Leica CR50

User Manual
Version 1.0
English

- when it has to be **right**

Leica Geosystems

PART OF HEXAGON

Introduction

Purchase

Congratulations on the purchase of a Leica CR50 system.

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

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

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

Product identification

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

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

Trademarks

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

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to the Leica CR50.

Available documentation

Name	Description/Format		
Leica CR50 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference field guide.	✓	✓
Leica CR50 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 CR50 documentation/software:

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

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

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

The availability of services depends on the instrument model.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.

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

Table of Contents

1 Safety Directions

1.1 General Introduction

Description

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

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

About warning messages

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

Warning messages...

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

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

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

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

1.2 Definition of Use

Intended use

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

Reasonably foreseeable misuse

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

⚠WARNING

Altered function and safety of the machine

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

Precautions:

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

1.3 Limits of Use

Environment

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

⚠WARNING

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

Life Risk.

Precautions:

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

1.4 Responsibilities

Manufacturer of the product

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

Person responsible for the product

The person responsible for the product has the following duties:

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

⚠WARNING

Unqualified installation on building or construction machinery

This may result in personal and material damage.

Precautions:

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

1.5 Hazards of Use

⚠CAUTION

Unsuitable installation location

Installing near mechanically moving machine components may damage the product.

Precautions:

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

NOTICE

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

Watch out for erroneous measurement results.

Precautions:

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

⚠DANGER

Risk of electrocution

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

Precautions:

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

⚠WARNING

Distraction/loss of attention

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

Precautions:

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

⚠WARNING

Inadequate securing of the working site

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

Precautions:

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

⚠CAUTION

Not properly secured accessories

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

Precautions:

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

⚠WARNING

Lightning strike

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

Precautions:

- Do not use the product in a thunderstorm.

⚠DANGER

Risk of being struck by lightning

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

Precautions:

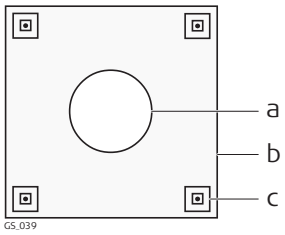
- Do not use the product in a thunderstorm as you can increase the risk of being struck by lightning.
- Be sure to remain at a safe distance from electrical installations. Do not use the product directly under or close to power lines. If it is essential to work in such an environment contact the safety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

Lightning conductors

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

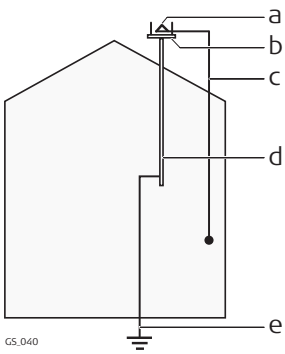
1. On non-metallic structures
   Protection by air terminals is recommended. An air terminal is a pointed solid or tubular rod of conducting material with proper mounting and connection to a conductor. The position of four air terminals can be uniformly distributed around the antenna at a distance equal to the height of the air terminal.
   The air terminal diameter should be 12 mm for copper or 15 mm for aluminium. The height of the air terminals should be 25 cm to 50 cm. All air terminals should be connected to the down conductors. The diameter of the air terminal should be kept to a minimum to reduce GNSS signal shading.
2. On metallic structures
   Protection is as described for non-metallic structures, but the air terminals can be connected directly to the conducting structure without the need for down conductors.

Air terminal arrangement, plan view



a Antenna
b Support structure
c Air terminal

Grounding the instrument/antenna



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

⚠WARNING

Incorrect fastening of the external antenna

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

Precautions:

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

⚠CAUTION

Inadequate steering if machine is defective

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

Precautions:

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

⚠WARNING

Missing attention of operators or malfunctions

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

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

Precautions:

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

⚠WARNING

Improper disposal

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

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

Precautions:

- ▸ 

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

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

⚠WARNING

Improperly repaired equipment

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

Precautions:

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

1.6 Electromagnetic Compatibility (EMC)

Description

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

⚠CAUTION

Electromagnetic radiation

Electromagnetic radiation can cause disturbances in other equipment.

Precautions:

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

⚠CAUTION

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

This may cause disturbances in other equipment.

Precautions:

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

⚠CAUTION

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

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

Precautions:

- Check the plausibility of results obtained under these conditions.

⚠CAUTION

Electromagnetic radiation due to improper connection of cables

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

Precautions:

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

⚠WARNING

Use of product with radio or digital cellular phone devices

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

Precautions:

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

2 Description of the System

2.1 System Components

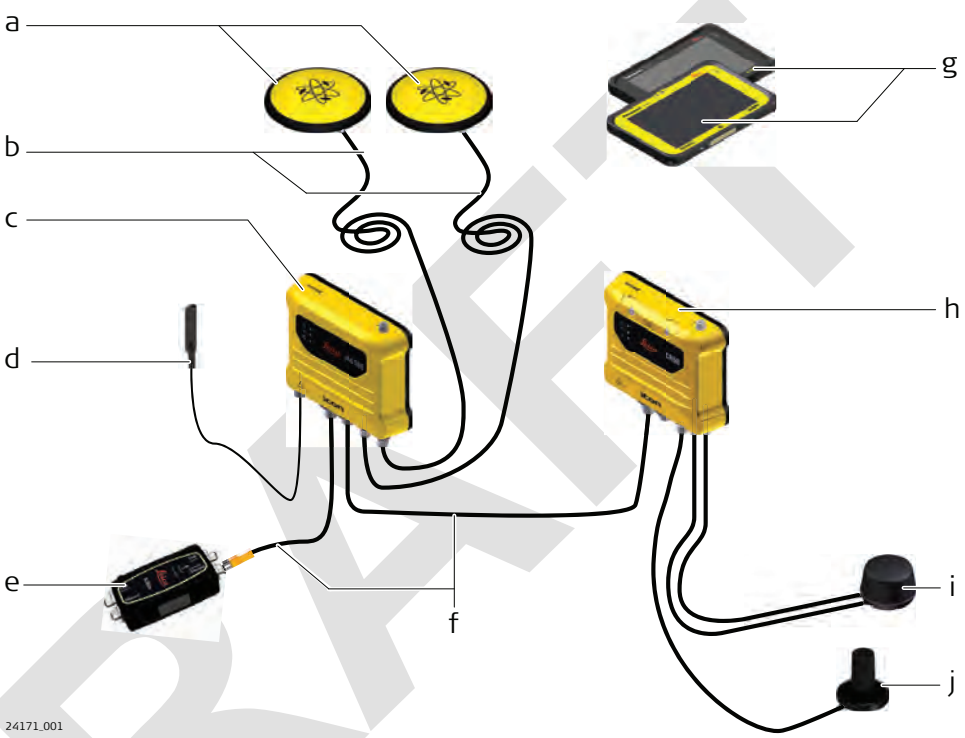
2.1.1 General Information

Description

The Leica CR50 instrument, paired with a GNSS instrument, offers you highest productivity and flexibility, allowing you to choose the right communication device for your use case.

An example configuration is shown in the following paragraph.

Main components, Radio Configuration with Dual GNSS



a CGA100 Robust multi-frequency GNSS antenna, 2 x
b CA16 Antenna cable, 10 m, 2 x
c iCG100 Instrument
d CA49/CA53 Bluetooth antenna
e Automotive Ethernet cable
f Junction box
g Machine PC CC70/CC80
h CR50 Instrument
i CA46/CA52 4G diversity modem antenna
j Radio antenna CA12/CA13/CA43 and CA22 magnetic radio antenna mount

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

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

Special features CR50

CR50 instruments are equipped with several special features:

- Wide supply voltage range of 9V to 36V
- 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
- Magnets for simple mountings
- Protection caps on connectors
- LEDs for status information
- Versatile connectivity with Automotive Ethernet
- USB host port for data transfer and firmware upgrade
- Integrated high speed LTE (4G) / HSPA+ (3.5G) modem
- Integrated radio options
- Robust, compact aluminium housing

Commands for Remote Config

The CR50 instrument can be communicated:

- via the Leica Machine Control Net Protocol on the Automotive Ethernet port.

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

2.1.2 Power Concept

General

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

Power options

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

☞ CR50 can only be powered using the Automotive Ethernet port.

2.2 Unpacking the Container

Description

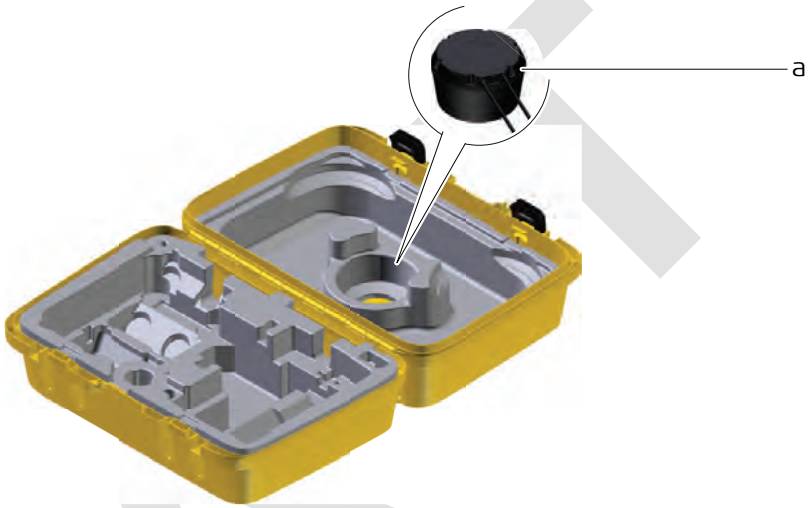
Available delivery packages:

- Delivery box: when a single CR50 instrument was ordered. Includes the instrument, the printed CR50 Quick Guide and the USB documentation card.
- A hard-top container comprising all items for a Dual GNSS configuration.

2.2.1 CR50 Dual GNSS Container

MTC1408 Container upper shell

The large-size MTC1408 container comprises all items for configuration of a CR50.



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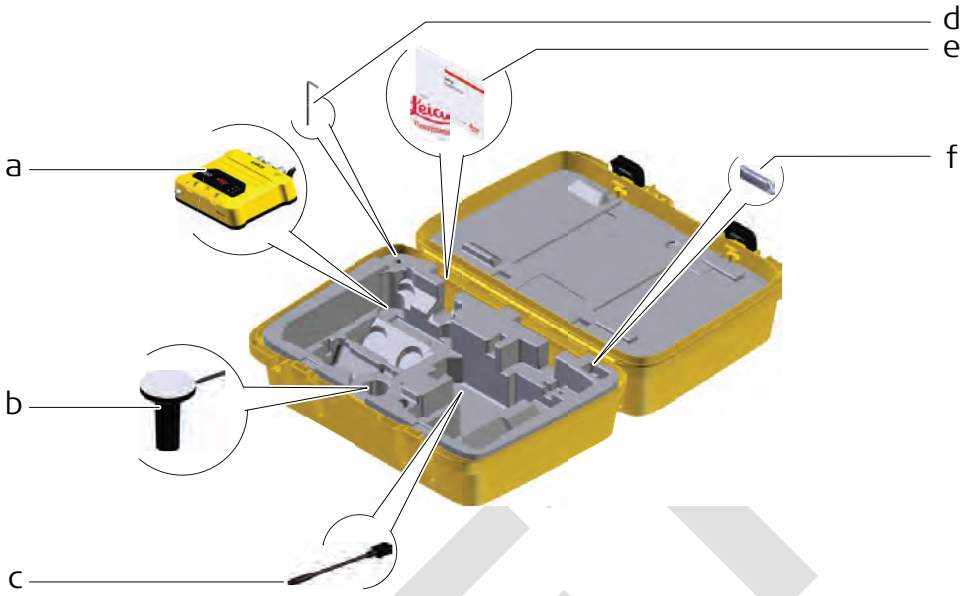
a CA46/CA52 4G diversity modem antenna

MTC1408 container lower shell

Large-size MTC1408 container configuration.



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a	CR50 Instrument	d	Hex key 2.5 mm
b	Radio antenna CA12/CA13/ CA43 and CA22 magnetic radio antenna mount	e	Quick Guide & USB documentation card CR50
c	USB adapter	f	Industrial 1 GB USB flash drive

2.3 Instrument Components

CR50 components

024359_001

a	Power and status LED
b	Internet status LED
c	UHF radio status LED
d	SIM card compartment
e	Grounding screw

f USB port
g Automotive Ethernet Port, Power in
h Automotive Ethernet Port, Power out
i UHF radio antenna port
j 4G modem antenna port 1
k 4G modem antenna port 2

Port	Description
USB 2.0	USB A data port via M8 to USB A adapter, for data exchange, software updates.
UHF Radio	For connection of a radio external antenna.
Automotive Ethernet 1	Power input and data input/output.
Automotive Ethernet 2	Power output and data input/output.
Modem 1, Modem 2	For connection of an external diversity antenna for the internal 4G modem.

3 Using CR50

3.1 Power Supply

External power supply only

From the Junction box via Automotive Ethernet cable.

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

3.2 Installing a SIM Card

Insert and remove the SIM card step-by-step

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

1. Loosen the screws of the Sim card compartment cover with the supplied Hex key.
2. Remove the cover.
   ☞ The indents on the 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 all the way in.
5. Place the cover back into position.
6. Tighten the screws of the 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 pull the card out.

3.3 Using USB Memory Devices

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

☞	Ensure the instrument is placed in its fixed position or place it onto a stable surface.
1.	Unscrew the cap from the USB port.
2.	Plug in the USB adapter cable.
3.	Slide the USB data storage device firmly into the USB host port until it clicks into position.
☞	Take care not to damage the USB data storage device when moving the CR50 or when handling around the device.
☞	Remove the adapter cable and close the USB port cover when no USB data storage device is used.

Preconditions for using USB Memory devices

- USB Memory devices must be formatted in the FAT, FAT32 or exFAT format.
- To import data from a USB Memory device to the CR50, appropriate folders must be created on the USB device and the files placed in the correct folder.
- Copy coordinate system files to the folder 'CoordinateSystems'. All other files should be copied to the 'System' folder.

3.4 Installation on a Machine

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

The installation information within this User Manual is indicated to increase the operators understanding of the system and its maintaining.

☞ Before installation:

- Please observe the maximum vibration and ambient temperature values indicated in chapter 7 Technical Data.
- Check that all parts needed are delivered. Refer to 2.2 Unpacking the Container for further information.
- It is strongly recommended that you bench test all components before commencing installation on the actual machine to make sure that all components are fully operational.

Installation location

The CR50 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.

Example of a **correctly placed** instrument.

☞ 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 CR50 instrument must be installed either vertically with the connectors pointing upwards/downwards or horizontally on a flat plane. Easy access to the connectors should be guaranteed.
- For outside assembly, it is strongly recommended to install the instrument vertically with the connectors pointing downwards. In case this is not possible, horizontally on a flat plane, but never with the connectors pointing upwards.

Fastening

The CR50 instrument must be supported by two magnets on opposite sides.

Electrical grounding

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

Different DC and RF noise may exist at different points in the machine which is out of the control of Leica Geosystems. Such noise may have a negative effect on the performance of the CR50.

For this reason, it is best that all external antennas connected to the CR50, including the 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 CR50 to the machine should not be required.

☞ **It is extremely important to disconnect all cables from the CR50 before starting any welding operations on the machine. Otherwise the instrument may be damaged beyond repair.**

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 an Ntrip solution.

Cable installation

- Ensure that the cables are installed such that they are not bent or stretched.
- It is recommended to use strain relief brackets.
- Route the cable as directly as possible and avoid crossing cables.
- Be sure not to tie the cables into “hot” hydraulic hoses.

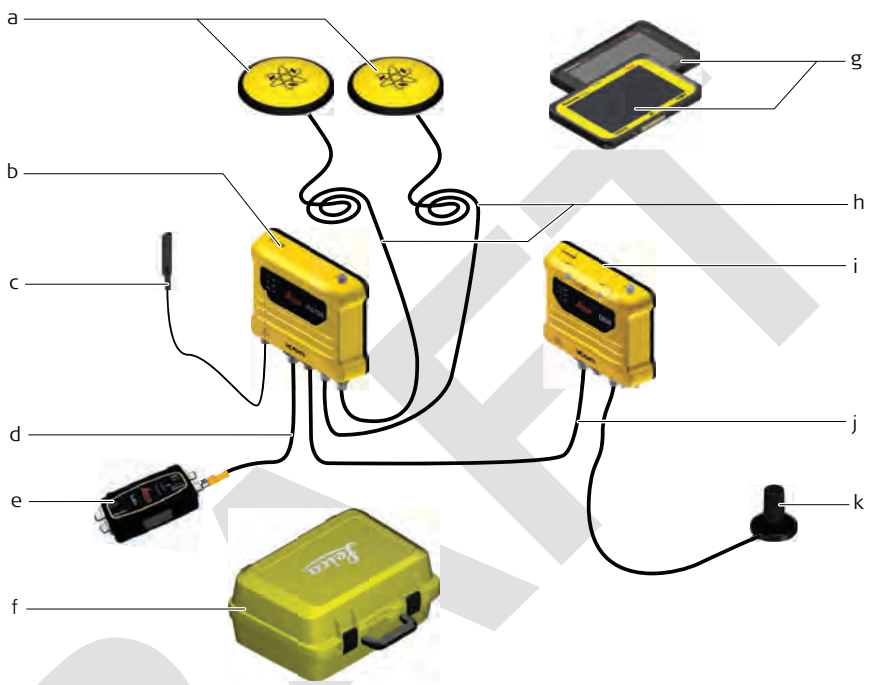
4 Setups with Accessories

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 Setup with UHF Radio

Setup with UHF radio



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i CR50 Instrument
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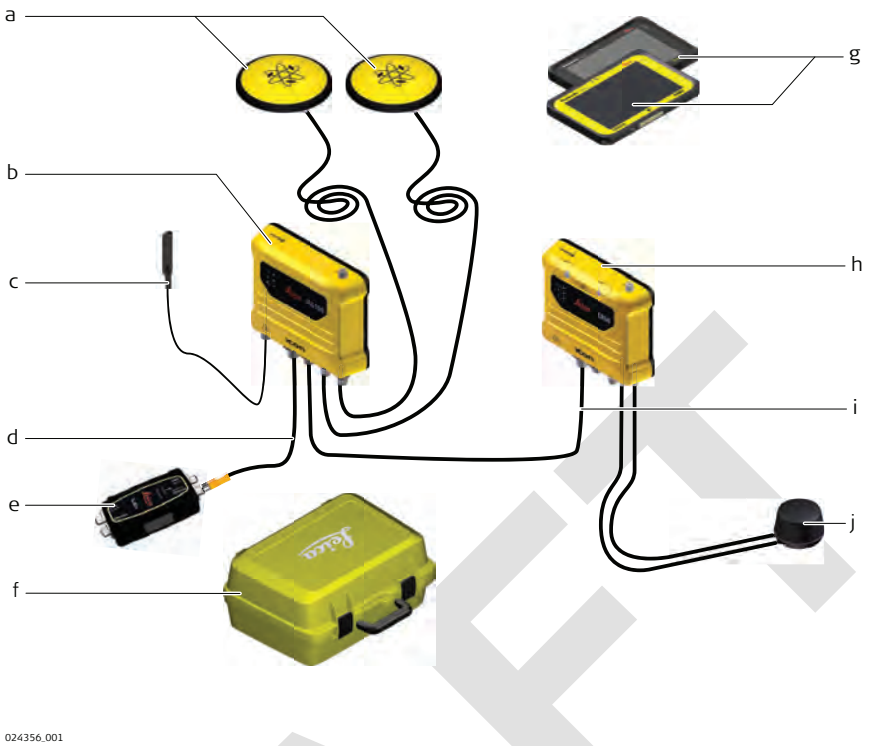
k Radio antenna CA12/CA13/CA43 and CA22 magnetic mount

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

Setup with 4G modem



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h CR50 Instrument
i Automotive Ethernet cable
j CA46 4G diversity modem antenna

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

5 CR50 Web Interface

Getting connected to the Web Interface

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

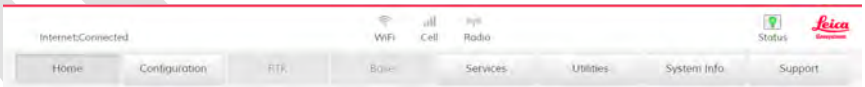
☞ The following instructions are based on using Windows10.

1. Power on the CR50.
   ☞ If you intend to use the Web Interface with CR50 make sure the external Bluetooth antenna is attached.
2. On your computer go to **Start Menu** > **Settings** > **Devices**.
   ☞ Activate Bluetooth if not yet switched on.
3. Click "Add Bluetooth or other devices".
   ☞ Make sure that computer and sensor are in reach for a Bluetooth connection.
4. Click Bluetooth and select the sensor from the list.
   Wait for the connection to be established.
   ☞ The sensor can be identified by its serial number.
5. Go to **Start Menu** > **Settings** > **Network & Internet**.
   Under **Advanced Network Settings** click "Change Adapter Options".
   In the **Network Connections** page double-click on "Bluetooth Network Connection".
   Finally, right-click on the sensor that you have just added and select **Connect using** > **Access Point** from the context menu.
6. Open a browser on your computer and enter the URL:
   http://www.crsetup.leica-geosystems.com
   User name is "leica", as password enter the serial number of the sensor.
   ☞ Alternatively you can enter the IP address: 172.16.0.1
7. Start configuring the CR50 using the Web Interface.

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

Web Interface - Frame

The header section contains a status information bar.



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

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

Status information bar

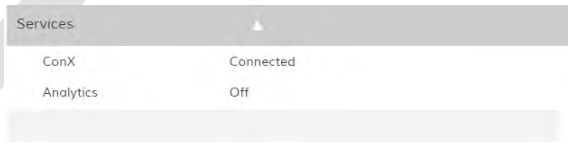
The status bar shows the internet connection, antenna configuration and receiver status information.

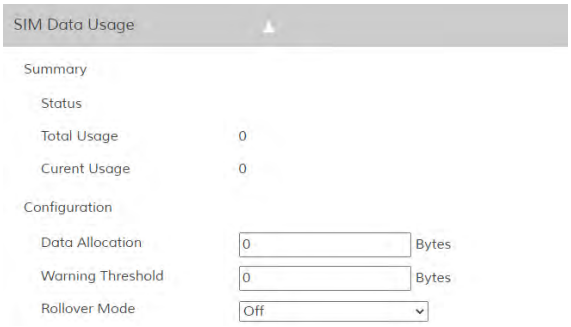
Item	Description
Internet	Indicates whether a connection is established on the sensor or not.
WiFi/Cell/Radio	Indicates the signal strength for each configured communication link.
	Indicates receiver operational status. Green: normal operation Yellow: warning Red: error When you tap the icon, you will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

Home

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

- Status of the RTK link
- Status of the communication devices
- ConX and Analytics services
- SIM data usage

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

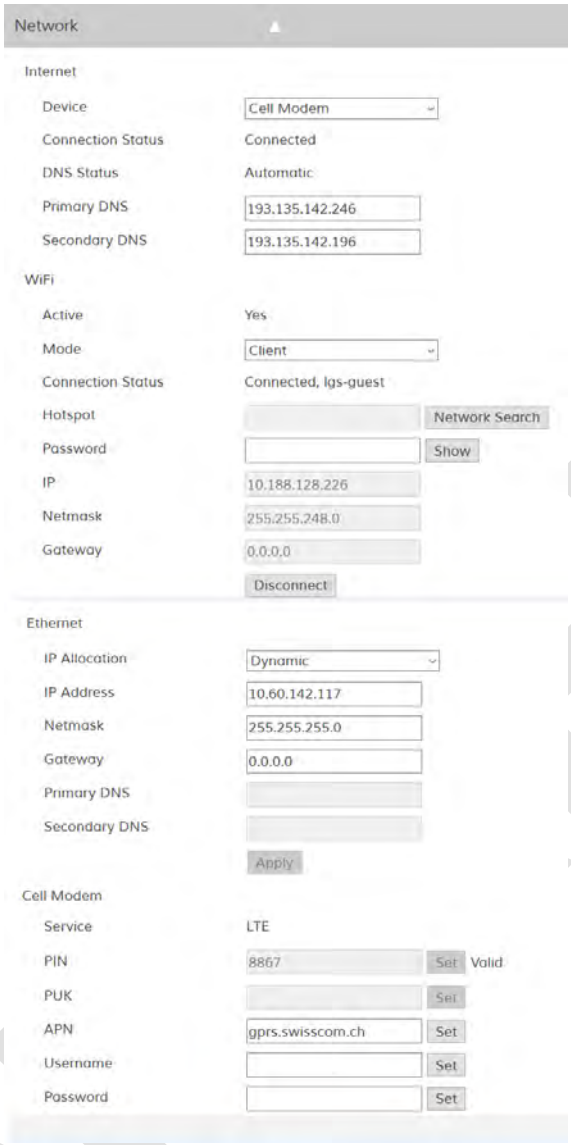
Category	Description
	Status and configuration of SIM data usage: from the **Rollover Mode** drop-down list you can select whether data count shall be reset daily, weekly or monthly, or never (off).

Sensor Configuration

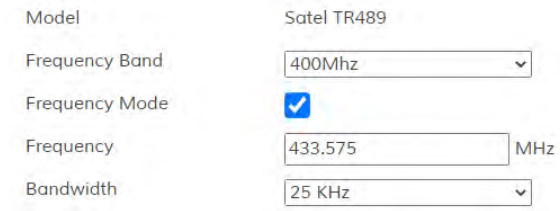
The **Configuration** page allows for configuring device settings such as:

- Rover antennae settings
- Bluetooth
- Network settings for the Internet connection via WiFi, Ethernet or Cellular modem
- Internal radio
- System language

Category	Description
	**Bluetooth** is always active. This ensures seamless communication with the web interface.

Category	Description
	**Internet** connection can be established via *Cell Modem*, *Ethernet* or *WiFi* depending on the chosen device. Each of the devices can be configured. Make sure that a connection is possible and the respective antenna is connected to the receiver. ☞ It is possible to configure **WiFi** as **Hotspot** where the internet connection is shared with external devices (provided an internet connection is established on the sensor). ☞ **Cell Modem** requires a SIM card. PIN, PUK and APN have to be entered and set. Click **Apply** to take over any changes.
	The internal radio can be configured by selecting a **Frequency Band** from the drop-down list. A **Protocol** can be selected from the drop-down list. Click **FEC** to enable **F**orward **E**rror **C**orrection. The current status of the radio is shown.

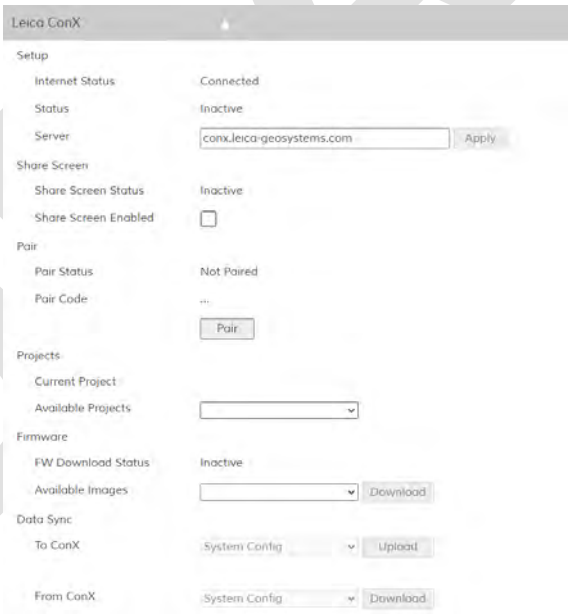
☞ Enable **Frequency Mode** in order to define **Frequency** and **Bandwidth** instead of selecting a **Channel**.

Category	Description
	

Services

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

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

Category	Description
	The iCON Analytics service is enabled by default and active once an internet connection is established on the sensor. If you wish to disable this service or send data anonimously, you can select the respective options from the drop-down list. ☞ Click the **About** button to get detailed information on the scope and implications of using iCON Analytics.
	You can set up and configure a connection to Leica ConX here. Click **Pair** to establish the connection and use the given **Pair Code** to proceed with the setup on the ConX server. • Select **Share screen** in order to see the CR50 screen on ConX and be able to control it from remote. • **Available Projects** can be selected from the drop-down list. Select a project from the list if you wish to use a different project.

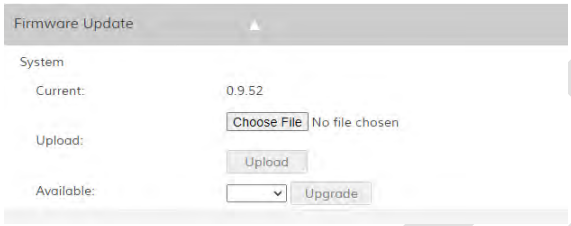
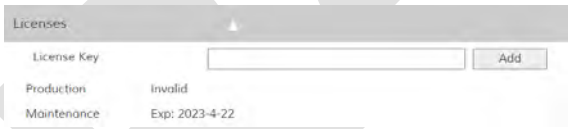
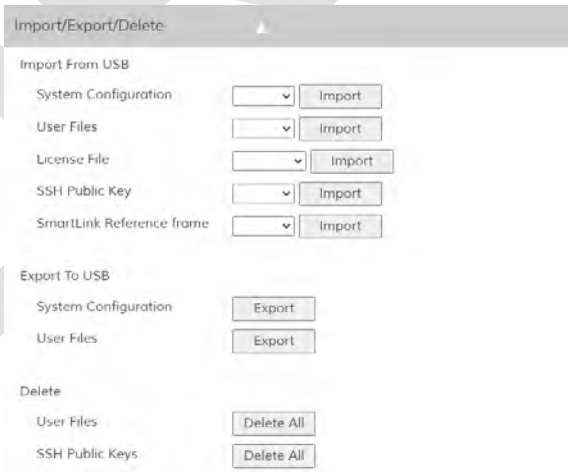
- Select which data shall be synchronised to or from ConX:
  You can upload *System Config* files, *Coordinate Sytems*, *Log Files* for Support or *User Files*. Select and click the **Upload** button.
  You can download *System Config* files, *Coordinate Sytems*, *Antenna Lists*, *Licenses* or *User Files*. Select and click the **Download** button.

Category	Description
• You can also download **Firmware** from ConX. If Firmware files are available for download, the **Status** turns to "Active" and you can select files from the list of **Available Images**. Select and click the **Download** button.	

Utilities

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

☞ No internet connection required on the sensor.

Category	Description
	The **Current** firmware version is shown. Click on **Choose File** to select an upgrade file stored locally on the connected device. Then click the **Upload** button to upload the file to the sensor (via Bluetooth).
	Individual licenses can be added to the sensor. The current status of all licenses is displayed below.
	You can as well import or export files via USB flash drive. Attach the USB flash drive to the sensor. See also: Using USB Memory Devices From the drop-down lists select the files you want to upload to or download from the sensor and click **Import**/**Export**. Click **Delete All** to delete all **User Files** or all **SSH Public Keys** stored in the internal memory on the sensor.

From the drop-down list select the uploaded file and click **Upgrade** to start the firmware upgrade process.

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

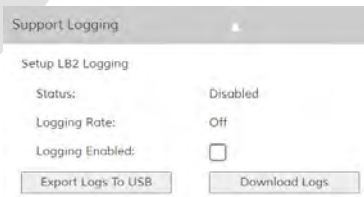
System Info

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

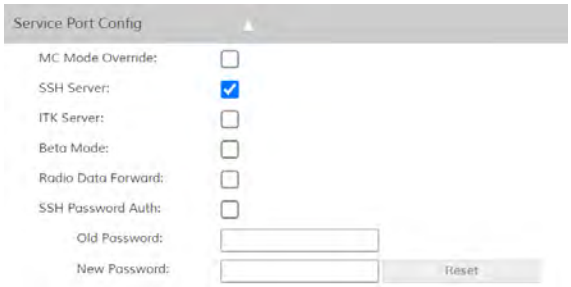
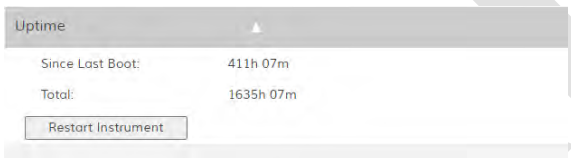
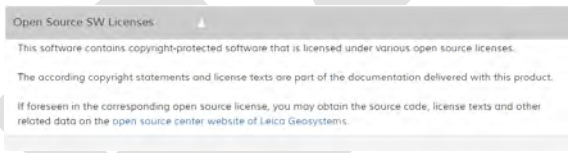
Category	Description
	Under **Hardware** you can visualise additional information about the hardware components inside the sensor.
	Under **Status** you can find detailed information on errors and warnings. In case there is an issue the light bulb icon in the Status information bar turns yellow or red.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

Support

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

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

☞ A USB flash drive must be connected. See also: Using USB Memory Devices

Category	Description
	Allows for configuring the **Service Ports** and resetting the SecureShell (SSH) password. Select **MC Mode Override** to pause CAN communication with the machine temporarily for troubleshooting. ☞ MC Mode Override is always disabled while booting the instrument.
	Allows for resetting single system components.
	Shows the elapsed time since the last system boot as well as the total uptime of the sensor. Tap **Restart Instrument** to reboot the system.
	Software Licence agreement for copyright-protected Open Source Software.

6 Care and Transport

6.1 Transport

Transport in the field

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

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

Transport in a road vehicle

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

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

Shipping

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

6.2 Storage

Product

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

6.3 Cleaning and Drying

Product and accessories

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

Damp products

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

Cables and plugs

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

Connectors with dust caps

Wet connectors must be dry before attaching the dust cap.

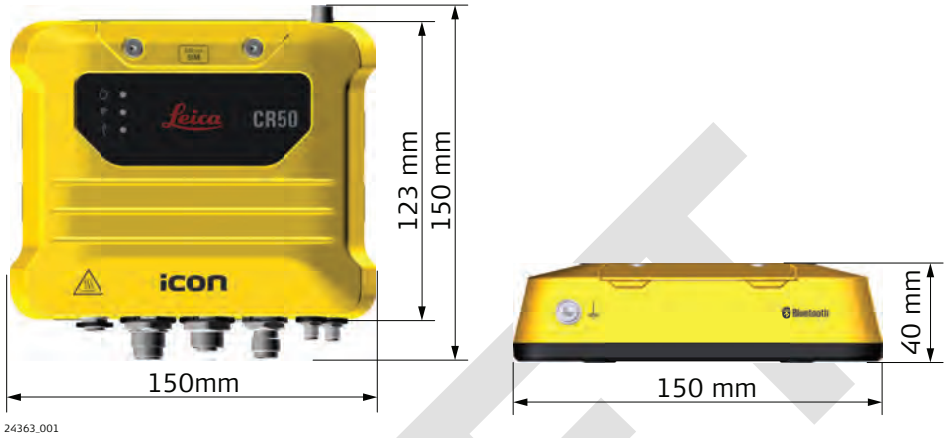
7 Technical Data

7.1 Technical Data CR50

7.1.1 General Technical Data of the Product

Dimensions

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



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

Weight

Type	Weight [kg]/[lbs]
CR50	0.84/1.86 (including internal LTE modem and UHF radio)

☞ The modem is integrated.

Power

Power consumption:	CR50 NTRIP Rover, radio excluded: 7.2 W typically, 24 V @ 300 mA
External supply voltage:	Nominal 24 V DC (⎓), voltage range 9 V to 36 V DC, supplied by the Junction Box via Automotive Ethernet cable.

Electrical data

Type	CR50
Voltage	Nominal 24 V
Current	NTRIP Rover, radio excluded: 7.2 W typically, 24 V @ 300 mA
Gain (internal antenna)	Typically -12 dBi
Noise Figure	Typically < 2 dBi

Environmental specifications

Temperature

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

Protection against water, dust and sand

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

Humidity

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

Vibration/Shock

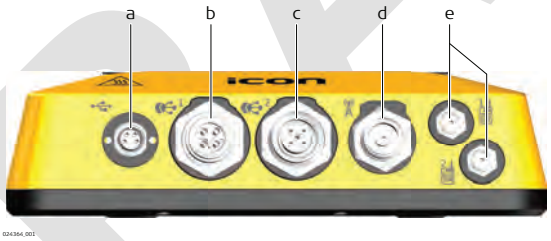
Type	CR50
Vibration	5 - 500 Hz, ± 15 mm, 5 g IEC60068-2-6 MIL-STD 810G - 514.6E-1-Cat24
Shock	60 g, 6 ms, IEC60068-2-27

7.2 Pin Assignments and Sockets

Expert knowledge required

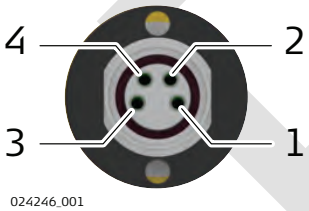
Modification or adaption on base of the pin assignments and socket descriptions need expert knowledge.

Connectors Overview



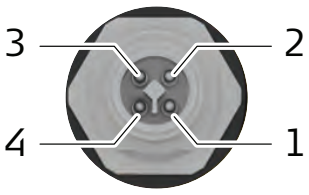
a USB port
b Automotive Ethernet Port, Power in
c Automotive Ethernet Port, Power out
d Radio antenna port
e 4G modem antenna antenna ports

USB M8 connector



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

Automotive Ethernet, power in

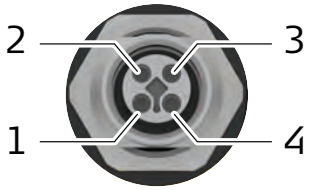


Type: M12 4 Pin

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

Pin	Name	Function	Direction
4	Vin–negative	-VE	Power

Automotive Ethernet, power out

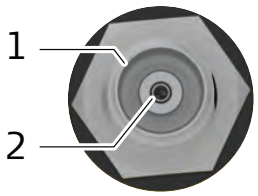


0024248_001

Type: M12 4 Pin

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

UHF Radio

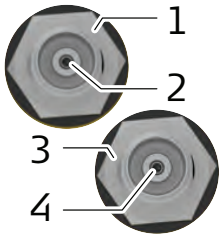


0024280_001

Type: TNC Female

Pin	Description
1	Shield/Ground
2	Signal and antenna power

Modem Antenna



024357_001

Type: TNC Female

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

7.3 Conformity Declarations

7.3.1 CR50

Labelling CR50

24388_001

Antenna

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

Type	Antenna type	Connector	Frequency band [MHz]
CA46/CA52	External diversity antenna	SMA	698 - 960 1710 - 2170 2300 - 2700

Frequency band

Type	Frequency band [MHz]
Bluetooth	2402 - 2480

EM7565

Type	Frequency band [MHz]
WCDMA	Band 1 Tx: 1920 - 1980 Rx: 2110 - 2170
	Band 2 Tx: 1850 - 1910 Rx: 1930 - 1990
	Band 4 Tx: 1710 - 1755 Rx: 2110 - 2155
	Band 5 Tx: 824 - 849 Rx: 869 - 894
	Band 6 Tx: 830 - 840 Rx: 875 - 885
	Band 8 Tx: 880 - 915 Rx: 925 - 960
	Band 9 Tx: 1749.9 - 1784.9 Rx: 1844.9 - 1879.9
	Band 19 Tx: 830 - 845 Rx: 875 - 890
LTE	Band 1 Tx: 1920 - 1980 Rx: 2110 - 2170
	Band 2 Tx: 1850 - 1910 Rx: 1930 - 1990
	Band 3 Tx: 1710 - 1785 Rx: 1805 - 1880
	Band 4 Tx: 1710 - 1755 Rx: 2110 - 2155

Type	Frequency band [MHz]
	Band 5 Tx: 824 - 849 Rx: 869 - 894
	Band 7 Tx: 2500 - 2570 Rx: 2620 - 2690
	Band 8 Tx: 880 - 915 Rx: 925 - 960
	Band 9 Tx: 1749.9 - 1784.9 Rx: 1844.9 - 1879.9
	Band 12 Tx: 699 - 716 Rx: 729 - 746
	Band 13 Tx: 777 - 787 Rx: 746 - 756
	Band 18 Tx: 815 - 830 Rx: 860 - 875
	Band 19 Tx: 830 - 845 Rx: 875 - 890
	Band 20 Tx: 832 - 862 Rx: 791 - 821
	Band 26 Tx: 814 - 849 Rx: 859 - 894
	Band 28 Tx: 703 - 748 Rx: 758 - 803
	Band 29 Tx: n/a Rx: 717 - 728
	Band 30 Tx: n/a Rx: 2350 - 2360
	Band 41 2496 - 2690 (TDD)

Output power

Type	Output power [mW]
Bluetooth	2.5
UMTS	Band 1, 2, 4, 5, 6, 8, 9, 19: 200

Type	Output power [mW]
LTE	Band 1, 2, 3, 4, 5, 8, 9, 12, 13, 18, 19, 20, 26, 28, 29, 30: 200 Band 7, 41: 160

Radiation Exposure Statement

The radiated output power of the instrument is below the radio frequency exposure limits. Nevertheless, the instrument should be used in such a manner that the potential for human contact during normal operation is minimised. To avoid the possibility of exceeding the radio frequency exposure limits, keep a distance of at least 30 cm between you (or any other person in the vicinity) and the instrument.

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 30 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

SAR limits

Country	Head	Body	Limb
EU	0.5 W/Kg, 10-gram	0.5 W/Kg, 10-gram	n/a
France	0.5 W/Kg, 10-gram	0.5 W/Kg, 10-gram	0.5 W/Kg, 10-gram
USA & Canada	1.492 W/Kg, 1-gram	1.6 W/Kg, 1-gram	n/a

EU

CE

Hereby, Leica Geosystems AG declares that the radio equipment type CR50 is in compliance with Directive 2014/53/EU and other applicable European Directives.
The full text of the EU declaration of conformity is available at the following Internet address: http://www.leica-geosystems.com/ce.

USA

FCC ID: RFD-CR50
FCC Part 15, 22, 24, 27 and 90

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

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

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

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

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

However, there is no guarantee that interference does not occur in a particular installation.
If this equipment does cause harmful interference to radio or television recep-

tion, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

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

Canada

CAN ICES-003 Class B/NMB-003 Class B
IC: 3177A-CR50

Canada Compliance Statement

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

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

Canada Déclaration de Conformité

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

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

Radio Frequency (RF) Exposure Compliance Statement

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

⚠WARNING

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

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

China

CCC

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

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

Japan

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

South Korea

Applicant name: Leica Geosystems AG
Product name: Specific small output wireless device
Model name: 2020-07-09
KC number: R-R-rks-CR50
Manufacture date: Marked separately
Manufacturer: LEICA GEOSYSTEMS AG/SWITZERLAND

Others

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

8 Software Licence Agreement/Warranty

Software Licence Agreement

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

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Appendix A Glossary

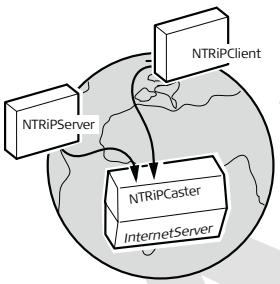
A.1 N

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.

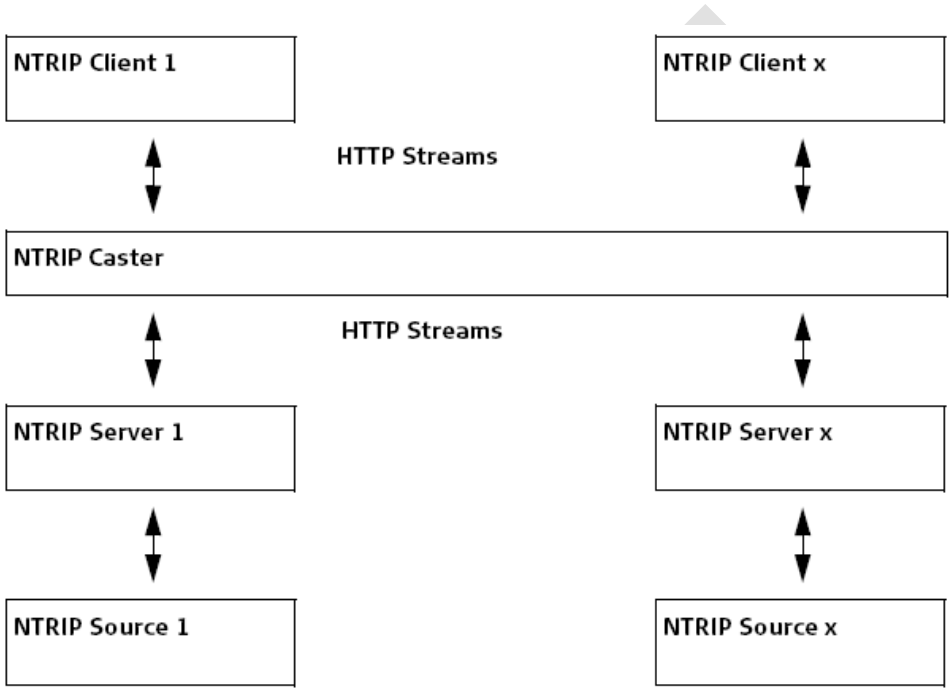
Ntrip Source

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



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