

GPS Equipment

User manual



This user manual contains important safety directions as well as instructions for setting up the equipment and operating it. Read carefully through the user manual before you switch on the equipment.

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1 Product identification

The model and serial number of the GPS Controller (CR) and Sensor (SR) are indicated on the type plate. The model designation of the External Antenna (AT) is indicated on the housing. Enter them in your user manual, and always refer to this information when you need to contact your agency or service workshop.

GPS Controller : Type:_____ Serial No.:_____

GPS Sensor : Type:_____ Serial No.:_____

External Antenna : Type: _____

2 Meanings of symbols

The symbols used in this user manual have the following meanings:



DANGER:

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING:

Indicates a potentially-hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION:

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage. The symbol is also used to alert against unsafe practices.



Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

3. Introduction

Leica GPS System 200 and System 300 comprise of GPS receiver hardware and PC based software for GPS Surveying and related applications.

The Main components are:

GPS Sensors: Receive the satellite signals.

GPS Controllers: Control the Sensor, log the data and steer the survey operation.

Post-processing software: Used to process GPS data.



All of the instructions you need in order to operate your GPS system to a basic level are contained in this manual.

In the "Technical Reference Help System" and SKI Help (available only in English and other selected languages), there are more detailed descriptions of special software/hardware settings and software/hardware functions. These are intended for technical specialists.

4. System description

4.1 GPS Sensors

GPS Sensors are GPS receivers. The Sensors have neither a control panel or a display. The GPS Sensor receives the GPS signal from the NAVSTAR satellites and calculates a range to the satellites that are visible.

There are various types of Sensors, the following are available:

SR260 - 6 L1 channels, code only

SR261 - 6 L1 channels, code and phase

SR9400 - 12 L1 channels, code and phase

SR299/299E - 9 L1, 9 L2 channels, code and phase

SR399/399E - 9 L1, 9 L2 channels, code and phase.

SR9500 - 12 L1, 12L2 channels, code and phase.

The AT202/302 Antennas are intended for use with the SR299E, SR399E and SR9500 Sensors. The AT201 Antenna is intended for use with the SR260, SR261 and SR9400 Sensors.

See section 8 for technical specifications.

Note on SR299/299E, SR399/399E and SR9500 Sensors:

The SR299/299E, SR399/399E and SR9500 Sensors use the GPS P code signal, which by U.S. policy is liable to be switched off without notice.

Phase measurements on L2 are ensured however as these Sensors automatically switch to patented tracking techniques

4.2 GPS Controllers

The Controller controls the Sensor and logs the data. It has a display and keyboard and is the item that the surveyor uses when operating the equipment in the field.

There are two types of Controller, the CR333 and CR344. They are almost identical in appearance and operation, the main difference being that the CR344 has the ability to operate in a real time mode and may be connected to a radio modem for real time operations.

See section 8 for technical specifications.

4.3 Post-processing software

The Post-processing software is used to process the observations taken by the receivers (Sensor and Controller) in order to compute baselines and coordinates.

SKI Static Kinematic software is the standard post-processing software for dual-frequency receivers. SKI-L1 is for single frequency receivers and GIS-SKI is for code-only receivers. The method of operation is the same for SKI, SKI-L1 and GIS-SKI software packages.

4.4 SPCS Software

SPCS software runs on a computer and takes the place of a GPS Controller, the advantage being the large amount of data storage space offered by the computer hard disk.

5 Getting started with new equipment

5.1 SKI (SKI-L1, GIS-SKI) post-processing software

In most cases, the software will be installed by the local Leica representative and a short introductory course will be given.

Should this not be the case, install the software as follows:

1. Start Windows and insert Diskette 1 into drive A: or drive B:
2. Ensure no other applications are running. From the Program Manager choose "Run..." from the File menu. In the Command Line box type A:\SETUP or B:\SETUP and click on [OK]
3. When the set up screen disappears, the SKI Installation screen is displayed. You are asked which files you wish to install. The Program Files, Database Files and Geoidal Model are selected by default. Note that the card reader box is for the MEL-PC card reader, not the OMNIDrive PCMCIA card reader. The OMNIDrive card reader must be installed separately after the installation of SKI (see next section). If you wish to install the MEL-PC card reader, click on the check box. Click on [OK].
4. Specify the drive and path for the SKI Program Directory. By default the path C:\SKI\PROG is suggested. Type in a different path if required. Click on [OK]
5. The same is prompted for the SKI Database Directory and the SKI Working Directory. Follow the same procedure as in step 4 above.
6. The specified directories are created and checked and SKI installed. Insert the remaining disks in turn when the prompt appears.
7. SKI is installed in a new program group called SKI. You will be prompted to restart Windows to complete the installation.

The software contains a comprehensive Help System. This Help System is intended to replace the function of a printed manual. If required you may print out the entire help for use as a hard copy reference manual.

Installing the OMNIDrive card reader.

The OMNIDrive is supplied with an installation diskette.

With the SKI software protection key in place, connect the OMNIDrive card reader to the back. Any printer that was connected may now be connected to the rear of the OMNIDrive.

1. Insert the installation diskette into Drive A: or Drive B:
2. From DOS type A:\INSTALL E or B:\INSTALL E to install in English. A German installation program is available by typing A:\INSTALL or B:\INSTALL
3. The installation will begin by asking you where to install the OMNIDrive. Accept the default path of C:\OMNI\.
4. Accept the further default values that appear during the installation.
5. Lines are added to the CONFIG.SYS and AUTOEXEC.BAT files in order that the OMNIDrive is configured when the computer is started.

5.2 Receiver Hardware: Sensor and Controller

In most cases, a short introduction in the use of the Sensor and Controller will be provided by the local Leica representative. If this is not the case proceed as outlined in the following sections.

After installing SKI you will find that the SKI program group contains a comprehensive Technical Reference Help System. This is intended to replace the function of a printed manual. If required you may print out the entire help for use as a hard copy reference manual.

5.2.1 Charge the batteries

Charge the batteries with the Leica battery charger provided. GEB70 or GEB71 batteries may be used to power the GPS equipment.

The GEB70 and GEB71 batteries may be charged using GKL23 or GKL22 chargers. Additionally the GEB71 may be charged using the GKL14 charger and the GEB70 may be charged using the GKL12 charger.

Refer to the appropriate manual when using the GKL22 or GKL23 charger.

When using the GKL12 or GKL14 charger take note of the following guidelines:



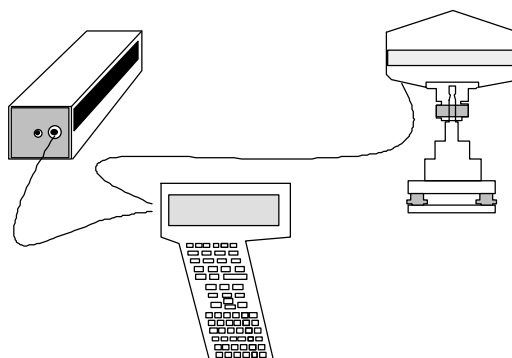
Set the charger to 110-115V or 220-240V according to the mains/line supply.

- A totally flat GEB70 or GEB71 battery requires charging for 14 hours. Charge at ambient temperatures between 10°C and 30°C. Do not overcharge.
- Press the red button on the GKL12 to start the 14 hours charging time.
- It is advisable to use a timer (commonly available from electrical and DIY stores) with the GKL14 to control the charging time.

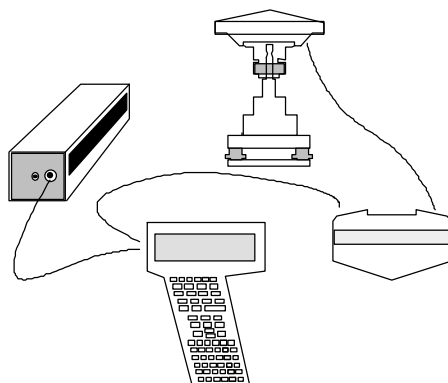
5.2.2 Set Up the Equipment

For an initial test and in order to familiarise yourself quickly with the basic operating procedure, set up TWO receivers a few metres apart and connect the Sensor, Controller and battery as illustrated below

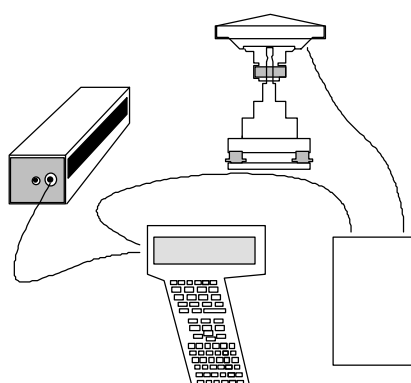
SR299/399



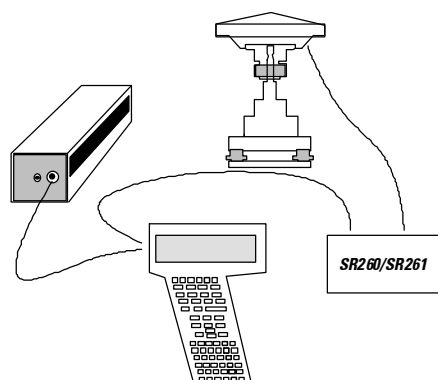
SR299E/399E



SR9400/9500



SR260/SR261



The Controller user interface works mainly via the six function keys (F1 to F6) positioned under the display. Six corresponding bars appear in the bottom line of the display. A function that appears in a bar is activated by pressing the corresponding function key. Where a menu appears with many options, you can move from option to option by using the cursor keys (\uparrow \downarrow \leftarrow \rightarrow). Additionally an option may sometimes appear with a definite range (e.g. observation rate may be set at 1,2,3,4,5,6,10,12,15,20,30 or 60 seconds). In these cases, the value is set by using the cursor left or cursor right key (\leftarrow \rightarrow).

5.2.3 Preparing to measure

Take the memory card and insert the memory card battery provided as shown in the memory card instructions. Insert a memory card into each Controller. When the cards are new and have not been used in the Controller they must first be formatted. Proceed as follows:

Panel	Action / Display	Key
	Switch ON Leica GPS System Testing hardware All hardware tests passed	ON ENTER
Main Menu [0000]	Use arrow keys Toggle to AUXILIARY	CONT/F1
Auxiliary [0500]	Format memory card/module	CONT/F1
Format Memory Card/ Inter Memory [0540]	Enter a label, e.g. Card 1 Note that F3 switches between MCARD andMMODULE Do you really want to format ? (Y/N) Formatting done. Format another ? (Y/N)	CONT/F1 Y (Yes) N (No)
Note: If the memory card is not formatted the Controller will display panel [0540] immediately on switching on		
Main Menu [0000]	Returned to main menu Toggle to Configuration	CONT/F1
Configuration [0200]	Toggle to Date, Time, Zone	CONT/F1
Configuration Date, Time, Zone [0230]	Input your local time zone e.g., +3 or -7 etc. Do NOT changeGPS Date and Time	SET/F2 CONT/F1
Main Menu [0000]	Returned to Main Menu Toggle to Configuration	CONT/F1
Configuration [0200]	Toggle to Data Logging	CONT/F1
Configuration Data Logging [0270]	Toggle using horizontal arrows Select MEMORY CARD (or INTERNAL MEMORY MODULE)	CONT/F1
Main Menu [0000]	Returned to Main Menu Toggle to Configuration	CONT/F1
Configuration [0200]	Toggle to Sensor Type	CONT/F1

Configuration Sensor Type [0290]	Select the Sensor and Antenna type depending upon which Sensor is connected.	CONT/F1
Main Menu [0000]	Returned to Main Menu Switch off	OFF

5.2.4 Measuring with the STSDEF Static Default mission

When you receive the equipment, you will find that there is one mission, the STSDEF Static Survey default mission, stored in the Controller. Proceed as follows at each Controller:

With a CR233, or CR333 Controller running firmware version 2.33 or earlier

Panel	Action / Display	Key
	Switch On	ON ENTER
Main Menu [0000]	Toggle to MISSIONS	CONT/F1
Missions [0100]	Toggle to STSDEF Static Survey DEFAULT STS If this is the only mission it will be highlighted	RUN/F1
Current Mission [1000]	Displays information about selected mission	CONT/F1
"Please Wait" flashes		
Set Operation [1021]	Horizontal arrows toggle between operation types Toggle to STATIC	CONT/F1
Set Initial Position [1005]	Vertical arrows toggle from field to field Horizontal arrows toggle within field i.e., Last fix/User input, N/S, E/W Toggle Use to USER INPUT Input approx.Lat, Lon, Hgt	CONT/F1
Set Satellite Tracking Control [1006]	Vertical arrows toggle from field to field Hz arrows toggle Health/L2 mode to AUTO<>USER Toggle Health/L2 mode to AUTO Accept minimum elevation 15°	CONT/F1
Set Time-Mark Parameters [1012]	Vertical arrows toggle from field to field Hz arrows toggle Time-mark between ON<>OFF. Toggle Time-mark to OFF Accept time-mark rate and bias settings	CONT/F1

Set Data Collection Parameters [1101]	Vertical arrows toggle from field to field Horizontal arrows toggle within field Toggle to COMPACTED Min sats for recording: input 4 Obs. rec.–rate stat.: toggle to 15secs	CONT/F1
Set Stop–Go Parameters [1103]	Accept the default settings: Baseline length approx. 10 km Stop at 100% NO Maximum recording time 60 min Stop at maximum time NO These setting have no influence on the observations	CONT/F1
Set Point Id Parameters [1104]	Accept the default settings. These setting have no influence on the observations	CONT/F1
Enter Data Set Parameters [1109]	This panel allows you to enter a project code and notes. These entries have no influence on the observations. Ignore this panel.	CONT/F1
"Please Wait" flashes		
Survey [1110]	You are now in the main surveying panel Press MEAS to start observations	MEAS/F1
Message: "Measuring – check your input" is displayed		

Let both receivers track satellites and record data for about 15 minutes. Enter a Point Id. Measure the height with the height hook provided. Enter this value in the Height field. When set up on a tripod with a GRT44 carrier and tribrach, the antenna offset is 0.441m. Enter this value in the Antenna offset field. Then exit the mission and switch off as follows:

Panel	Action / Display	Key
Survey [1110]	Press STOP to halt observations Stop measuring ? (Y/N) Press Y	STOP/F1 Y
Survey [1110]	Record the point information EXIT Mission Exit Mission ? (Y/N)	REC- PT/F1 EXIT- M/F2 Y
"Please Wait" Flashes		
Main Menu [0000]	Returned to Main Menu Switch OFF	OFF

With a CR244, or CR344 Controller running firmware version 3.20 or later.

Panel	Action / Display	Key
	Switch On Leica GPS testing hardware...	ON ENTER
Main Menu [0000]	Toggle to MISSIONS	CONT/F1
Missions [0100]	Toggle to STSDEF Static Survey DEFAULT STS If this is the only mission it will be highlighted	RUN/F1
Current Mission [1000]	Displays information about selected mission	CONT/F1
"Please Wait" flashes		
SELECT Project/Job [1002] Set Operation [1021]	Shows which project and job are selected. Accept the defaults shown. Horizontal arrows toggle between operation types Toggle to STATIC	CONT/F1 CONT/F1

SET Datalink Parameters [1013]	Leave datalink switched off.	CONT/F1
SET NMEA Parameters [1017]	Leave NMEA output off	CONT/F1
Set Initial Position [1005]	Vertical arrows toggle from field to field Horizontal arrows toggle within field i.e., Last fix/User input, N/S, E/W Toggle Use to USER INPUT Input approx. Lat, Lon, Hgt	CONT/F1
Set Satellite Tracking Control [1006]	Vertical arrows toggle from field to field Hz arrows toggle Health/L2 mode to AUTO<>USER Toggle Health/L2 mode to AUTO Accept minimum elevation 15°	CONT/F1
Set Data Collection Parameters [1101]	Vertical arrows toggle from field to field Horizontal arrows toggle within field Toggle to COMPACTED Min sats for recording: input 4 Obs. rec.-rate stat.: toggle to 15secs	CONT/F1
Set Stop-Go Parameters [1103]	Accept the default settings: Baseline length approx. 10 km Stop at 100% NO Maximum recording time 60 min Stop at maximum time NO These setting have no influence on the observations	CONT/F1
Set Point Id Parameters [1104]	Accept the default settings. These setting have no influence on the observations "Please Wait" flashes	CONT/F1
Survey [1110]	You are now in the main surveying panel Press MEAS to start observations	MEAS/F1
Message: "Measuring– check your input" is displayed		

Let both receivers track satellites and record data for about 15 minutes. Enter a Point Id. Then exit the mission and switch off as follows:

Panel	Action / Display	Key
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Survey [1110]	Press STOP to halt observations Stop measuring ? (Y/N) Press Y	STOP/F1 Y
Survey [1110]	Record the point information EXIT Mission Exit Mission ? (Y/N)	REC- PT/F1 EXIT-M /F2 Y
"Please Wait" Flashes		
Main Menu [0000]	Returned to Main Menu Switch OFF	OFF



If, during the measurement, you unplug connecting cables or remove the PCMCIA memory card it is possible that you may lose data.

Before you unplug the connecting cables or remove the PCMCIA memory card, first switch off the instrument.

5.3 SPCS Software installation

To install SPCS software insert the installation disk either in floppy drive A: or B: and change into the selected drive. Start installation by typing "INSTALL". The SPCS software will be installed onto drive C: under the sub-directory C:\SPCS\. The sub-directory structure will be created automatically. Under the root-directory C:\ a batch-file SPCS.BAT will be created. Your autoexec.bat file will not be changed.

Current limitations which have to be taken into account are:

- 1) The SPCS software will be installed automatically onto drive C:. There is no possibility to install the software on a different drive.
- 2) Due to limitations of the used multi-tasking operation system that is used the partition size of drive C: has to be ≤ 250 MB.
- 3) The data will be logged automatically under the sub directory C:\SPCS\DATA\.
- 4) The Stacker file compression program must not be used on drive C:.
- 5) Do not use a memory management program.
- 6) Math coprocessor emulation software is not accommodated by SPCS.

Connect the Sensor to the serial port using the cable (RS232-LEMO) provided. Provide the Sensor with power.

Start the Sensor by typing "SPCS" from the DOS prompt. SPCS software is operated in exactly the same way as a GPS Controller. All data is stored under the directory C:\SPCS\DATA. Data is stored in data sets consisting of several files. Note that deleting one or more of these files will corrupt the data set integrity and the data set will not be able to be imported into SKI.



In order to use the software correctly and reliably, you must follow the instructions given in the user manual or in the on-line help system. You must also adhere to the directions given in the user manual for the product with which you are using the software.

The rights and responsibilities accruing in respect to Leica as a result of acquisition of the software are set out in the Leica Software License Agreement.

To secure your rights with regard to the software acquired, it is essential that you follow the directions given on the Leica Software - Support Registration Card.

5.4 Processing the data in the SKI software

In most cases, a short introductory course to the software will have been given by the local Leica representative.

To import and process the data proceed as follows:

Switch on the computer, start Windows, start SKI.

- Create a new Project

Select the Project component. Select Manager. Select New. Enter a path under which you wish to store the project. Enter a project name. Leave the Project component.

- Import the data

For each Controller you must import the data into SKI.

Select the Import component. Select Measurement. Select GPS Controller. Select Memory Card if you recorded data on a memory card. Select Internal Memory if you recorded data on the Internal Memory. Follow the instructions that appear and press OK.

The data will then be read by SKI. Select the jobs or datasets that you wish to copy to the computer and press Copy. When the jobs/datasets that you require are copied press OK.

Then you must import the data into a particular Project. The data that you have copied to the computer is shown in the left hand box, the Project to which it will be copied is shown in the right hand box. Select the data by clicking on it and press Insert to transfer the data to the Project.

When you have imported the data from both Controllers, leave the Import component

- Process the data

Select the Data Processing component. The day on which you have measured will be displayed. Select this day and press OK.

The day will be selected. Press Manual. A chart will appear showing the two stations where you measured.

You must tell the program which station is the Reference and which is the Rover. Ensure that the Reference selection tool is selected. (Displayed at the bottom of the screen). Click on ONE of the lines. It will be selected as the Reference and will be displayed red.

Select the Rover selection tool from the bottom of the screen. Click on the other line. It will be selected as a Rover and will be displayed green.

The baseline selection is now complete. Click on OK.

To begin the computation click on Compute. The computation will begin. When the computation is complete, click on Results to view the result.

One line will be displayed with the accuracy of that line. From here you may export the result for further work. To view the coordinates click on details and move the cursor to the line. Click on the line. The coordinates of the rover point will be displayed.

6 Care and Transport



When dispatching the equipment, always use the complete original Leica shipping case.



- If the equipment gets wet, always dry it before repacking it in the case.

- When storing the equipment, particularly in summer and inside a vehicle, take the storage-temperature limits into account.

- If the hard case is left open and exposed to damp or wet conditions for long periods of time, remove the foam inserts and dry the inside of the case before repacking the equipment.



Cleaning

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



Keep plugs and sockets clean and dry. Blow away any dirt lodged in the cable plugs or instrument sockets.

7 Safety Instructions

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

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

7.1 Intended use of equipment

7.1.1 Permitted uses

Leica GPS equipment is designed and intended for the following applications:

- Measuring and computing coordinates using P-code and/or C/A-code signals from NAVSTAR GPS satellites
- Carrying out measurement tasks using various GPS measuring techniques
- Recording GPS and point related data
- Computation and evaluation by means of software.

7.1.2 Adverse uses

- Using the GPS equipment and software without proper instruction.
- Using the equipment for applications for which it is not designed and in environments for which it is not specified.
- Deactivation of any safety systems and removal of any hazard notices.
- Opening of the product by using tools (e.g. screwdriver) unless, for special purposes, expressly permitted in the instructions.
- Modification or conversion of the product.
- Using the equipment or software after misappropriation.
- Use of accessories from other manufacturers without the express approval of Leica.
- Inadequate safeguards at the site (e.g. when measuring on roads etc.).



WARNING: Adverse use can lead to injury, malfunction and damage.

It is the task of the person responsible for the equipment to inform the user about possible hazards and how to counteract them. Leica GPS equipment is not to be operated until the user has been instructed how to work with it.

7.2 Limits to use

Refer to Section 8 "Technical specifications"

Environment:

Suitable for use in an atmosphere appropriate for permanent human habitation (not in an aggressive or explosive environment).

The CR233, CR244, CR333 or CR344 Controllers are not intended for long term installation in an outdoor environment.

7.3 Responsibilities

- Responsibilities of the manufacturer of the original equipment LEICA AG, CH-9435 Heerbrugg, Switzerland (hereinafter referred to as Leica):

Leica is responsible for supplying the product, including the user manual and original accessories, in a safe condition.

- Responsibilities of the manufacturers of non-Leica accessories:



The manufacturers of non-Leica accessories for Leica GPS equipment are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica product.

- Responsibilities of the person in charge of the equipment



WARNING: The person responsible for the equipment must ensure that it is used in accordance with the instructions. This person is also accountable for the training and deployment of personnel who use the equipment and for the safety of the equipment when in use.

The person in charge of the instrument has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to accident prevention.
- To inform Leica immediately if the equipment becomes unsafe.

7.4 Hazards in use

7.4.1 Main hazards in use



WARNING: The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the instrument



WARNING: The charger and the PCMCIA memory-card reader may not be used under damp or inclement conditions. If moisture penetrates the charger, the user may receive an electric shock.

Precautions:

Use the charger and the PCMCIA card reader only indoors, in dry rooms. Protect them from damp. If they are damp, do not use them.



WARNING: If you open the charger or the PCMCIA memory-card reader, either of the following actions may cause you to receive an electric shock:

- Touching live components
- Using after incorrect attempts to carry out repairs.

Precautions:

Do not open the charger or the PCMCIA memory-card reader. Only a Leica-approved service technician is entitled to repair them.



CAUTION: If the equipment is defective or has been dropped, misused or modified, erroneous measurements may result.

Precautions:

If you suspect the equipment to be defective or that the equipment has been dropped, misused or modified, carry out test measurements before using it further.



WARNING: If computers intended for indoor use are used out of doors in the field, there is a danger of electric shock.

Precautions:

Adhere to any instructions given by the computer manufacturer with regard to field use.



CAUTION: If components of the equipment are not properly connected together or if tripods, quickstands etc. are not properly set up, the equipment may be damaged or people may sustain injury if the equipment is subsequently subjected to mechanical shock.

Precautions:

When setting up the equipment, make sure that all components (e.g. tripod, tribrach, connecting cables etc.) are correctly adapted, fitted, secured and locked in position.



WARNING: Inadequate safeguarding of the survey site can lead to dangerous situations, for example in traffic, on building sites and at industrial installations.

Precautions:

Always ensure that the survey site is adequately safeguarded. Adhere to the regulations governing accident prevention and road traffic.



CAUTION: During the transport of charged batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions: Before dispatching your equipment, discharge the battery, either by running the instrument until the batteries are flat, or by discharging them with the GKL23 charger.



WARNING: If an External Antenna is not properly fitted to the roof rack of a vehicle it can be torn off by mechanical shock, vibration or wind, possibly causing accident and injury.

Precautions:

Use nothing other than the External Antenna on the roof rack of a vehicle. Secure the External Antenna correctly to the roof rack by means of the adapter. Leica offers the adapter as an accessory.

Secure the safety cord to the External Antenna and connect the cord to the adapter in accordance with the instruction plate on the adapter.

Ensure that the roof rack is correctly mounted and able to safely carry the weight of the Antenna and accessories.



WARNING: If the equipment 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 equipment 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:

Dispose of the equipment appropriately in accordance with the regulations in force in your country. Always prevent access to the equipment by unauthorised personnel.



DANGER: If the GPS Receiver Hardware is used in exposed locations (e.g. on masts, mountains or buildings), it is at risk from 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 a GPS receiver in a thunderstorm as you may increase the risk of being struck by lightning.
- Be sure to remain at a safe distance from electrical installations. Do not use the GPS Antenna or Sensor directly under or in close proximity to power lines. If it is essential to work in such an environment contact the

local statutory regulatory bodies responsible for electrical installations and follow their instructions.

- If a GPS Antenna or Sensor 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 a GPS Sensor or Antenna is given below. Always follow the regulations in force in your country with regard to grounding Antennas and masts. These installations must be carried out by an authorised specialist.
- Additional protection against lightning:
If there is a risk of a thunderstorm, or if the equipment is to remain unused and unattended for a long period, protect your Leica GPS equipment additionally by unplugging all systems components and disconnecting all connecting cables and supply cables (e.g.. PC - Controller, Controller - Battery, Sensor - Antenna) .

Suggestion for design of a Lightning Conductor for a GPS Sensor/Antenna

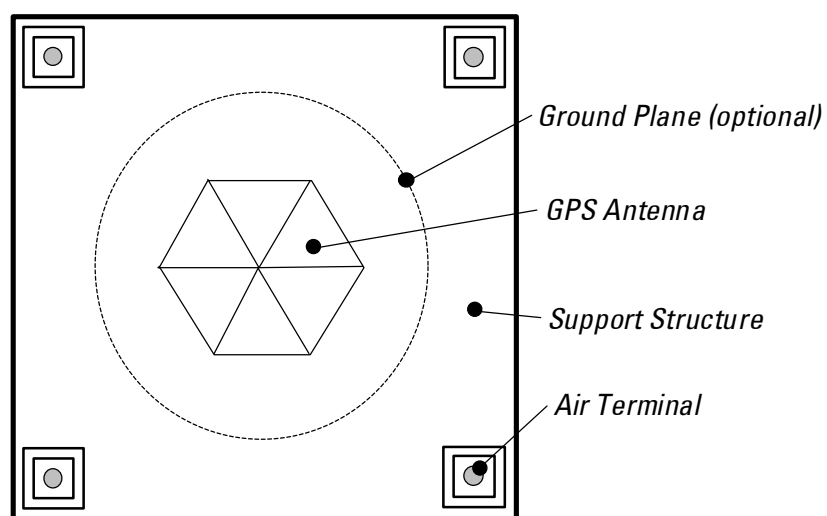
1. On non-metallic structures

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 4 Air Terminals should be uniformly distributed around the Sensor/Antenna at a distance equal to the height of the Air Terminal. The Air Terminal diameter should be 12mm for copper or 15mm for aluminium. The height of the Air Terminals should be 25 to 50cm. All Air Terminals should be connected to the down conductors. The diameter of the Air Terminal should be kept to a minimum to reduce GPS signal shading.

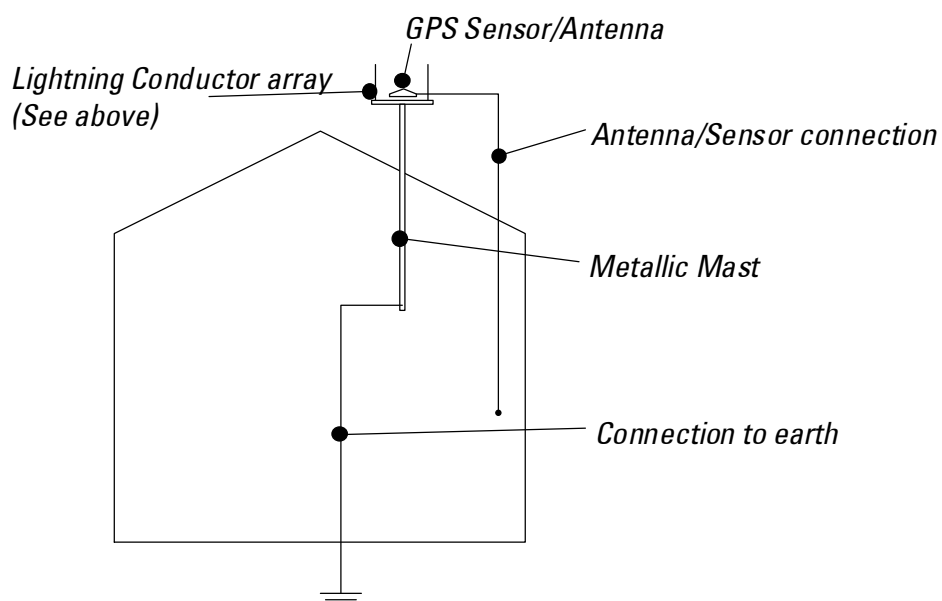
2. On metallic structures

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)



Grounding the Sensor/Antenna



7.4.2 Electromagnetic acceptability

The term "electromagnetic acceptability" is taken to mean the capability of the Leica GPS equipment to function correctly 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 Leica GPS equipment meets the strict regulations and standards which are in force in this respect, Leica 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 Leica GPS equipment is used in conjunction with accessories from other manufacturers, e.g. field computers, personal computers, radios, non-standard cables, external batteries etc.

Precautions: Use only the equipment and accessories recommended by Leica. When using computers and radios, pay attention to the information about electromagnetic acceptability provided by the manufacturer.



CAUTION: Disturbances caused by electromagnetic radiation can result in the tolerance limits for measurements being exceeded.

Although the Leica GPS equipment meets the strict regulations and standards which are in force in this connection, Leica cannot completely exclude the possibility that the Leica GPS equipment may be disturbed by very intense electromagnetic radiation, for instance near radio transmitters. Check the plausibility of results obtained under these conditions.



WARNING: If the Leica GPS equipment is operated with connecting cables attached at only one of their two ends (e.g. external supply cables, interface cables), the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other instruments may be impaired

Precautions:

While the Leica GPS equipment is in use, connecting cables (e.g. instrument to external battery, instrument to computer) must be connected at both ends.

7.4.3 FCC statement (applicable in U.S.)

**WARNING:**

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and 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 for compliance could void the user's authority to operate the equipment.

Product labelling:

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.

8 Technical Specifications

The Technical Specifications for Leica GPS equipment are contained on the following pages.

8.1 SR9500 Tracking Characteristics

Satellite Reception:	Dual frequency
Receiver channels:	12 L1 continuous tracking 12 L2 continuous tracking
L1 channels:	Carrier phase, P1 code, C/A code
L2 channels:	Carrier phase, P2 code

Carrier Tracking

L1, AS on or off:	Reconstructed carrier phase via C/A code
L2, AS off:	Reconstructed carrier phase via P2 code
L2, AS on:	Switches automatically to patented P code-aided technique providing full L2 reconstructed carrier phase

Code Measurements

L1, AS off:	Carrier phase smoothed code measurements: C/A code narrow correlation, P1 code
L1, AS on:	Carrier phase smoothed code measurements: C/A code narrow correlation, patented P1 code-aided code
L2, AS off:	Carrier phase smoothed code measurements: P2 code
L1, AS on:	Carrier phase smoothed code measurements: Patented P2 code-aided code

Note. Carrier phase and code measurements on L1 and L2 are fully independent with AS on or off.

Satellites Tracked: Up to 12 simultaneously on L1 and L2

Time to first phase measurement typically 60 seconds.

8.2 SR399/399E Tracking Characteristics

Satellite Reception: Dual frequency
Receiver channels: 9 L1 continuous tracking
9 L2 continuous tracking
L1 channels: Carrier phase, P1 code, C/A code
L2 channels: Carrier phase, P2 code

Carrier Tracking

L1, AS on or off: Reconstructed carrier phase via C/A code
L2, AS off: Reconstructed carrier phase via P2 code
L2, AS on: Switches automatically to patented P code-aided technique providing full L2 reconstructed carrier phase

Code Measurements

L1, AS off: Carrier phase smoothed code measurements:
C/A code narrow correlation, P1 code
L1, AS on: Carrier phase smoothed code measurements:
C/A code narrow correlation, patented P1 code-aided code
L2, AS off: Carrier phase smoothed code measurements:
P2 code
L1, AS on: Carrier phase smoothed code measurements:
Patented P2 code-aided code

Note. Carrier phase and code measurements on L1 and L2 are fully independent with AS on or off.

Satellites Tracked: Up to 9 simultaneously on L1 and L2

Time to first phase measurement typically 60 seconds.

8.3 SR299/299E Tracking Characteristics

Satellite Reception: Dual frequency
Receiver channels: 9 L1 continuous tracking
9 L2 continuous tracking
L1 channels: Carrier phase, C/A code
L2 channels: Carrier phase, P code

Carrier Tracking

L1, AS on or off: Reconstructed carrier phase via C/A code
L2, AS off: Reconstructed carrier phase via P code
L2, AS on: Switches automatically to proprietary code-aided squaring.

Code Measurements

L1, AS on or off: Carrier phase smoothed C/A code measurements
L2, AS off: Carrier phase smoothed code measurements
L1, AS on: Carrier phase smoothed code measurements

Note. Carrier phase and code measurements on L1 and L2 are fully independent with AS on or off.

Satellites Tracked: Up to 9 simultaneously on L1 and L2

Time to first phase measurement typically 60 seconds.

8.4 SR261 Tracking Characteristics

Satellite Reception: Single frequency
Receiver channels: 6 L1 continuous tracking
L1 channels: Carrier phase, C/A code

L1 Carrier Tracking: Reconstructed carrier phase via C/A code

L1 Code Measurements: Carrier phase smoothed C/A code measurements

Satellites Tracked: Up to 6 simultaneously

Time to first phase measurement typically 60 seconds.

8.5 SR260 Tracking Characteristics

Satellite Reception: Single frequency
Receiver channels: 6 L1 continuous tracking
L1 channels: Carrier phase, C/A code

L1 Code Measurements: Carrier phase smoothed C/A code measurements

Satellites Tracked: Up to 6 simultaneously

Time to first phase measurement typically 60 seconds.

8.6 SR9400 Tracking Characteristics

Satellite Reception: Single frequency
Receiver channels: 12 L1 continuous tracking
L1 channels: Carrier phase, C/A narrow code

L1 Carrier Tracking: Reconstructed carrier phase via C/A code

L1 Code Measurements: Carrier phase smoothed C/A code measurements

Satellites Tracked: Up to 12 simultaneously

Time to first phase measurement typically 60 seconds.

8.7 Time-mark (pps) output

A Time-mark (pps) output may be fitted to all Sensor types as an option.

Accuracy of pps output 100 nsec (3 sigma without SA)

Output rate 1 second

8.8 GPS Antennas

AT302 and AT202

Microstrip L1/L2 antenna with built in groundplane.

AT201

Microstrip L1 antenna with built in groundplane.

Note: SR299 and SR399 Sensors contain built in antennas that are the same as the AT302/202.

8.9 GPS Controllers

CR233

Display: Liquid Crystal, 8 lines of 40 characters, may be illuminated.

Keyboard: Full alphanumeric plus PC functions.

Data Input/Output: RS232 and LAN capability.

Data Storage: Via SRAM Flash card (512KB, 1MB or 2MB) or via 1MB internal memory (optional).

CR244

As CR233 except:

May connect to communications link for output/input of RTCM SC104 v2.0 messages or RT-SKI messages (optional).

Supports output of NMEA 0183 v2.00 messages.

CR333

As CR233 except:

Data storage: Via PCMCIA Type I SRAM card (512KB or 2MB) or via 1MB internal memory (optional).

CR344

As CR233 except:

May connect to communications link for output/input of RTCM SC104 v2.0 messages or RT-SKI messages (optional).

Supports output of NMEA 0183 v2.00 messages.

Data Storage: Via PCMCIA Type I SRAM card (512KB or 2MB) or via 1MB internal memory (optional).

8.10 Equipment weights

Sensors

SR9500:	2.6kg (5.7lb)
SR399/SR299 with adapter:	2.3kg (5.0lb)
SR399E/299E:	2.0kg (4.4lb)
SR260/SR261:	1.0kg (2.2lb)
SR9400:	1.25kg (3.5lb)

Antennas

AT302/AT202/AT201 with adapter:	0.6kg (1.3lb)
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Controllers

CR233/CR244/CR333/CR344:	1.0kg (2.2lb)
(without plug-in battery)	

8.11 Power

Power consumption

S9500:	maximum 10 Watts
SR299 or SR399:	maximum 9 Watts
SR299E or SR399E and AT302/202:	maximum 9 Watts
SR260 or SR261 and AT201:	maximum 3.5 Watts
SR9400 and AT201:	maximum 7 Watts

With CR233/244/333/344 Controller connected

SR9500:	maximum 13 Watts
SR299 or SR399:	maximum 12 Watts
SR299E or SR399E and AT302/202:	maximum 12 Watts
SR260 or SR261 and AT201:	maximum 6.5 Watts
SR9400 and AT201:	maximum 8.5 Watts

Supply Voltage

All equipment combinations:	Nominal 12V DC (Range 11-16V DC)
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8.12 Environmental Specifications

Instrument	Operation	Storage
SR9500	-20°C to +60°C	-40°C to +70°C
SR299/299E	-20°C to +50°C	-40°C to +70°C
SR399/399E		
SR260/SR261	-20°C to +50°C	-40°C to +70°C
SR9400	-20°C to +50°C	-40°C to +70°C
AT201	-40°C to +75°C	-40°C to +75°C
AT202/302		
CR233/244	-20°C to +50°C	-40°C to +70°C
CR333/344		
Leica SRAM Flash Card, all sizes.	-10°C to +50°C	-40°C to +70°C
Leica PCMCIA cards, all sizes.	-20°C to +70°C	-40°C to +70°C
Optional 1MB internal memory.	-20°C to +50°C	-40°C to +70°C

Humidity (all instruments): Up to 95% non-condensing
 Weather: Will withstand rain, snow, dust, sand etc.

8.13 Separation distances

Sensor to Controller

Maximum with Power supply at Controller or Sensor only: 12.8m

With power supply at both Controller and Sensor: 150m

SR299E/399E and SR260/261/9400/9500 to AT202/302 or AT201 Antenna

Supplied cables: 2.8m and 10m

Optional Cable: 30m

Longer cables available on request.

8.14 Baseline precision

The following specifications are based on measurements processed using SKI software and are given as baselines (root mean square).

Differential Phase

Operation	SR399/399E	SR299/299E	SR9500
Static	5mm +1ppm	5mm +1ppm	5 mm +1ppm
Rapid static	5-10mm +1ppm	5-10mm +1ppm	5-10mm +1ppm
Reoccupation	5-10mm +1ppm	5-10mm +1ppm	5-10mm +1ppm
Stop & Go	10-20mm +1ppm	10-20mm +1ppm	10-20mm +1ppm
Kinematic	10-20mm +1ppm	10-20mm +1ppm	10-20mm +1ppm

Operation	SR261	SR260	SR9400
Static	5-10mm +2ppm	N/A	5-10mm +2ppm
Rapid static	--	N/A	--
Reoccupation	--	N/A	--
Stop & Go	10-30mm +2ppm	N/A	10-25mm +2ppm
Kinematic	10-30mm +2ppm	N/A	10-25mm +2ppm

Differential Code

Operation	SR399/399E	SR299/299E	SR9500
Static	30cm	50cm	30cm
Kinematic	50cm	50cm-1m	50cm

Operation	SR261	SR260	SR9400
Static	1m approx	1m approx	30cm
Kinematic	1-2m approx	1-2m approx	50cm

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



Leica Geosystems AG
GPS
CH-9435 Heerbrugg
(Switzerland)
Phone +41 71 727 31 31
Fax +41 71 727 47 02
www.leica.com