceed to the next step. ☞ The following step-by-step descriptions explain the different options in detail.

Rover setup with internal radio step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Radio**.
3.	Use the → navigation key to proceed to the next step.
4.	• In the **Internal Radio (1)** screen the **Model** is displayed. • In the **Internal Radio (2)** screen select the **Channel**, **Frequency**, and **Bandwidth**. **Protocol** and **FEC** can be defined under **Advanced Settings**. ☞ **Protocol** and **FEC** are available and the frequency can be set manually just for an internal Satelline radio TA13, when radio firmware version 06.17.3.61 or higher is installed. ☞ If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.
5.	Use the → navigation key to proceed to the next step.
6.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Ref.Rec.** (Reference Receiver), the **Ref.Ant.** (Reference Antenna) and the **Accept Ref.** (Accepted References). ☞ Refer to "RTK correction format" for further information about the correction formats.
7.	Use the → navigation key to proceed to the next step.

Step	Description
8.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
9.	Use the ➔ navigation key to proceed to the final step.
10.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
11.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

Rover setup with external radio step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Ext. Radio P2**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **External Radio (1)** screen select the **Model**: • For generic radio setting (**Generic RS232**), where no device is auto-detected, select **Baud rate** and **Flow contr.**. • For external radios which are automatically detected, the **Model** is also selected automatically. In the **External Radio (2)** screen select the **Channel** and the **Protocol**. • For external radios which are not automatically detected, select the **Model** in the **External Radio (1)** screen and in the **External Radio (2)** screen select the **Channel** and the **Protocol**. ☞ **Protocol** and **FEC** are available and the frequency can be set manually just for the external GFU27 radio, when radio firmware version 06.17.3.61 or higher is installed. ☞ If a frequency is required that is not given as part of a channel, the frequency can be typed in manually. If required the bandwidth can be changed as well.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Ref.Rec.** (Reference Receiver), the **Ref.Ant.** (Reference Antenna) and the **Accept Ref.** (Accepted Reference ID). ☞ Refer to "RTK correction format" for further information about the correction formats.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
9.	Use the ➔ navigation key to proceed to the final step.
10.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
11.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

Rover setup with NTRIP Bridge step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **NTRIP Bridge P2**. ☞ A NTRIP Bridge may also be known as UMTS-CDMA router.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **External Radio (1)** screen select **Baud rate**, **Parity** and **Flow contr.**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna). ☞ Refer to "RTK correction format" for further information about the correction formats.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
9.	Use the ➔ navigation key to proceed to the final step.
10.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
11.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

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

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Modem**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Int. Modem** screen select **NTRIP Client** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **NTRIP Settings** screen select the Address **Mode**, enter **Address**, **Port** number, **User** and **Password**. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **Mount Point** screen select the **Method**. • If the Method **Source Table** is selected, then start the mount point search by selecting **Start** in the **Search** line. Once the source table has been downloaded, the desired mount point can be selected from the list available in the **Mountpoint** line. • If the Method **Manual** is selected, then it is possible to manually enter the mount point name.
9.	Use the ➔ navigation key to proceed to the next step.

Step	Description
10.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna). ☞ Refer to "RTK correction format" for further information about the correction formats.
11.	Use the ➔ navigation key to proceed to the next step.
12.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
13.	Use the ➔ navigation key to proceed to the final step.
14.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
15.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

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

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Modem**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Int. Modem** screen select **TCP Client** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the Provider ID. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter the **User ID** and the **Password**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **Server Settings** screen select the Address **Mode**, enter **Address** and the **Port** number. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna). ☞ Refer to "RTK correction format" for further information about the correction formats.
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
11.	Use the ➔ navigation key to proceed to the final step.
12.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
13.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

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

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Modem**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Int. Modem** screen select **Dialup** as **Mode**, enter **PIN** and **PUK**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **Dial-Up Settings** screen enter the **Ph. Number** and select the **Modem Prot.**, the **Net Data Rate**, and if the **Connection** should be transparent.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna). ☞ Refer to "RTK correction format" for further information about the correction formats.
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
11.	Use the ➔ navigation key to proceed to the final step.
12.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
13.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

Rover setup with Ethernet using NTRIP Client step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Ethernet**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Ethernet** screen select **NTRIP Client** as **Mode**. Set **DHCP** to: • **On** to use the DHCP (Dynamic Host Configuration Protocol) to automatically get IP address and networking parameters requested from a DHCP server. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen use the **Renew DHCP Lease** functionality if necessary. • **Off** to manually enter IP address and networking parameters. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen enter **IP**, **Netmask**, and **Gateway**. Use the ➔ navigation key to proceed to the next step. In the **DNS Servers** screen enter the primary and, if needed, the secondary DNS server parameters.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **NTRIP Settings** screen select the Address **Mode**, enter **Address**, **Port** number, **User** and **Password**. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the ➔ navigation key to proceed to the next step.

Step	Description
8.	In the **Mount Point** screen select the **Method**. • If the Method **Source Table** is selected, then start the mount point search by selecting **Start** in the **Search** line. Once the source table has been downloaded, the desired mount point can be selected from the list available in the **Mountpoint** line. • If the Method **Manual** is selected, then it is possible to manually enter the mount point name.
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna). ☞ Refer to "RTK correction format" for further information about the correction formats.
11.	Use the ➔ navigation key to proceed to the next step.
12.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
13.	Use the ➔ navigation key to proceed to the final step.
14.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
15.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

Rover setup with Ethernet using TCP Client step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Ethernet**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Ethernet** screen select **TCP Client** as **Mode**. Set **DHCP** to: • **On** to use the DHCP (Dynamic Host Configuration Protocol) to automatically get IP address and networking parameters requested from a DHCP server. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen use the **Renew DHCP Lease** functionality if necessary. • **Off** to manually enter IP address and networking parameters. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen enter **IP**, **Netmask**, and **Gateway**. Use the ➔ navigation key to proceed to the next step. In the **DNS Servers** screen enter the primary and, if needed, the secondary DNS server parameters.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **Server Settings** screen select the Address **Mode**, enter **Address** and the **Port** number. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the ➔ navigation key to proceed to the next step.

Step	Description
8.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna). ☞ Refer to "RTK correction format" for further information about the correction formats.
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **Antenna 1** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.8 Antenna Heights" for information about Antenna Heights.
11.	Use the ➔ navigation key to proceed to the final step.
12.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
13.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

RTK correction format

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

NMEA Output description

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

☞ The appropriate position rate licences must be installed to access all output rates.

☞ Two NMEA interfaces can be active in parallel. The NMEA interfaces can be assigned to one of the serial ports, the Bluetooth port, a Net port via the Ethernet port, or via the modem.

NMEA Output settings step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **NMEA Output**.
2.	In the **NMEA Output** screen select **On**, **Off**, or **Edit** for each NMEA interface.
3.	When the NMEA Output settings have been done before, select **On** or **Off** to active/deactivate the output and press ↵ to confirm. Then press ESC to save the setting and return to the **Tools** menu.
4.	When the NMEA Output settings have not been done before, select **Edit** to start the NMEA Output wizard and confirm with ↵.
5.	Select the **Port** for the NMEA output. P1, P2, Bluetooth, TCP Server (over Ethernet) and UDP client (over Ethernet or modem) are supported. When using TCP Server: • To use a static IP the DHCP service must be turned off. This allows to set the IP manually. • This must be done before configuring a NMEA stream over Ethernet. • Go to **Settings** › **System Configuration** › **Network Settings** to turn **DHCP Off** and enter **IP**, **Netmask**, **Gateway** and **DNS Servers**. When using UDP Client: • Up to 100 hosts can be defined under **Manage Hosts**. • All defined hosts are active in parallel. For the **Talker ID** select between **Auto** or **User**. When **User** is selected set the **User Talker ID** additionally. Finally select **Baud rate** and **Flow contr.**.
6.	Use the ➔ navigation key to proceed to the next step.
7.	For **ORP**, select **Off**, **Edit**, or set a rate. When **Edit** is selected: set the **Rate**, the **Coords** (coordinate format), and the **Output** position additionally. • For **Output**, select between **Pos 1** only, **Pos 1 & 2** or **Pos 1,2 & Hdg (N)**. • The **Height** is set automatically according to the coordinate system used: for WGS84 it is Ellipsoidal, and Orthometric for Local Grid. Refer to "Appendix B ORP – Orientation and Position" for further information about ORP. For **GGA**, **GGK**, **GGQ**, and **GLL** select **Off** or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
8.	Use the ➔ navigation key to proceed to the next step.
9.	For **GNS**, **GSA**, **GSV**, **HDT**, and **LLK** select **Off** or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
10.	Use the ➔ navigation key to proceed to the next step.

Step	Description
11.	For **LLQ**, **RMC**, **VTG**, **XDR**, and **ZDA** select **Off** or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
12.	Use the ➔ navigation key to proceed to the final step.
13.	• To save the changes select **Save** and confirm with  . • To discard the changes select **Undo** and confirm with  .

ORP Output

The ORP output differs from standard NMEA messages:

- The ORP message is a Leica proprietary message and delivers position information of one or two antennas.
- In a two antenna setup the orientation between the antennas is calculated as well. This feature is only available for iCG82.

Configurable values

- **Rate**: Define the output rate.
- **Output**: It is possible to stream the Master position (**Pos 1**) or Master and Slave positions (**Pos 1 & 2**). Using **Pos 1,2 & Hdg (N)** allows to stream Heading data as well. Available for WGS84 and when the coordinate system is set to Local Grid.
- **Coords** and **Height**: The available Height format depends on the selected Coordinate format. For local coordinates a "*.lok", a "*.xml" or "TRFSET.DAT" file is required.

ORP settings can be accessed via **Settings** › **Tools** › **NMEA Output**. Select the port you want ORP data to be output from (**NMEA Out 1** or/and **NMEA Out 2**) and toggle to **Edit**. ORP is available on the second page of the wizard.
Refer to "Appendix B ORP – Orientation and Position" for further information about ORP.

6.4 Raw Data Logging

Raw Data logging

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

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

Description

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

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

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

☞ An Internet connection on the instrument is needed, using a 4G modem. Refer to "3.2 Installing a SIM Card" for information about SIM card installation.

iCON Telematics first setup step-by-step

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

Step	Description
1.	**Establish an Internet connection on the instrument, following these steps:** ☞ Refer to "3.2 Installing a SIM Card" for information about SIM card installation. • Access the wizard via **Settings** › **Tools** › **iCON Telematics** › **iCON Telematics Setup**. • In the **Internet conn.** screen select **Modem** or **Ethernet** as device. • For an Internet connection using **Modem**: – In the **Int. Modem** screen enter **PIN** and **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. – When **Use** is selected: Use the ➔ navigation key to proceed to the next step. In the **APN ID** screen enter **User ID** and **Password**. • For an Internet connection using **Ethernet**: Set **DHCP** to: – **On** to use the DHCP (Dynamic Host Configuration Protocol) to automatically get IP address and networking parameters requested from a DHCP server. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen use the **Renew DHCP Lease** functionality if necessary. – **Off** to manually enter IP address and networking parameters. Use the ➔ navigation key to proceed to the next step. In the **IP Address** screen enter **IP**, **Netmask**, and **Gateway**. Use the ➔ navigation key to proceed to the next step. In the **DNS Servers** screen enter the primary and, if needed, the secondary DNS server parameters.

Step	Description
	• Use the ➔ navigation key to proceed to the next step. • Ensure that **Server** is set to **icontelematics.com**. • Select **Start pairing ...** and press ↵ to confirm. • The software starts connecting to the selected Web page. After a successful connection the pairing code is displayed. Be sure to leave this screen open or note down the code.
☞	In case of failure, check **PIN** and **APN**.
2.	**Pair the instrument to the iCON telematics web page.** ☞ This is only necessary for the first time the instrument is connected to the iCON telematics web page.
3.	On the remote computer: • Start a web-browser. Google Chrome is recommended for best performance. • Go to the iCON telematics web page: **www.icontelematics.com**. • Use your **User name** and **Password** to login. ☞ To use this functionality an account is needed for the iCON telematics web page. The license is handled on the instrument. Ask your agency or your Leica Geosystems representative for information about licensing and how to get an account. • Now create a new **Unit**: – Select the **Company** or create a new one. – Select the **Project**, that the Unit should be assigned to. If no project is available, create a project first. – Tap **Configure**, and select **Units**. – Tap the **+** icon. – Enter the desired **Unit Name** and select the **Unit Type**. If desired, use **Note** to enter additional information. Tap **Next**. – Set **Equipment Type** to **GNSS Machine Receiver**. Tap **Add Equipment** to create a Unit with the current settings. • To pair the instrument and the created (Web) Unit, enter the pairing code and tap **Pair**.
4.	On the instrument: • The screen with the pairing code should have been replaced by a confirmation that the instrument is paired with the server. The device is now paired/registered on the web page, and ready to connect. • Use the ➔ navigation key to proceed to the next step. • In the **Telematics Project** screen the selected **Project** is highlighted. If needed, select another project from the list. • Use the ➔ navigation key to proceed to the next step. • To allow to send the position of the paired instrument to the iCON telematics web page, set **Track** to **Yes**. Select the **Interval** as well in the **Telematics Track** screen. • Use the ➔ navigation key to proceed to the next step. • In the **Save Settings** screen use the ➔ navigation key to save the settings and exit the setup.
☞	The device is connected to the iCON telematics web page now and ready for **View**, **Sync** and **Track**. Information about the different functions can be found on the following paragraphs.

iCON Telematics Status

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

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

iCON Sync Download

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

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

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

iCON Sync Upload

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

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

- The base point list will be stored at **System/iCG81-SN.bpl**.
- The system configuration will be stored at **System/iCG81-SN.cfg**.
- Coordinate systems will be stored at **CoordinateSystems/**.
- Support Logs will be stored at **Logging/logs-iCG81-SN/** and deleted from the instrument after successful upload.
- Raw Data Logs will be stored at **Logging/RINEX-iCG81-SN-yyyyMMdd** and be kept on the instrument after successful upload.

☞ iCG81 will be replaced by iCG82, if a iCG82 instrument is used.

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

iCON Telematics Firmware

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

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

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

iCON Telematics settings step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **iCON Telematics** › **iCON Telematics Setup**.
2.	In the **Internet conn.** screen, use the ➔ navigation key to proceed to the next step.
3.	In the **Int. Modem** screen enter **PIN** and **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. • When **Use** is selected: – Use the ➔ navigation key to proceed to the next step. – In the **APN ID** screen enter **User ID** and **Password**.
4.	Use the ➔ navigation key to proceed to the next step.
5.	Ensure that **Server** is set to **icontelematics.com**.
6.	If required, select **Pair again ...** and press to confirm. After a successful connection, an appropriate message is displayed. Otherwise skip this step.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **Telematics Project** screen select a **Project** from the list. ☞ System configuration, coordinate systems, support and raw data logfiles are stored within the selected project on the iCON telematics web page when using **iCON Sync Upload**.
9.	Use the ➔ navigation key to proceed to the next step.
10.	• To allow to send the position of the paired instrument to the iCON telematics web page, set **Track** to **Yes**. • Select the **Interval**.
11.	Use the ➔ navigation key to proceed to the next step.
12.	In the **Save Settings** screen use the ➔ navigation key to save the settings and exit the setup.

Access the Import / Export / Delete function

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

Import data from USB

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

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

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

Export data to USB

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

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

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

Delete data on the instrument

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

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

6.7 Licensing

Licences

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

Licenses can be ordered at your local sales representative. The following options are available for iCON gps 80:

- CSW560, RTK low Accuracy (Hz)
- CSW561, RTK high Accuracy (Hz)
- CSW562, Enables Base Station
- CSW563, Position update 2 Hz
- CSW564, Position update 20 Hz
- CSW565, RTK Baseline optional 2.5 km
- CSW566, RTK unlimited Baseline
- CSW567, RTK Network access
- CSW568, GPS L2 Support
- CSW569, GLONASS Support
- CSW570, GPS L5 Support
- CSW571, Galileo Support
- CSW572, BeiDou Support
- CSW574, NMEA streaming
- CSW575, Open Interface License
- CSW576, Dual Position / Heading
- CSW577, Demo License
- CSW596, iCON telematics 1 Year
- CSW597, iCON telematics 2 Years
- CSW598, iCON telematics 3 Years
- CSW599, iCON telematics 1 Day
- CSW900, iCON telematics additional 1 Year
- CSW901, RTK low Accuracy (2D)
- CSW902, RTK low Accuracy Heading, for iCG82
- CSW903, Upgrade to Precise Heading
- CSW905, SmartLink Service 2 Years

7 Coordinate Systems

Description

GNSS measured points are always stored based on the global geocentric datum known as WGS 1984. Most surveys require coordinates in a local grid system. For example, based on a country's official mapping datum or an arbitrary grid system used in a particular area such as a construction site. To convert the WGS 1984 coordinates into local coordinates a coordinate system must be created. Part of the coordinate system is the transformation used to convert coordinates from the WGS 1984 datum to the local datum.

A coordinate system
- allows the conversion from WGS 1984 geodetic or cartesian coordinates to local grid coordinates and back.
- can be directly received from a reference network.
- can be uploaded from a USB Memory device.
- can be exported to a USB Memory device.

☞ Refer to "6.6 Import, Export, or Delete Data" for information about importing, exporting, or deleting coordinate systems.

Default coordinate systems

The default coordinate system is **WGS 1984**. It cannot be deleted. It is not possible to create a coordinate system called **WGS 1984**.
Additional default coordinate systems may be available for certain countries.

Active coordinate system

The active coordinate system is the one selected under **Settings** › **System Configuration** › **Coordinate systems**. One coordinate system is always considered as the active coordinate system.

Automatic coordinate system (RTCM transformation parameters)

When **Via Network** is selected under **Settings** › **System Configuration** › **Coordinate systems**, the coordinate system is directly received from the reference network via RTCM correction data.

☞ Reference networks do not always provide a coordinate system. This will depend on how the network provider has chosen to configure their data streams.

Coordinate system components

The iCON gps 80 supports the same coordinate system formats as other Leica iCON products including iCON 3D, iCON Office, iCONstruct field software, as well as Leica RedLine and GNSS Leica Viva sensors.

Coordinate systems can be made up of up to three linked files:
- **.lok**: Localisation file, contains all the needed parameters and settings, for example datum, map projection and local transformation.
- **.ccg**: Correction grid (**C**ountry **S**pecific **C**oordinate **S**ystem model). Refer to "CSCS model (*.ccg)" for information about CSCS.
- **.grd**: Geoid model. Refer to "Geoid model" for further information.

TRFSET.DAT files can also be imported and used on the iCON gps 80.
- **TRFSET.DAT**: Localisation file, contains all the needed parameters and settings, for example datum, map projection and local transformation.
- **.csc**: Correction grid (**C**ountry **S**pecific **C**oordinate System model).
- **.gem**: Geoid model.

☞ TRFSET.DAT files are read only and cannot be exported in .lok or .xml format.

8 Care and Transport

8.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you
- either carry the product in its original transport container,
- or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.

Transport in a road vehicle

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

Shipping

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

Shipping, transport of batteries

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

8.2 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.

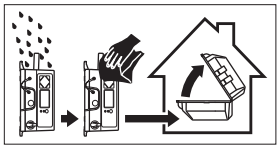
8.3 Cleaning and Drying

Product and accessories

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

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C/104°F and clean them. Remove the battery cover and dry the battery compartment. Do not repack until everything is dry. Always close the transport container when using in the field.



Cables and plugs

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

Connectors with dust caps

Wet connectors must be dry before attaching the dust cap.

9 Technical Data

9.1 Technical Data iCON gps 80

9.1.1 Tracking Characteristics

Instrument technology

SmartTrack

Satellite reception

Triple frequency

Instrument channels

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

Supported codes and phases

GPS

Type	L1	L2	L5
iCON gps 80	Carrier phase, C/A-code	Carrier phase, C code (L2C) and P2-code	Carrier phase, code

GLONASS

Type	L1	L2
iCON gps 80	Carrier phase, C/A-code	Carrier phase, P2-code

Galileo

Type	E1	E5a	E5b	AltBOC
iCON gps 80	Carrier phase, code	Carrier phase, code	Carrier phase, code	Carrier phase, code

BeiDou

Type	B1	B2
iCON gps 80	Carrier phase, code	Carrier phase, code

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

Satellites tracked

Up to 60 satellites simultaneously on two frequencies

9.1.2 Accuracy

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

The following accuracies, given as **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 post-processing

Static and rapid static

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

Static with long observations

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

Differential phase in real-time

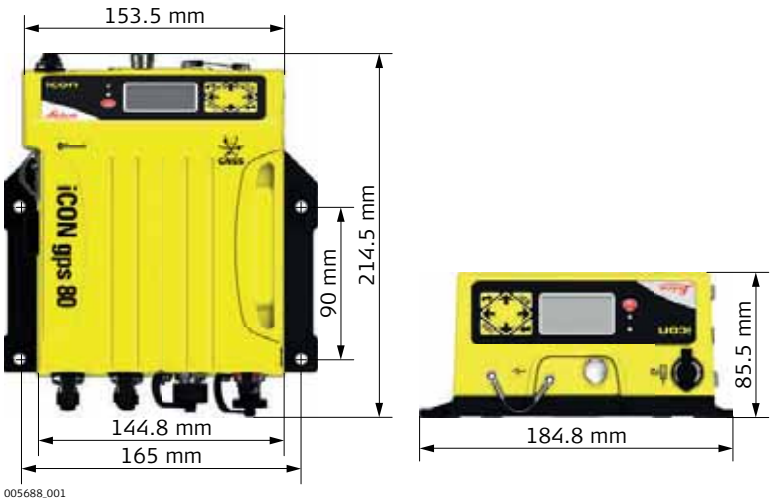
Type	Horizontal	Vertical
Single Baseline (<30 km)	8 mm + 1 ppm	15 mm + 1 ppm
Network RTK	8 mm + 0.5 ppm	15 mm + 0.5 ppm

Precise Heading

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

Dimensions

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



Length [mm]	Width [mm]	Thickness [mm]
214.5	184.8	85.5

Weight

Type	Weight [kg]/[lbs]
iCG81	2.20/4.85 (including internal LTE modem)
iCG82	2.25/4.96 (including internal LTE modem)

The internal modem is installed by default.

Recording

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

Capacity [MB]	Data capacity
• 466	466 MB is typically sufficient for about GPS only (12 satellites) • 3600 h L1 + L2 + L5 data logging at 15 s rate • 14000 h L1 + L2 + L5 data logging at 60 s rate GPS + GLONASS (12/8 satellites) • 3100 h data logging at 15 s rate • 12300 h data logging at 60 s rate

Power

Power consumption: iCON gps 80 (Single GNSS), NTRIP Rover, radio excluded: 8.0 W typically, 24 V @ 333 mA
iCON gps 80 (Dual GNSS), NTRIP Rover, radio excluded: 11. W typically, 24 V @ 475 mA

External supply voltage: Nominal 24 V DC (⎓), voltage range 9 V to 36 V DC, supplied by:

- 9 V to 36 V DC power supply (machine or vehicle) via a converter cable supplied by Leica Geosystems, or
- GEB371 battery connected via a cable, or
- 110 V/240 V AC to 12 V DC power supply unit, supplied by Leica Geosystems.

Battery external

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

Electrical data

Type	iCON gps 80
Voltage	Nominal 24 V
Current	Single GNSS: 8.0 W typically, 24 V @ 333 mA Dual GNSS: 11.0 W typically, 24 V @ 475 mA
Frequency	GPS L1 1575.42 MHz GPS L2 1227.60 MHz GPS L5 1176.45 MHz GLONASS L1 1602.5625 MHz - 1611.5 MHz GLONASS L2 1246.4375 MHz - 1254.3 MHz Galileo E1 1575.42 MHz Galileo E5a 1176.45 MHz Galileo E5b 1207.14 MHz Galileo Alt-BOC 1191.795 MHz BeiDou B1 1561.098 MHz BeiDou B2 1207.14 MHz BeiDou B3 1268.52 MHz Bluetooth 2400 MHz - 2483.5 MHz
Gain	Typically 27 dBi
Noise Figure	Typically < 2 dBi

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

☞ Galileo AltBOC covers bandwidth of Galileo E5a and E5b.

Pulse Per Second (PPS)

Type	iCON gps 80
Peak	5.0 V
Pulse length	1 ms
Positive/Negative Edge	Selectable on display
Connector	LEMO HMI.1B.308.YLWP
Typical PPS pulse accuracy	50 ns (120 ns 3σ)

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
Instrument	-40 to +65	-55 to +85

Protection against water, dust and sand

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

Humidity

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

Vibration/Shock

Type	iCON gps 80	CGA60
Vibration	5 - 5000 Hz, ± 1.5 mm, 0.7 g IEC60068-2-6 MIL-STD 810G - 514.6E-1-Cat24 MIL-STD 810G - 514.6C-3-Cat4	10 - 10000 Hz, ± 1.5 mm, 10 g 8 - 150 Hz, ± 15 mm, 15 g ISO9022-36-08 MIL-STD 810F – 514.5-Cat24
Shock	60 g, 6 ms, IS09022	100 g, 2 ms

9.2 Antennas Technical Data

Description and use

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

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

Dimensions

Type	CGA60
Height	62 mm
Diameter	170 mm

Connector

TNC female

Mounting

5/8" Whitworth

Weight

0.4 kg

Electrical data

Type	CGA60
Voltage	4.5 V to 18 V DC
Current	35 mA typical
Frequency	
GPS L1	1575.42 MHz
GPS L2	1227.60 MHz
GPS L5	1176.45 MHz
GLONASS L1	1602.5625 - 1611.5 MHz
GLONASS L2	1246.4375 - 1254.3 MHz
Galileo E1	1575.42 MHz
Galileo E5a	1176.45 MHz
Galileo E5b	1207.14 MHz
Galileo AltBOC	1191.795 MHz
BeiDou B1	1561.098 MHz
BeiDou B2	1207.14 MHz
BeiDou B3	1268.52 MHz
Gain (typically)	27 dBi
Noise Figure (typically)	< 2 dBi

☞ Galileo AltBOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

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

Protection against water, dust and sand

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

Humidity

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

Vibration/Shock

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

Cable length

Separation distance from instrument ...	to antenna	Optional cable lengths [m]
iCON gps 80	CGA60	2.8, 5, 10

9.3 Pin Assignments and Sockets

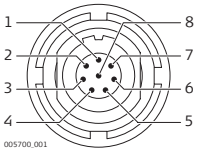
Expert knowledge required

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

WARNING

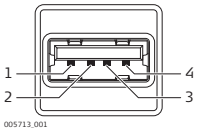
Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Port 2- Lemo



Pin	Name	Function	Direction
1	RTS	RS232, **R**equest **T**o **S**end	Out
2	CTS	RS232, **C**lear **T**o **S**end	In
3	GND	Signal Ground	-
4	RxD	RS232, receive data	In
5	TxD	RS232, transmit data	Out
6	ID	Identification pin	In
7	NC	Not connected	-
8	+12 V out	12 V DC power supply out	Out

USB 2.0 host connector

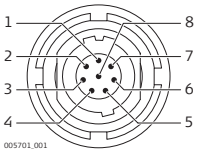


Type: USB-A receptacle

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

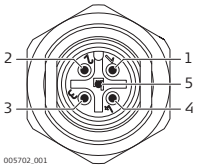
Picture: Receptacle viewed from mating side.

Port 1- Lemo



Pin	Name	Function	Direction
1	RTS	RS232, **R**equest **T**o **S**end	Out
2	CTS	RS232, **C**lear **T**o **S**end	In
3	Vin-	Ground	-
4	RxD	RS232, receive data	In
5	TxD	RS232, transmit data	Out
6	PPS	Pulse per Second	Out
7	Vin+	Power in, 9 V to 36 V DC	In
8	NC	Not connected	-

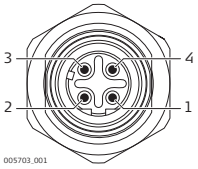
CAN1, CAN2



Type: CAN M12 5 Pin

Pin	Name	Function	Direction
1	Vcan+	Input power/ bus supply	In/Out
2	CANH	CAN high	Bus
3	Vcan-	Ground	-
4	CANL	CAN low	Bus
5	CANON	Internal signal, reserved for machine system check	-

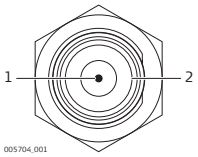
Ethernet



Type: M12 4 Pin

Pin	Name	Function	Direction
1	Rx+	Receive data +	In +
2	Tx+	Transmit data +	Out +
3	Rx-	Receive data -	In -
4	Tx-	Transmit data -	Out -

ANT1, ANT2, RADIO, MODEM

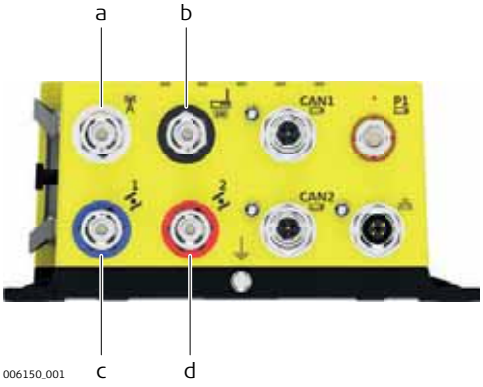


Type: TNC Female

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

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 four TNC connectors are colour coded. Cables with corresponding colours are available.

The colour coding is as follows:



a) White: Radio
b) Black: Modem
c) Blue: GNSS Antenna 1
d) Red: GNSS Antenna 2

9.4 Conformity Declarations

9.4.1 iCON gps 80

Conformity to national regulations

- FCC Part 15, 22, 24 and 27 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product iCON gps 80 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

  Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.
- The conformity for countries with other national regulations not covered by the FCC part 15, 22, 24 and 27 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
Bluetooth	2402 - 2480
WCDMA	WCDMA 2100 Tx: 1920 - 1980 Rx: 2110 - 2170
	WCDMA 1900 Tx: 1850 - 1910 Rx: 1930 - 1990
	WCDMA 850 Tx: 824 - 849 Rx: 869 - 894
	WCDMA 800 Tx: 830 - 840 Rx: 875 - 885
	WCDMA 900 Tx: 880 - 915 Rx: 925 - 960
GSM	GSM 850 Tx: 824 - 849 Rx: 869 - 894
	EGSM 900 Tx: 880 - 915 Rx: 925 - 960
	GSM 1800 Tx: 1710 - 1785 Rx: 1805 - 1880
	GSM 1900 Tx: 1850 - 1910 Rx: 1930 - 1990

Type	Frequency band [MHz]
LTE	Band 1 Tx: 1920 - 1980 Rx: 2110 - 2170
	Band 3 Tx: 1710 - 1785 Rx: 1805 - 1880
	Band 7 Tx: 2500 - 2570 Rx: 2620 - 2690
	Band 8 Rx: 880 - 915 Tx: 925 - 960
	Band 20 Rx: 791 - 821 Tx: 832 - 862

Output power

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

Antenna

Type	Antenna type	Connector	Frequency band [MHz]
Bluetooth	Integrated antenna	-	2402 - 2480
CA26	External stub antenna	TNC (CA22, Magnetic antenna mount)	698 - 2700

Specific Absorption Rate (SAR)

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

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GFU14, GFU27 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

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

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia

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

Frequency band

403 MHz - 470 MHz

Output power

GFU14, GFU27: 0.5 W - 1.0 W

Antenna

Type	GAT1	GAT2
Frequency band [MHz]	400 - 435	435 - 470
Type	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	TNC	TNC

Specific Absorption Rate (SAR)

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

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GFU15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - Russia
  - Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
  - Georgia
  - Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

Receive only

Antenna

Type	GAT1	GAT2
Frequency band [MHz]	400 - 435	435 - 470
Type	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	TNC	TNC

Specific Absorption Rate (SAR)

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

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product 1200DL is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - Russia
  - Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
  - Georgia
  - Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

902 MHz - 928 MHz

Output power

5 mW - 1 W

Antenna

Type	CA6	CA26
Frequency band [MHz]	902 - 928	698 - 2700
Type	Detachable λ/2 antenna	External stub antenna
Connector	TNC (CA22, Magnetic antenna mount)	TNC (CA22, Magnetic antenna mount)

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product TFR-300L is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

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

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia

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

Frequency band	348.56 MHz - 348.80 MHz
Output power	Receive only
Antenna	The appropriate antenna must be ordered directly from your local Tescom Office or Representative.
Specific Absorption Rate (SAR)	The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product CCD14 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

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

- Russia
- Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
- Georgia
- Serbia

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

Frequency band

403 MHz - 470 MHz

Output power

CCD14: 0.5 W - 1.0 W

Antenna

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

Specific Absorption Rate (SAR)

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

Conformity to national regulations

- FCC Part 15 and 90 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product CCD15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - Russia
  - Ukraine (max. 10 mW output power, 433.050 - 434.790 MHz)
  - Georgia
  - Serbia
- The conformity for countries with other national regulations not covered by the FCC part 15 and 90 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

902 MHz - 928 MHz

Output power

5 mW - 1 W

Antenna

Type	CA6	CA26
Frequency band [MHz]	902 - 928	698 - 2700
Type	Detachable λ/2 antenna	External stub antenna
Connector	TNC (CA22, Magnetic antenna mount)	TNC (CA22, Magnetic antenna mount)

10 Software Licence Agreement

Software Licence Agreement

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

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Open source information

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

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

If foreseen in the corresponding open source licence, you may obtain the corresponding source code and other related data on http://opensource.leica-geosystems.com/icon.
Contact opensource@leica-geosystems.com in case you need additional information.

Appendix A NMEA Message Formats

A.1 Overview

Description

National **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 **Settings > Tools > NMEA Output**.

☞

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

A.2 Symbols Used for Describing the NMEA Formats

Description

NMEA messages consist of various fields. The fields are:

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

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

Header

Symbol	Field	Description	Example
$	-	Start of sentence	$
--ccc	Address	• -- = alphanumeric characters identifying the talker Options: GN = **G**lobal **N**avigation **S**atellite **S**ystem GP = GPS only GL = GLONASS GA = Galileo BD = BeiDou • ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message.	 GNGGA GPGGA GLGGA GAGGA BDGGA

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. • Leading zeros are always included for hours, minutes and seconds to maintain fixed length.	115744.00
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.

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

Examples

User-defined Talker ID = GN

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

A.4 GGK - Real-Time Position with DOP

Syntax

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

Description of fields

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

Field	Description
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

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

User-defined Talker ID = GN

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

A.5 GGQ - Real-Time Position with CQ

Syntax

$--GGQ,hhmmss.ss,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

Standard Talker ID

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

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

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

User-defined Talker ID = GN

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

A.6 GLL - Geographic Position Latitude/Longitude

Syntax

$--GLL,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

Standard Talker ID

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

User-defined Talker ID = GN

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

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	Mode indicator N = Satellite system not used in position fix or fix not valid A = Autonomous; navigation fix, no real-time fix D = Differential; real-time position, ambiguities not fixed R = Real-time kinematic; ambiguities fixed
xx	Number of satellites in use, 00 to 99
x.x	HDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
x.x	Geoidal separation in metres
x.x	Age of differential data
xxxx	Differential base station ID, 0000 to 1023
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

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

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

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

User-defined Talker ID = GN

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

A.8 GSA - GNSS DOP and Active Satellites

Syntax

$--GSA,a,x,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 3 = 3D
xx	Numbers of the satellites used in the solution. This field is repeated 12 times. 1 to 32 = PRN numbers of GPS satellites 33 to 64 = Numbers of WAAS and WAAS like satellites 65 to 96 = Slot numbers of GLONASS satellites
x.x	PDOP
x.x	HDOP
x.x	VDOP
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

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

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

User-defined Talker ID = GN

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

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 4
x	Message number, 1 to 4
xx	Number of theoretically visible satellites according to the current almanac.
xx	PRN (GPS) / Slot (GLONASS) number of satellite
xx	Elevation in degrees, 90 maximum, empty when not tracking
xxx	Azimuth in degrees true north, 000 to 359, empty when not tracking
xx	**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
*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

Standard Talker ID

$GPGSV,3,1,11,01,55,102,51,11,85,270,50,14,31,049,47,17,21,316,46*7A
$GPGSV,3,2,11,19,31,172,48,20,51,249,50,22,00,061,,23,11,190,42*7E
$GPGSV,3,3,11,24,11,292,43,25,08,114,,28,14,275,44,,,,*45
$GLGSV,2,1,06,65,16,055,42,66,64,025,48,67,46,262,42,68,01,245,*64
$GLGSV,2,2,06,81,52,197,47,83,07,335,,,,,,,,*68

User-defined Talker ID = GN

$GNGSV,3,1,10,01,55,100,51,11,86,263,50,14,31,049,47,17,22,316,46*65
$GNGSV,3,2,10,19,30,172,48,20,52,249,51,23,12,190,42,24,12,292,42*6C
$GNGSV,3,3,10,25,09,114,,28,14,274,44,,,,,,,,*62

A.10 HDT - Heading, True

Syntax

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

Description of fields

Field	Description
$--HDT	Header including talker ID
x.x	Heading, degrees True
T	Fixed text T for true north
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

$GNHDT,11.4,T, 00*4B

A.11 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
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

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

User-defined Talker ID = GN

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

A.12 LLQ - Leica Local Position and Quality

Syntax

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

Examples

Standard Talker ID

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

User-defined Talker ID = GN

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

A.13 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
a*hh	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

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

User-defined Talker ID = GN

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

A.14 VTG - Course Over Ground and Ground Speed

Syntax

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

Description of fields

Field	Description
$--VTG	Header including talker ID
x.x	Course over ground in degrees true north, 0.0 to 359.9
T	Fixed text T for true north
x.x	Course over ground in degrees magnetic North, 0.0 to 359.9
M	Fixed text M for magnetic North
x.x	Speed over ground in knots
N	Fixed text N for knots

Field	Description
x.x	Speed over ground in km/h
K	Fixed text K for km/h
a	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID
$GNVTG,11.4285,T,11.4285,M,0.007,N,0.013,K,D*3D
User-defined Talker ID = GN
$GNVTG,287.7273,T,287.7273,M,0.002,N,0.004,K,D*3E

A.15 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.16 ZDA - Time and Date

Syntax

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

Description of fields

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

Standard Talker ID
$GPZDA,091039.00,01,10,2003,-02,00*4B
User-defined Talker ID = GN
$GNZDA,113806.00,10,04,2006,02,00*76

Appendix B ORP – Orientation and Position

Description

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

Access

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

Description of fields

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

Message type	Format	Description
	The following block is only available if **Control Type** = **2** (Dual GNSS)	
	x,	Position Status Flag - 2nd antenna[3]
	If Position Status Flag - 2nd Antenna != "0" (not computed yet) and != 4 (not used)	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency[4] [milliseconds]
	xx.xx,	Quality Latitude/Northing [metres]
	xx.xx,	Quality Longitude/Easting [metres]
	xx.xx,	Quality Height [metres]
	If Coordinate System = 0 (Geodetic) the following block is present:	
	llll.ll,	Latitude (+: North -: South)
	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
,546672.161,371.528,1,254,084709.25,310713,100,0.005,0.004,0.012,5250781.2
77,546671.390,371.497,1,084709.25,310713,100,272.683,0.592*23

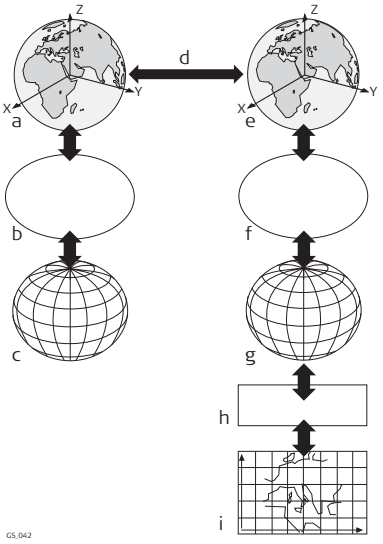
Appendix C Glossary

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.

Type	Description
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.

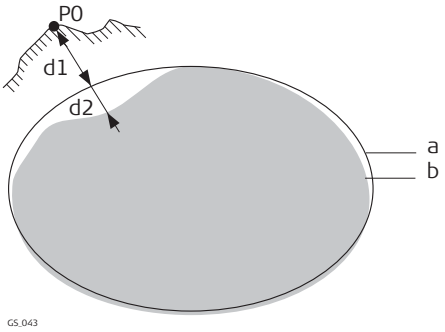
C.2 G

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

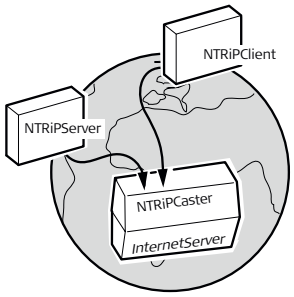
C.3 N

Ntrip

Networked **T**ransport of **R**TCM via **I**nternet **P**rotocol

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

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



Ntrip and its role in the Internet

Ntrip Caster

The Ntrip Caster

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

Ntrip Client

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

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

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

to the Ntrip Caster.

Ntrip Server

The Ntrip Server transfers data streams.
In order to send real-time corrections, the Ntrip Server must first send

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

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

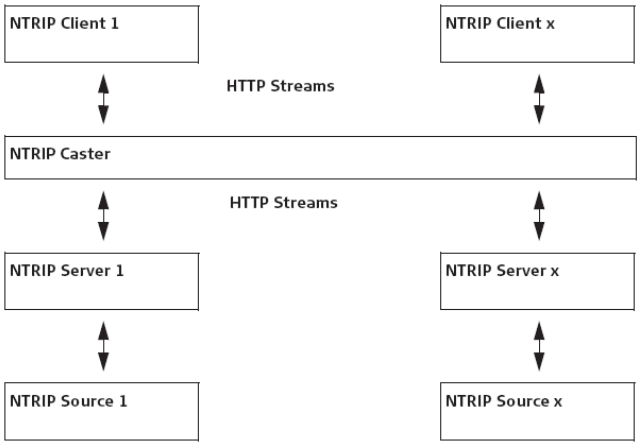
Ntrip Source

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

Ntrip system components

Ntrip consists of three system components:

- Ntrip Clients
- Ntrip Servers
- Ntrip Caster



C.4 W

WGS 1984

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

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Leica Geosystems AG
Heinrich-Wild-Strasse
CH-9435 Heerbrugg
Switzerland
Phone +41 71 727 31 31
www.leica-geosystems.com

- when it has to be **right**

Leica Geosystems