GeoSIG
swiss made to measure

GMS^{plus}

User Manual

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Applicability of This Manual

GMS[plus] Instruments are constantly being improved. Although the manual you receive along with your instrument corresponds to the actual software versions, **you are advised to check www.geosig.com periodically for the most recent version of this document**, and especially after performing any software upgrades. This manual is based on the following software and firmware versions:

Component	Description	Required version or higher
GeoDAS	Data acquisition and analysis software on the computer	2.28
armdas	Data acquisition software of the instrument	21.12.25
RTC	Real time clock	80.02.03
DSP	Digital signal processor	51.03.05
U-Boot	U-Boot bootloader	2013.01-r1
Web Interface	Web Interface	1.12
Linux OS	Root file system Kernel Version	rootfs-gms-102 2.6.39.4-r7

Warnings and Safety

☞ *STATIC ELECTRICITY*

The instrument and its sensor unit (if available) contain CMOS devices, and when serviced care must be taken to prevent damage due to static electricity. This is very important to ensure long-term reliability of the unit. Such risk exists when both the housing lid and the internal panel are removed.

☞ *INSIDE THE INSTRUMENT (MAINTENANCE)*

When it is desired to fully restrict access to the unit so that even its housing lid cannot be removed, lockers can be mounted in the middle of the handles, on the side of the instrument. Under normal circumstances there is no need to remove the internal panel of the instrument. In any case, only a trained person should remove the front panel or the cover. Moreover untrained access may lead to serious damage to the instrument, and may void the warranty. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
Before removing the internal panel:

1. ***Turn the unit off***
2. ***Disconnect all cables connected to the unit***
3. ***Disconnect the battery***
4. ***Make sure that all LED indicators are OFF***

☞ *INSTALLATION SITE*

This instrument is designed for highly specialized applications. If installed in publicly accessible areas it is the responsibility of the instrument owner to ensure that the device is installed in a safe and secure manner.

The instrument should be installed in a well ventilated place and when possible be protected from direct sunlight and heat.

The housing provides no protection against explosive atmosphere. The instrument must not be operated without necessary protective measures (e.g. EX-proof housing) in an area where explosive gases could be present.

☞ *BATTERY (MAINTENANCE) AND SAFETY*

The instrument is usually shipped with an internal rechargeable battery (main battery), which is an optional accessory.

In addition there is a non-rechargeable button battery (backup battery) on the circuit board of the instrument.

NEVER use any battery other than the ones supplied or approved in writing by GeoSIG.

An external power module, which is an optional accessory, is also usually shipped with the instrument.

NEVER use any other power module than the one supplied or approved in writing by GeoSIG.

Do not forget to connect the main battery when installing the instrument. The main battery is provided with a short cable that has a polarised connector to avoid any wrong connections. Please ensure that this connector is fully inserted and secured on the mating connector inside the instrument.

CAREFULLY observe the polarity,

when replacing the main battery:
RED cable = ***(+) plus terminal of the battery***
BLACK cable = ***(-) minus terminal of the battery***

when replacing the button backup battery:
(+) sign marked on the battery

Battery	Battery model	Replacement interval
Main Battery (Internal)	FIAMM FG20721, 12V 7.2Ah	3 years from date of production[1]
	Yuasa NP7-12, 12V 7Ah	3 years from date of production[1]
	FIAMM 12FGHL34, 12V 9Ah (long life)	8 years from date of production[1]
Button Backup Battery	Renata CR2430 MFR, 3V, 285mAh	5 years from date of production[1]
	Duracell CR2430, 3V, 285mAh	5 years from date of production[1]
	EEMB CR2430, 3V, 270mAh	5 years from date of production[1]

[1]assuming operation at a steady 20°C or below

The expected lifetime of a battery can drastically change depending on operating conditions. Strong discharge of the battery and extreme temperatures must be avoided as per specific battery manufacturer's recommendations and guidelines.

Lifetime and replacement intervals mentioned in this manual are based on a constant ambient temperature of 20°C or below. If this condition cannot be met the user must check with the documentation of the battery manufacturer for information about the battery lifetime at elevated temperatures.

When replacing the battery only newly manufactured batteries may be installed. The replacement interval specified above starts from the manufacturing date of the battery, which is typically found printed on the battery itself. When replacing the battery it is the users' responsibility to update the "battery installation dates" parameter in the configuration as described in chapter 10.2. This parameter is used to issue a warning of required battery change.

For safety reasons the battery and operating conditions have to be checked annually to ensure that they are still within the manufacturer's recommended operational criteria.

It is important that all necessary precautions about operating a battery, such as the ones installed in the instrument, are taken into consideration and the safety instructions are followed accordingly.

Lack of care or misuse of the battery as per battery manufacturer's recommendations can be hazardous, may damage your instrument and may even cause explosions. Please consult the battery manufacturer's website for the latest operating, maintenance and safety guidelines. Please contact GeoSIG in writing if the specific safety, operating, maintenance and disposal information for your battery type can't be found.

The internal main battery (if installed) is a Lead Acid-type battery and is classified as "dangerous waste". The user is obliged to follow local laws and manufacturer's guidelines for safe use and correct disposal of any battery.

☞ *SD AND COMPACT FLASH CARDS*

SD and compact flash cards are available in a variety of quality levels on the market. This results in problems with compatibility due to memory layout, signal structuring and power requirements. Additionally some SD and compact flash card manufacturers refuse to provide adequate information or factory controls to ensure that the product being sold today is the same as the product sold earlier under the same part number.

Therefore GeoSIG cannot guarantee a SD or compact flash card will work in a GeoSIG instrument unless it is purchased through GeoSIG. The SD and compact flash cards provided by GeoSIG are tested and certified in-house to work with the related GeoSIG instrument and are industrial rated for harsh environment conditions such as extreme temperatures, shock, and vibration.

CLEANING

Disconnect the power from the instrument prior to cleaning. Do not remove the housing lid during cleaning. Wipe all exterior surfaces with a damp cloth. Use mild detergent if required. No water should be used if cleaning inside the instrument is required.

HOUSING LID

In case your instrument does not have a lid with holes as described in chapter 3.2 you must contact GeoSIG to order a replacement lid.

GeoSIG Cybersecurity Recommendations

GeoSIG instruments, as described in their documentation, have built-in security and safety features against unauthorised access or use. However, ultimately it is the user's responsibility to ensure the safe and secure usage of our instruments based on their actual implementation. No factory delivered solution can fit each and every possible scenario. The user is advised herein that once you connect a device to a network, you are also connecting that network to that device. It is the responsibility of the user to take appropriate precautions so that all devices should be adequately hardened, such as with individual strong passwords, and should have their traffic monitored and managed via appropriate security features, such as firewalls. Also, non-critical devices should be segmented away from networks that contain sensitive information.

Compliance with a well-defined security procedure helps protect not only an individual device, but also other devices connected through the network. Such procedure would be intended to prevent exploitation of an individual device's resources by unauthorized individuals, including the use of such device to attack other systems on the network or the Internet.

The following recommendations can be considered in establishing such a security procedure:

1. **Physical access restriction**

   All devices must be restricted from unauthorised physical access and a well-defined physical access procedure shall be utilised.

2. **No Unattended Console Sessions**

   Except for the devices which are physically secured, no unattended console sessions shall be left running.

3. **No Unattended Network Sessions**

   No unattended user interface sessions shall be left running towards any device accessed through its network interface.

4. **Use of a Firewall**

   For a network that has any connection to the outside world, a hardware firewall must be running and configured to block all inbound traffic that is not explicitly required for the intended use of the network and the connected devices. The user can also consider limiting outbound traffic.

   ☞ | ***Any communication ports that are required for the operation must be protected.***

5. **No Unnecessary Services or Ports**

   If a service or port is not necessary for the intended purpose or operation of the device, that service must not be running and the port must be closed. (e.g. if seedlink server is running, but not used, turn it off)

6. **Use of authentication**

   Network and console device access must require authentication by means of strong and individualised passwords per device (no passe-partout passwords).

   Wireless access must require strong encryption to associate (such as WPA2), or some other strong mechanism to keep casual users near the access point from using it to get full access to the network. WEP or MAC address restrictions do not meet this requirement.

7. **Password complexity and security**

   When passwords are used, they must meet the specifications similar to below:

   ☞ | ***All default passwords must be changed at time of initial access or latest at deployment into service.***

   Passwords MUST:

   contain eight characters or more
   contain characters from AT LEAST two of the following three character classes:

   ```
   Alphabetic (e.g., a-z, A-Z)
   Numeric (i.e. 0-9)
   ```

`Punctuation and other characters (e.g., !@#$%^&*()_+|~-=\‘{}[]:";’<>?,./)`

8. **Privileged Accounts**

   Privileged and super-user accounts (Administrator, root, etc.) must not be used for non-administrator activities. A secure mechanism to escalate privileges with a standard account is acceptable to meet this requirement. Network services must run under accounts assigned the minimum necessary privileges.

9. **No Unencrypted Authentication**

   All network-based authentication must be strongly encrypted. In particular, insecure services such as Telnet, FTP, SNMP, POP, and IMAP must not be used or must be replaced by their encrypted equivalents.

10. **Software / Firmware updates**

    Networked devices must only run software/firmware that are updated according to supplier's guidelines. A periodical check of any available updates from the supplier must be sought.

Please contact GeoSIG Ltd if you require any further advice or clarification.

Symbols and Abbreviations

ADC	Analog to Digital Converter
ARM	Main processor
armdas	GeoSIG data acquisition software
Bootloader	First program executed when unit starts
CF	Compact Flash, memory card using Flash memory
Compact Flash	See CF
DSP	Digital Signal Processor in charge of controlling the ADCs
GSIAFW	GeoSIG data acquisition software.
EEW	Earthquake Early Warning
Flash	Program storage memory device. It contains the Linux file system in Read Only mode and some block areas under direct control of main program or bootloader
FTP	File Transfer Protocol
GPS	Global Positioning System
GUI	Graphical User Interface
IMAP	Internet Message Access Protocol
LAN	Local Area Network, a simple branch of private network using private IP address. It could have or not have access to Internet (WAN)
NTP	Network Time Protocol
POP	Post Office Protocol
PPS	Pulse Per Second
RAM	Random Access Memory
RTC	Real Time Clock
SD	Secure Digital Memory Card
SNMP	Simple Network Management Protocol
SPS	Samples Per Second
SSH	Secure Shell
SSID	Service Set Identifier. This is the identifier name of a wireless network.
STP	Shielded Twisted Pair
SUP	Supervisor in charge of controlling the power management.
Telnet	Teletype network
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair
VPN	Virtual Private Network
WAN	Wide Area Network. It is a network connection established between 2 LAN or a LAN and a server over the internet (usual case) or through a rented link.
WPA	Wi-Fi Protected Access. It is a secure specification that allows users to access information instantly via wireless link. It is a more modern and secure link than the WEP type.
WEP	Wired Equivalent Privacy
	Important information related to the current section.
	Caution. Refer to the instructions next to the marking, or refer to the relevant section of this user manual.
	Direct current. This symbol indicates a direct current (DC) power line derived from an alternating current (AC) power source.
	Earth terminal.
	CE. This symbol indicates that the device conforms to all legal requirements needed to achieve free movement and sale of the product through the European Economic Area (EEA).

1 Introduction

Dear Valued GeoSIG Customer, thank you for purchasing this product.

These instruments have been optimised to meet the requirements of the majority of customers out of the box and may have even been delivered tailored to your needs. In any case, to be able to get the most out of our product, please carefully study this manual, its appendices and referenced manuals, as well as any other documents delivered with it.

This is a reliable and easy-to-use device, and at the same time a sophisticated product that requires care, attention and know-how in configuring, installing, operating and maintaining.

GeoSIG continually improves and enhances capabilities of all products. There may be several other connectivity, hardware or software options for the instrument, which are not covered in this manual. Refer to separate documentation from GeoSIG about available options or ask GeoSIG directly.

2 Incoming Inspection

All instruments are carefully inspected both electrically and mechanically before they leave the factory. Please check if all received items correspond with the packing list and your order confirmation. In case of discrepancy please contact GeoSIG or your local representative immediately.

2.1 Damage During Shipment

If requested at the time of order, all instruments can be insured prior to shipment. If you receive a damaged shipment and shipping insurance was previously arranged you should:

- Report the damage to your shipper immediately
- Inform GeoSIG or your local representative immediately
- Keep all packaging and shipping documents

Insurance claims may be void if the above procedure is not followed.

2.2 Warranty

GeoSIG Ltd (hereafter GeoSIG) warrants hardware and software products against defects in materials, workmanship and design for the defined period in the relevant contract or offer, starting from date of shipment and 5 years parts and maintenance support commitment. If GeoSIG receives notice of such defects during the warranty period, GeoSIG shall at its option either repair (at factory) or replace free of charge hardware and software products that prove to be defective. If GeoSIG is unable—within a reasonable time—to repair or replace any cabinet to a condition as warranted, buyer shall be entitled to a refund of the purchase price upon return of the cabinet to GeoSIG. 50% of freight charges on shipments of warranty repairs or replacements will be borne by GeoSIG (normally one way freight).

2.2.1 Limitation of Warranty

The foregoing guarantee shall not apply to defects resulting from:

- Improper or inadequate maintenance by buyer
- Buyer supplied software or interfacing
- Unauthorised modification or misuse
- Operation and storage outside of the environmental specifications of the instrument
- Related to consumables or batteries
- Improper preparation and installation at site.

3 Description

3.1 Housing

The instrument is a housing mounted with a base plate. The base plate is fixed on ground and leveled one time during installation, then the instrument can be replaced without need for leveling.

Figure 1: Instrument overview [1]

3.2 Housing Lid

If your instrument has been supplied with an internal Lead Acid battery (main battery), the housing lid will have two ventilation holes that are covered by special membrane vents, as shown in Figure 2. A Lead Acid battery as a matter of course will release small amounts of hydrogen which could cause an explosion under certain conditions. A typical GMS[plus] housing will allow hydrogen to escape through various small openings in the housing, **however** as an extra level of safety, precautionary measures have been taken by providing two ventilation holes to allow additional air circulation within the housing. The specially applied membrane vents will prevent external matter from entering the housing while allowing air circulation through specially designed PolyVent membranes as shown.

Please ensure that the vents are not covered and that the instrument is not placed in a confined area without adequate ventilation. GeoSIG will not accept any responsibility for the safe operation of the battery or any safety-related consequences that may result from using the battery.

Please consult GeoSIG in writing if you have any specific questions or require clarification with regards to use of the battery in the instrument.

[1] Connectors may vary depending on ordered configuration

Outside view

Inside view

Figure 2: Housing lid ventilation holes

3.3 Base Plate

A base plate is supplied with the instrument for fixation and leveling of instrument on site. Three leveling feet are provided to adjust horizontally the base plate. The fixation is done as a single point in the middle of the plate.

To ensure correct orientation when an instrument is installed on the plate, two pins are provided with the plate. They can be mounted in different positions according to the orientation required and will fit in the two holes existing in the base of the instrument.

A connection point for earthing is also provided with the plate as an M6 thread.

See chapter 4.2.2 for details about how to fix the base plate on the ground.

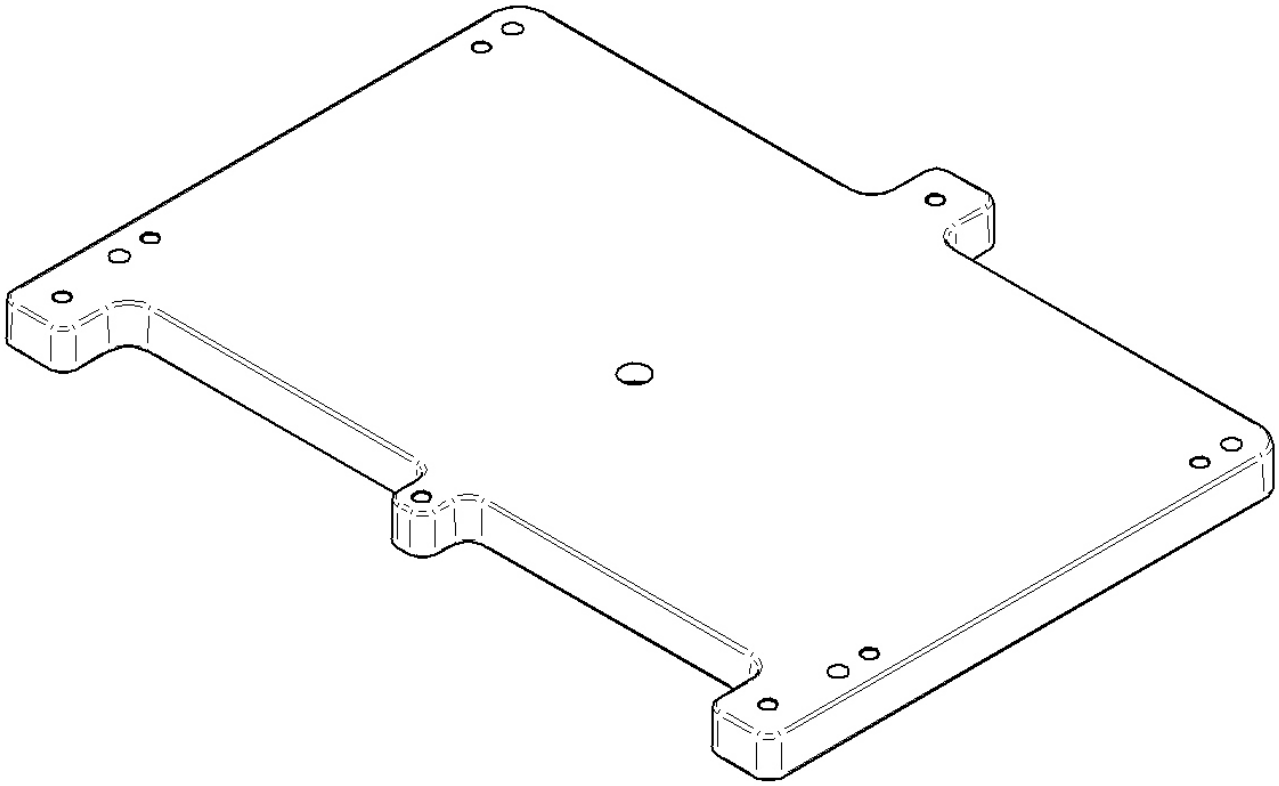


Figure 3: Instrument base plate

3.4 Connectors

The instrument has up to nine connectors and two antenna plugs:

Figure 4: Instrument with all connectors. Antennas are not mounted [2]

See Appendix A for the detailed pinout description of the connectors.

3.4.1 Standard External Connectors

These connectors always will be assembled:

POWER	Connection to the power supply module of the instrument or to an external battery.
ETHERNET	Connection with Ethernet cable to a LAN. The cable connection is dominant over the Wi-Fi link. As soon as the cable connector is plugged in the instrument ETHERNET socket, the Wi-Fi module will be turned off, even if the RJ45 connector at the end of the cable is not plugged into any socket.
SERIAL	Connection to the console or for the serial data stream output, depending on the cable type. Optionally also the cellular modem can be connected to this port.
GPS	For connection to a GPS receiver.

3.4.2 Optional External Connectors

These connectors depend on the ordered options:

SENSOR1	Connection to an external sensor.
SENSOR2	Connection to a second external sensor in case of a six channel instrument with two external sensors.
INTERCON	Connection to the interconnection network allowing common time and common triggering.
MODEM	Connection to analog phone line for the internal analog modem.
ALARM	Contacts of the internal alarm relays.

[2] Connectors may vary depending on ordered configuration

3.4.3 Optional External Antennas

Wi-Fi	Antenna connector for the wireless Internet.
WiSync	Antenna connector for 433 MHz synchronisation, allowing time synchronisation of several instruments wirelessly.

3.4.4 Connectivity Options

A large variety of options can be connected to the instrument. The following figure should give an overview of the main possibilities. Ask GeoSIG for details about any specific connectivity options.

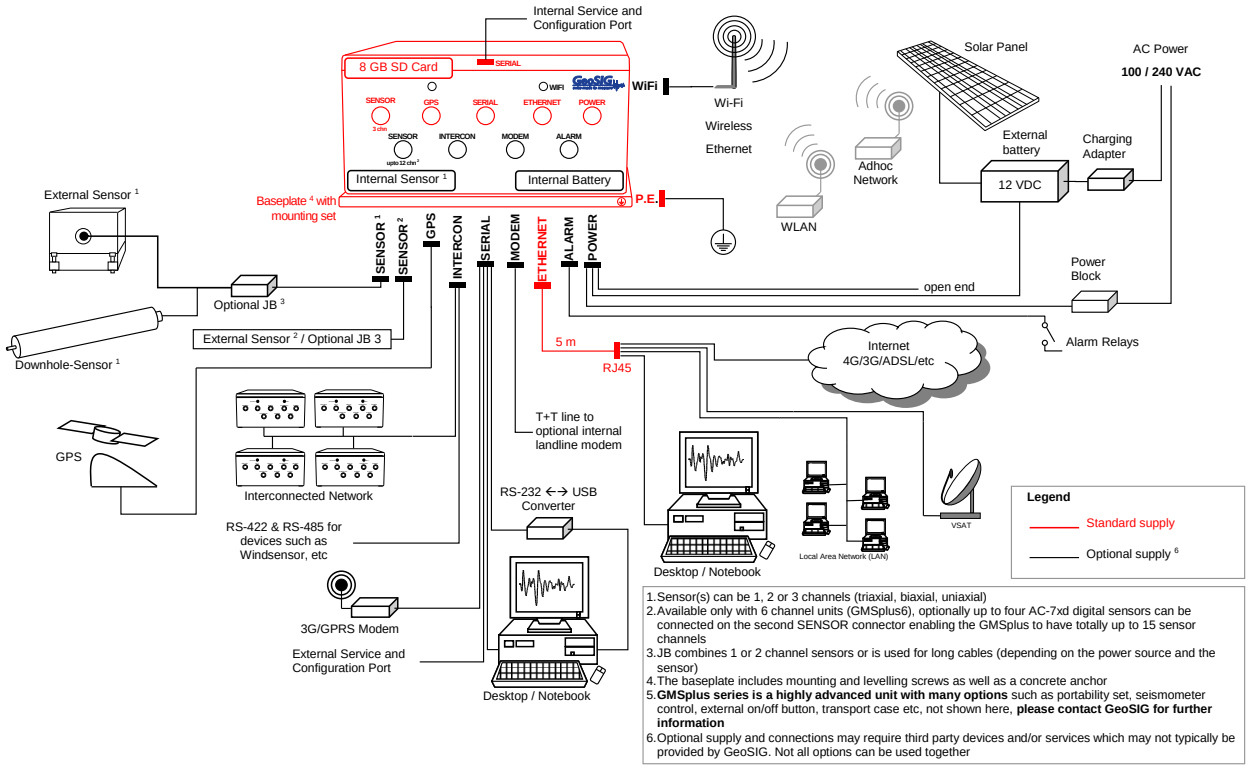


Figure 5: Connectivity options

3.4.5 Internal Connector

The instrument is equipped with an internal RS-232 connector giving access to the console. A standard RS-232 extension cable (straight, female-male) can be used to connect to a computer.

Figure 6: Internal RS-232 connector for the console

3.5 Visual Indicators

Several visual indicators (LEDs) show the status of the instrument.

Figure 7: Visual indicators on the housing lid (left) and on the internal panel of the instrument (right)

Indicators, from left to right:

Colour	Indication	States
GREEN	AC indicator	When ON, the external power supply is present
GREEN	RUN indicator	**OFF:** the unit is off **Blinking 20% ON, 80% OFF at 2 sec period:** The instrument is starting up or the data acquisition program has been stopped or is not running **Blinking 20% ON, 80% OFF at 1 sec period:** Normal operation of the instrument, data acquisition is running **Blinking 80% ON, 20% OFF at 2 sec period:** Instrument is shutting down, data acquisition is not running and the instrument will be powered down soon
YELLOW	EVENT indicator	**OFF:** Unit is not recording and no events are on the CF card **Blinking:** Indicates the amount of memory used on the CF card (<25%, >25%, >50%, >75%) **ON:** The unit is recording
BLUE	LINK indicator	**OFF:** Link with the data server is established, no communication ongoing **Blinking at 1 sec period:** Problem with the link to the data server **ON:** Link with the data server is established, communication or data transfer ongoing
RED	ERROR / STATE indicator	**OFF:** No problem or warning **Blinking at 2 sec period:** Warning is present **Blinking at 1 sec period:** Error is present **ON:** Data acquisition is not running, e.g. during start up

Table 1: Indicators description

3.5.1 Detail Description

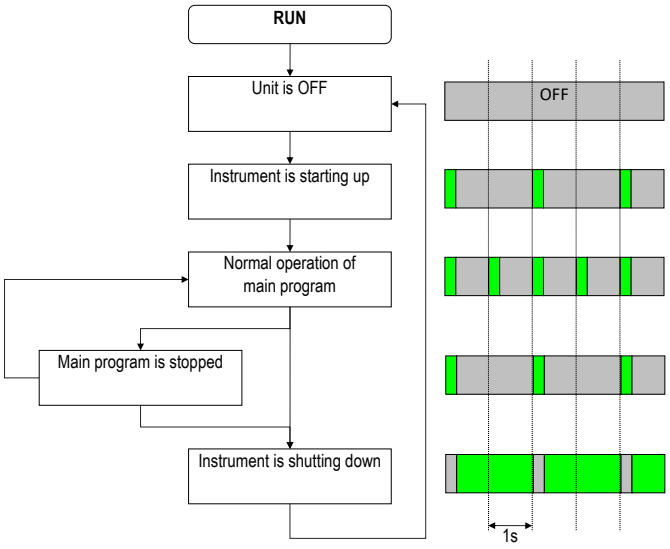


Figure 8: RUN indicator

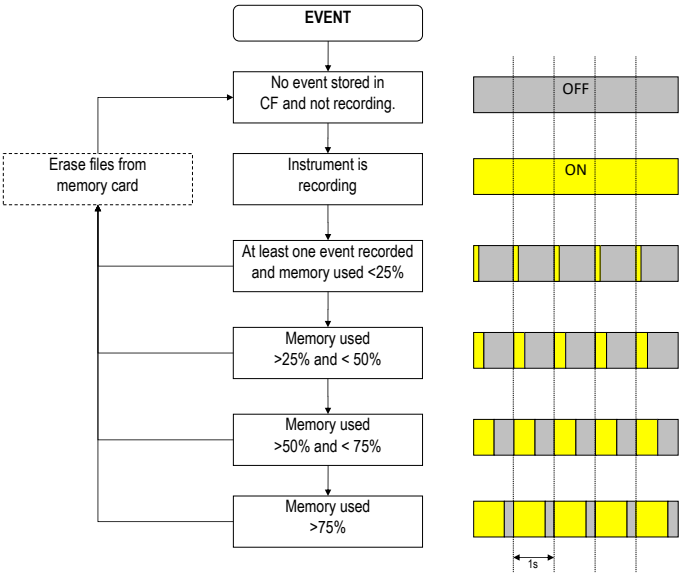


Figure 9: EVENT indicator

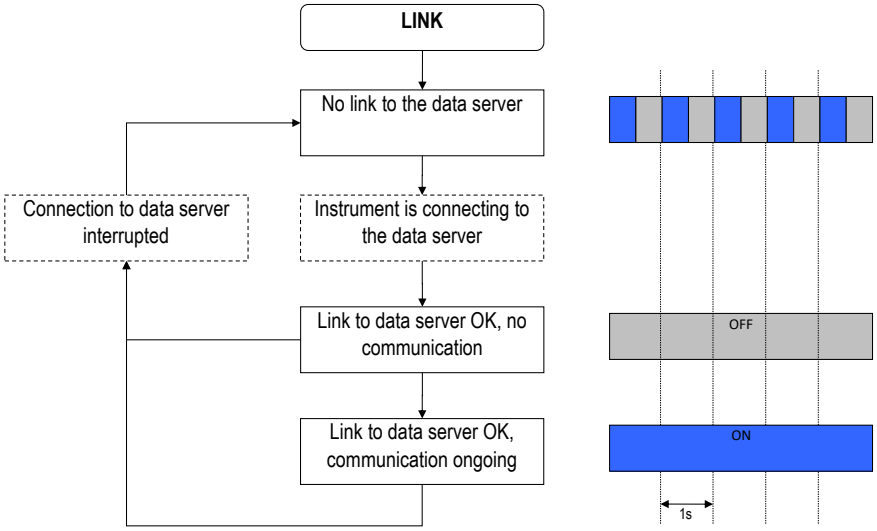


Figure 10: LINK indicator

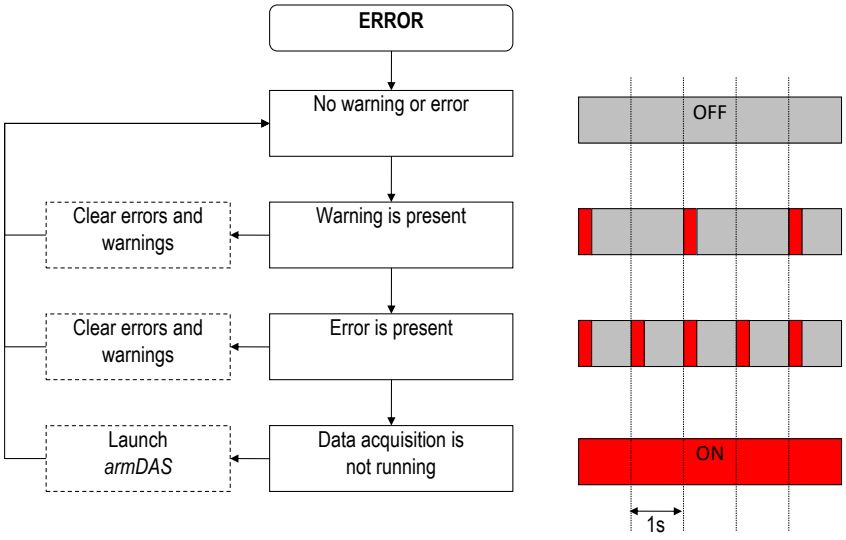


Figure 11: ERROR indicator

File Checkup

At startup, three LEDs (yellow, blue and red) may flash synchronously for some while, which indicates that firmware is performing the full check of all files stored on the compact flash card. The process may take longer if there are many files collected.

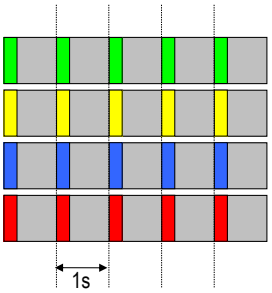


Figure 12: File checkup

3.6 Internal Batteries

3.6.1 Main Battery

The safety instructions given in **Warnings and Safety** must be strictly followed.
Following the safety instructions helps to reduce risk of fire, electric shock, personal injury and material damage.

If installed, the battery is used in the instrument to power it in case of external power loss. If the external power is not restored when the battery reaches a low level, the unit will switch off by itself to avoid deep discharge of the battery. This protects the battery against capacity reduction or destruction occurring usually in case of deep discharge for such battery type. The battery has the following specifications:

Description	Specification
Nominal Voltage	12 V
Capacity	7.2 Ah
Length	153 mm
Width	66 mm
Height	96 mm
Overall height	102 mm
Weight	2.65 kg
Connection	Faston 6.3

Table 2: Main battery specification

The following models have been checked to be compatible with the instrument:

Supplier	Model
FIAMM	FG20721
Yuasa	NP7-12

Table 3: Main battery models

3.6.2 Backup Battery

The backup battery is used to maintain time in the instrument when it is powered off. It requires the following specifications:

Description	Specification
Nominal Voltage	3 V
Capacity	285 mAh / 270 mAh
Cell diameter	24.5 mm
Cell height	3 mm
Weight	4.1 g

Table 4: Backup battery specification

The following models have been checked to be compatible with the instrument:

Supplier	Model
Renata	CR2430 MFR
Duracell	CR2430
EEMB	CR2430

Table 5: Backup battery models

3.6.3 Storage (Instrument Shelf Life)

In case the instrument is stored, the batteries have to be maintained according to the storage duration.

Period of time	External power supply	Instrument is operating	Main battery	Real Time Clock backup battery
< 1 month	ON	YES	Connected	Connected
	ON	NO	Connected	Connected
	OFF	NO	Connected	Connected
1 - 3 months	ON	YES	Connected	Connected
	ON	NO	Connected	Connected
	OFF	NO	**Disconnected**	Connected
3 - 6 months	ON	YES	Connected	Connected
	ON	NO	Connected	**Disconnected**
	OFF	NO	**Disconnected**	**Disconnected**
More than 6 months	ON	YES	Connected	Connected
	ON	NO	Connected	**Disconnected**
	OFF	NO	**Disconnected, must be recharged every 6 months for at least 24 hours.**	**Disconnected**

Table 6: Storage instruction

Removing or replacing the backup battery must be done by a trained person only. Therefore if the instrument is stored for more than three months, always have it connected to power and let it run.

If the instrument is stored for longer than 3 months, the battery must be removed from the instrument and stored elsewhere in a well ventilated location as per the battery manufacturer's recommendations. The battery must, in this case, be charged every six months for at least 24 hours.

If the instrument is connected to AC power through its power supply module while stored, the main battery (if it exists) can remain in the unit. It is highly recommended to ventilate the stored instrument by removing the lid of the instrument.

Current leakage on main battery when unit is off, without external supply, is about $40\,\mu A$.

Autonomy of Real Time Clock on its backup battery is typically three years at ambient temperature. The jumper JMP_BBATT on the main board has to be put in position 2-3 to disconnect this backup battery. This must be done by a trained person. The removal of the internal panel is required.

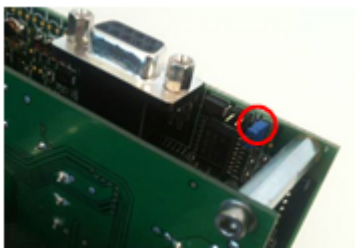


Figure 13: Position of JMP_BBATT

3.7 Power Supply

3.7.1 Choice of Power Supply

The main power should be provided to the instrument from a 15 VDC supply. The optional AC/DC power module provides 15 VDC at 1.2 A unless otherwise specified. The AC entry is compatible with 110 / 60 Hz or 230 / 50 Hz network without any adjustment. The block has a C7 connector and can use any standard power cord with such connector. The power module and the power cord supplied are both CE and UL approved. The power module must be connected to AC with a 2-wire power cable providing Phase and Neutral.

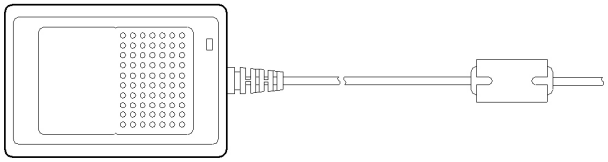


Figure 14: Power supply

Optionally the instrument can be built to have a 9 to 36 VDC input voltage range. This option must be specified at order time.

3.7.2 Automatic Power On and Off

The instrument has a defined minimum start-up voltage of 12.5 VDC and will automatically make a controlled power down if the supply voltage goes below 10.6 VDC.

3.8 Supplied and Optional Accessories

3.8.1 Standard Supplied Accessories

The following parts will be included in a shipment additional to the instrument:

- **Fixation base plate** with leveling feet
- **Screw and anchor bolt** for fixation
- **Ethernet cable**, category 5 cable for 10/100 Mbit network with a suitable connector for the instrument, 5 meters of cable and a standard RJ45 connector. Other cable lengths are available by request.

3.8.2 Optional Accessories

The following parts can be ordered additionally and will be added if specified at order time:

- External **power supply** module, 100 to 230 VAC / 50-60 Hz, CE and UL approved
- **AC power cable**, depending on the shipping address with European, US or Swiss power plug
- **GPS** time code receiver with 20 meter cable, other cable length on request. GPS is an option as the time can also be synchronised through the network using NTP
- **Console cable** for use on the external SERIAL connector
- **Data stream cable** for use on the external SERIAL connector
- **SD/CF card reader for USB** for reading the memory card on a computer or laptop
- **Cellular modem**
- Any **spare connectors**
- Any **spare antennas**
- Spare **battery**

4 Installation

This section lists the procedures involved in installation of the instrument. The procedures will be outlined as steps to be performed in the field or in-house prior to deploying the instrument in the field.

4.1 Site Selection

4.1.1 Environmental Considerations

The choice of an installation site for a seismic event recorder is similar in most respects to that of a regular continuous recording seismic station.

Although the instrument is housed in a solid, weatherproof case, it should be installed in a place free from direct sunlight, precipitation, the danger of falling materials in the event of a severe earthquake and the risk of tampering or vandalism if the unit is to be left unattended.

There are also special considerations for event recorder installations. It is important to select the site and set the trigger level to avoid unwanted data recording, such as vibration from machinery, highway traffic, aircraft, waves, etc. It is wise to check the instrument frequently during the first several days of operation after each set-up, to see if there are previously unsuspected sources of noise which are triggering the instrument and using up the memory.

In addition, the user should select a site with a provision for 115 / 230 VAC power if the unit will be left in place for a long period of time (more than 26 hours). Although this is not necessary for the operation of the device, it does preclude concerns about battery charging.

You should make note at this point of any cultural or environmental sources of noise and vibration around the selected site, which may cause false triggers of the recording mechanism. These will have to be considered when setting the trigger parameters.

The operating temperature of the instrument itself is -20℃ to +70℃. Nevertheless, if any additional internal or external accessories/modules (e.g. batteries, sensors, modems, etc) with lower operating temperature ranges are used, the operating temperature of the combined system will be then limited by the temperature characteristics of these accessories/modules.

4.1.2 Power Supply Considerations

The instrument may be powered from a 115 / 230 VAC supply through an external AC/DC converter, from an internal or external battery, or optionally from a 15 VDC external supply such as an automotive battery or solar panels. It can also be powered from an external DC power supply from 9 to 36 VDC (any of these options must be specified at order time).

- If the supply in the field will be from a 115 / 230 VAC supply, you need to connect the VAC cable from the external AC/DC to the power source only. The instrument operates continuously, providing a trickle charge to the internal battery, if supplied. The VAC supply must consist of Phase and Neutral.
- If the supply in the field will be from a 9 to 36 VDC supply (optional), you need to connect the power cable from instrument to the power source only. The instrument operates continuously, providing a trickle charge to the internal battery, if supplied.
- If the instrument is running from an external battery (optional), you need to connect the delivered battery cable from instrument to the power source only. In this case there should be no internal battery installed. The external battery must be charged with an external battery charger.
- If the supply will be exclusively from the instrument's internal battery, it is necessary to charge the battery sufficiently beforehand. Make sure to have at least 24 hours of uninterrupted charging prior to leaving the instrument in the field. The configuration of the instrument, of course, may be performed while the charger is connected to the instrument. The external AC/DC converter has to be plugged to 115 / 230 VAC for charging the internal battery.

The best approach to the deployment of the instrument is to use an internal battery along with the VAC/VDC power at the remote site. It is highly recommended to check and configure the instrument for the correct time,

trigger and other relevant settings in the lab, prior to the installation (see chapter 5). It may then be carried to the remote site (it should be switched OFF to conserve the internal battery) and then connected to the VAC power through the external AC/DC converter or directly to the VDC power supply. After turning the instrument ON (see chapter 9.1), the instrument runs with the pre-configured parameters. This reduces the amount of time needed to configure in the field – an important consideration in the case of an adverse condition.

4.1.3 Communication Considerations

An Ethernet connection or Wi-Fi signal must be present to have data communication. If the instrument uses an NTP Server as time source, please make sure that an internet connection is available and the network settings are properly set in the instrument. Optionally an external cellular modem can be used for the connection to the internet. Use of NTP is not recommended when using a cellular modem; a GPS should be used instead if possible.

If the instrument is used as a stand-alone recording station, a notebook with an Ethernet connector can be used for downloading the data on a regular basis. In a network the stations will upload the data to the configured server.

4.2 Installation

For your convenience a training video explaining the installation of the instrument is available at ***www.geosig.com→ Support→ 'How To . . . ' Videos***

Many times the locations of seismic equipment are highly exposed to electrical disturbances caused by lightning or by the industrial environment. Although the instrument contains over-voltage protection, it may sometimes be necessary to use additional surge protectors for the equipment. Contact GeoSIG or your local representative for more information.

Typically it is required to connect the base plate to the local earth to avoid or minimise 50/60 Hz distortions in the signal by surrounding power lines. Use the provided M6 earth screw and make sure to have a proper connection by using only short cables with large diameters.

4.2.1 Requirements for the Instrument Foundation

Minimum surface area requirements

- with internal sensor: 30 x 26 cm
- with external sensor (excluding area of sensor itself): 30 x 30 cm

4.2.2 Mounting the Instrument

The unit must be fixed rigidly on the building foundation; it has a base plate that must be first fixed on the ground and then the instrument mounted on it. For that purpose, the base plate has a central fixation hole (suitable for 8 mm screws) and three leveling screws. Prepare the base plate (see also Figure 15):

- Mount the three leveling screws **(D)**.
- Check that the four M6 threads for the instrument fixation are free from dust.
- Mount the two polarization pins on the base plate on the side where the connectors will be **(E**/**F)**.

Place the base plate at the selected location. Verify that the surface is sufficiently flat and horizontal so that the three feet can level the plate. Be sure to leave enough space at the front of the instrument for the connectors and for opening the housing lid. The sides of the instrument should typically not be closer than 100 mm (4 inches) from a wall. Mark on the ground the location of the central hole in the plate. Remove the base plate.

The instrument itself can be mounted in any orientation desired under the condition that it does not have an internal battery. In cases where the instrument has an internal battery it must always be mounted flat on the ground in a non-tilted position. If the installation requires both a battery and a tilted, wall- or ceiling-mounted instrument, the battery must be placed externally.

Drill an 11 mm hole in the concrete with a typical depth of 50 mm for the supplied M8 concrete anchor **(C)**. If another model is used, please adapt the hole dimensions accordingly. Clean the hole area of dust. Insert the concrete anchor into the hole. Mount the plate in place and insert the M8 fixation screw **(A**/**B)** in its hole.

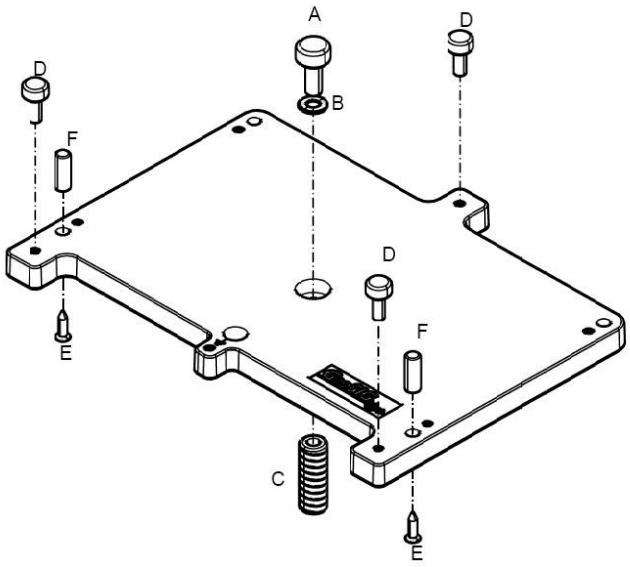


Figure 15: Installation of the base plate

Turn the plate so it is oriented according to requirement. Make a coarse leveling of the plate **(D)**. Start fixing the plate by tightening the M8 central screw **(A)**. Check regularly the plate orientation and level until the plate is rigidly fixed **(D)**. Remove the housing lid of the instrument and put it on the mounting plate using the four screws and washers to fix it. With all GMS-type housing, the base plate is leveled to 0.8Nm evenly on each screw. Take care about the two orientation pins on the plate **(E/F)**.

Do not over tighten the leveling screws.
Do not cause any short circuit on the battery poles or inside the unit.
Connect the base plate to the local protection earth.

4.2.3 Orientation, Leveling and Calibration of the Sensor

Check it is really fixed by pushing from all directions. If you feel any movement, recheck the fixation.

Internal Sensor: The sensor is located under the internal panel. Since no setup is required for the sensor, there is no need to remove the internal panel. The leveling is done on the base plate, and the sensor is already configured to operate with the recorder.

Nevertheless for most applications it is important that the internal sensor is aligned according to the requirements. This can be done using the axes label on the wall of the instrument. In case the axes shall be aligned according to the global coordinate system, the Y-axis must point direction north. So X-axis corresponds then to East-West, Y-axis to North-South and Z-axis to Up-Down.

External Sensor: Mount and level the sensor according to its manual and connect to the external sensor of the instrument. There is no need to align the instrument to a certain direction. All standard sensor housing should be leveled to 0.6Nm evenly on each screw.

4.2.4 Installing other Components, Options, Accessories

For installation of other components, options, or accessories please refer to the specified option manual.

4.3 First Start and Communication Setup

With the instrument correctly fixed on the ground through the fixation plate please proceed with chapter 5 for the first start-up and configuration.

5 Quick Start Up

This chapter is intended to configure simple communication between the instrument and *GeoDAS* software running on a Windows workstation, working as data server.

It is assumed that the GeoDAS software is already installed on a computer. If not, please do the installation first with help of the GeoDAS User Manual before proceeding.

5.1 Preparation

- Make sure the instrument is powered by the provided power supply. Remove the instrument housing lid using the four screws on the top corners.The green AC indicator should be *ON*.
- Make sure the instrument is connected to a LAN by the supplied Ethernet cable.
- If installed, verify that the battery is correctly fixed and connected to the system.

In case there is no LAN available, the Ethernet cable can be connected directly to a computer. For this a crossed Ethernet cable is needed; please contact GeoSIG. Nevertheless in modern computers normally it works as well with the supplied patch cable.
In any case the instrument and the computer must be configured to have a fixed IP. Please follow the procedure to adjust these settings.

- Connect the instrument to a serial port of your computer by using a standard RS-232 patch cable.
- Open any terminal program and choose the appropriate COM port. Baud rate is 115200. Alternatively open GeoDAS, go to ***Tools*** → ***Terminal . . .*** and choose the COM Port. As Baud rate select ***115200***. Then Press ***Connect***

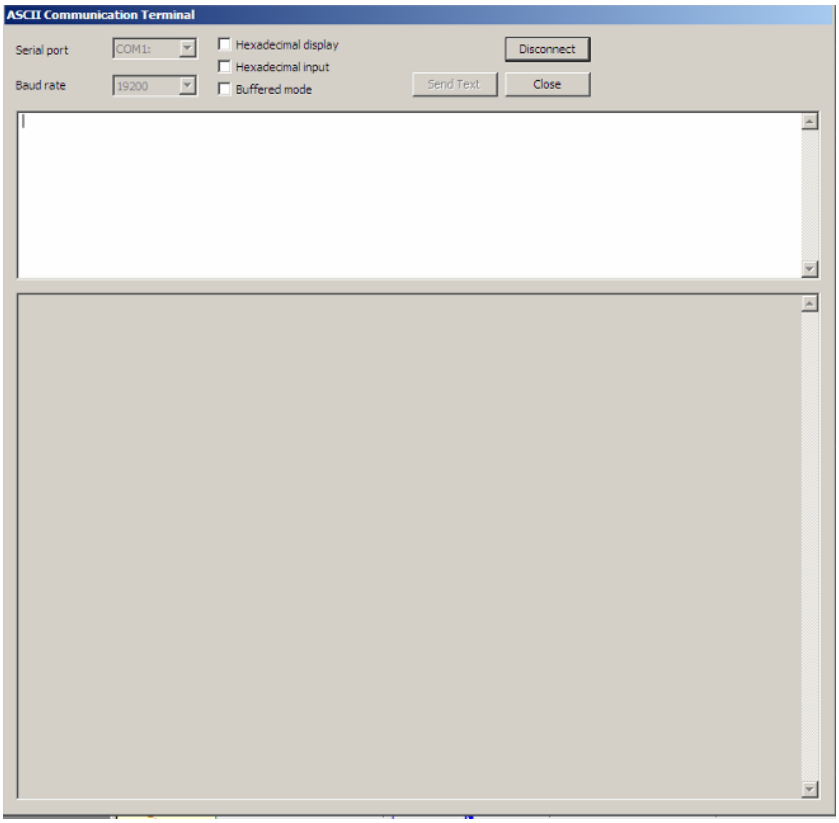


Figure 16: GeoDAS terminal

- Keep the terminal open for the next step.

5.2 Set IP Address of the Instrument

Network settings of the instrument can be changed during startup of the instrument. By default the instrument has a dynamic IP.

- If the instrument is on and running, send the command to reboot the instrument, otherwise switch on the instrument (See chapter 9.1).
- Press ***'Ctr + Z'*** as soon the following message appears on the console to enter the test mode.

```
################################################
###### Test and Initial Configuration Mode ######
################################################
Press Ctrl+Z to enter the test mode.....
```

The following menu will appear (see chapter 10 for details):

```
-------------------------------------------------------------------------------
Level         Shortcut Password Description
-------------------------------------------------------------------------------
User          Ctrl+U   None    Basic operations only
Powerful User Ctrl+W   None    Also hardware options and pre-selected tests
Administrator Ctrl+A   None    Also manual tests and altering the FLASH memory content
-------------------------------------------------------------------------------
Your level [U/W/A] or press B to boot now:
```

- By default no passwords are set, so press ***'U'*** to enter the User Mode, and then ***'N'*** to enter the menu Network settings.

```
==== Network Settings ====

---- Primary network interface ----
Configure network interface (Y/N)? Y
Static IP address (1=YES, 0=AUTO)? (0 = 0x0):
```

- Select ***'Y'*** to change the settings and then select if the instrument should have a static or a dynamic IP by pressing ***'1'*** (Static) or ***'0'*** (dynamic). In case a dynamic IP is chosen, a DHCP server must be available in the network to provide the IP settings.
- In case a static IP is selected, an additional message will appear asking for the instrument IP address, instrument network mask and instrument gateway IP. If you don't know these parameters please ask your network administrator.
- If the instrument has a Wi-Fi module, a second interface menu appears. Here static or dynamic IP can be chosen and the available Wi-Fi networks can be scanned. Please see chapter 7.4 for details.

```
---- Wireless network interface ----
Configure network interface (Y/N)? Y
Static IP address (1=YES, 0=AUTO)?
```

- If the instrument is connected to the Internet via a PPP connection (cellular or analog modem), then the APN and password must be configured. See chapter 7.4 for details.

```
---- PPP Communication ----
Edit Analog Modem settings (Y/N)? Y
Phone number of the service provider  [T313001]:
Login  [demo]:
Password  [demo]:
Updating configuration...
PPP settings have been updated
Edit Cell Modem settings (Y/N)? N
```

- The instrument allows access to the operating system from remote over SSH. This feature is not needed for normal operation of the instrument and can be disabled in case of security concerns. By default it is

enabled; to disable press ***'1'***.

```
---- Miscellaneous parameters ----
Disable remote login over ssh (1=Yes, 0=Enable)? (0 = 0x0):
```

- It's highly recommended to put a *recovery server IP address and recovery server port*. The instrument will contact this server every *Recovery server contact interval* in case the connection to the main data server (configured in the configuration of the instrument) is not possible anymore. This could happen, for example, if a configuration file with wrong server settings were accidentally uploaded to an instrument.

```
Recovery server IP address (192.168.10.107):
Recovery server port (3456 = 0xD80):
Recovery server contact interval, hours (24 = 0x18):
```

- As soon the following menu appears, press ***'5'*** to start the instrument.

```
Access level: User

 --- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
5 - Boot now
X - Reboot the instrument
Y - Power off

 --- Hardware Setup and Monitor ---
N - Network settings

 --- Security ---
O - Set password

-->
```

- Start ***GeoDAS*** (if not already done), to add the instrument in its configuration

5.3 No Stations Configured at first Start Up

*The following steps require GeoDAS version 2.24 or higher. If you have an older version download the newest release from **www.geosig.com → Support → Downloads***

- When GeoDAS is started for the first time, it will ask to add stations in its configuration.
- Click ***Yes***

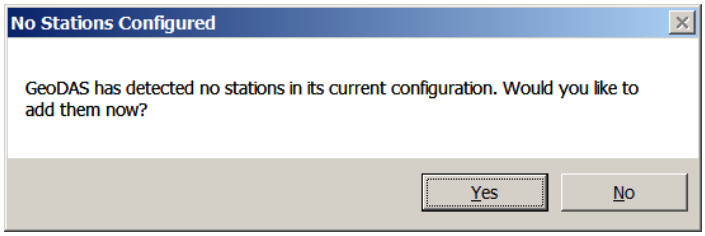


Figure 17: "No stations configured" message at startup of GeoDAS

If there are already stations configured in GeoDAS, this window will not appear. Please press the wizard button in the GeoDAS menu

An exported GeoDAS configuration is in the USB stick that gets shipped with the instrument

5.4 Adding New Stations . . .

Make sure the computer is connected to the same network as the instrument and in the same IP range.

- In the following window, select ***My instrument other than GSR is connected to the local network*** and press ***Next >***

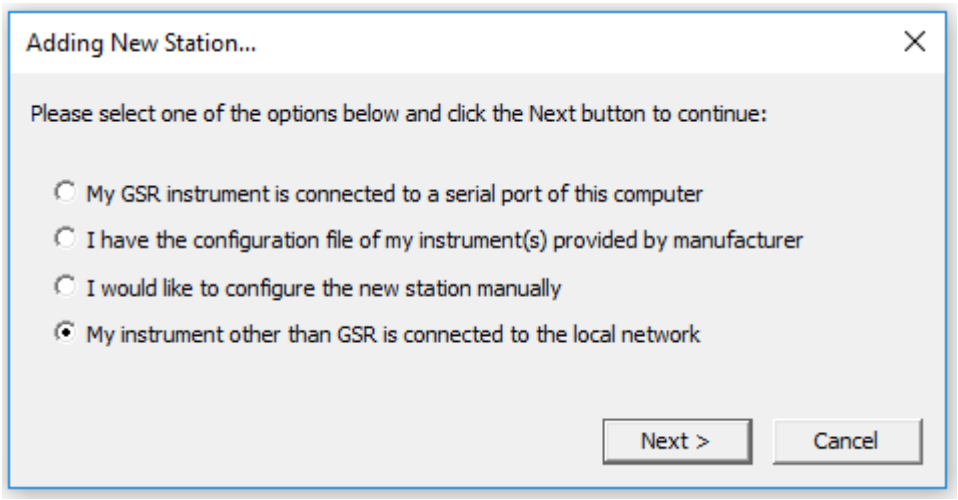


Figure 18: Instrument wizard

- Enter the ***Serial number*** of the instrument and press ***Login >***. It is also possible to add more than one station by entering only a fragment of the serial number which is similar on all instruments. For example if there are the serial numbers 100210, 100211 and 100234. By entering '1002' all the stations will be added. By putting '10021' just the stations 100210, 100211 will be added.

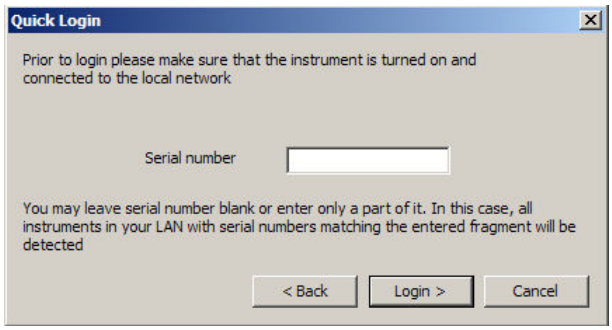


Figure 19: Quick Login Window

- All the found stations will be listed, press ***Finish*** to add them to GeoDAS

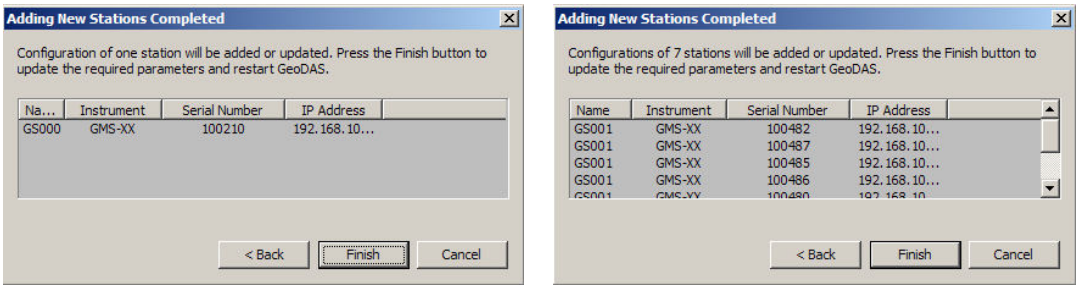


Figure 20: List of all stations found - single station left, multi-selection right side

5.5 Configuration of Data Server

- Proceed to the menu ***Settings*** → ***Configure Stations . . .***
- The following window will appear where all the instruments are listed in the area 1. To add stations make a right click and choose *Add Station to current configuration*. Please see chapter C.1 for details.

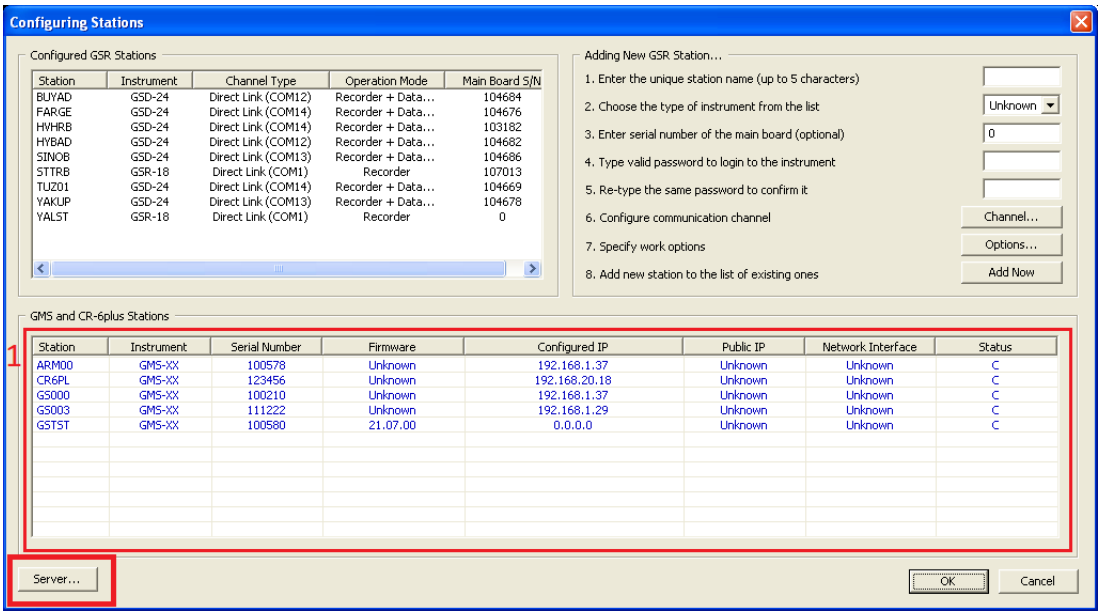


Figure 21: Configuration and overview of the stations

- Press the button ***Server...*** When the window below appears, enter the following data:
  - *My server IP address* **IP of your computer**
  - *Server port* Select a user defined port, use ***3456*** by default

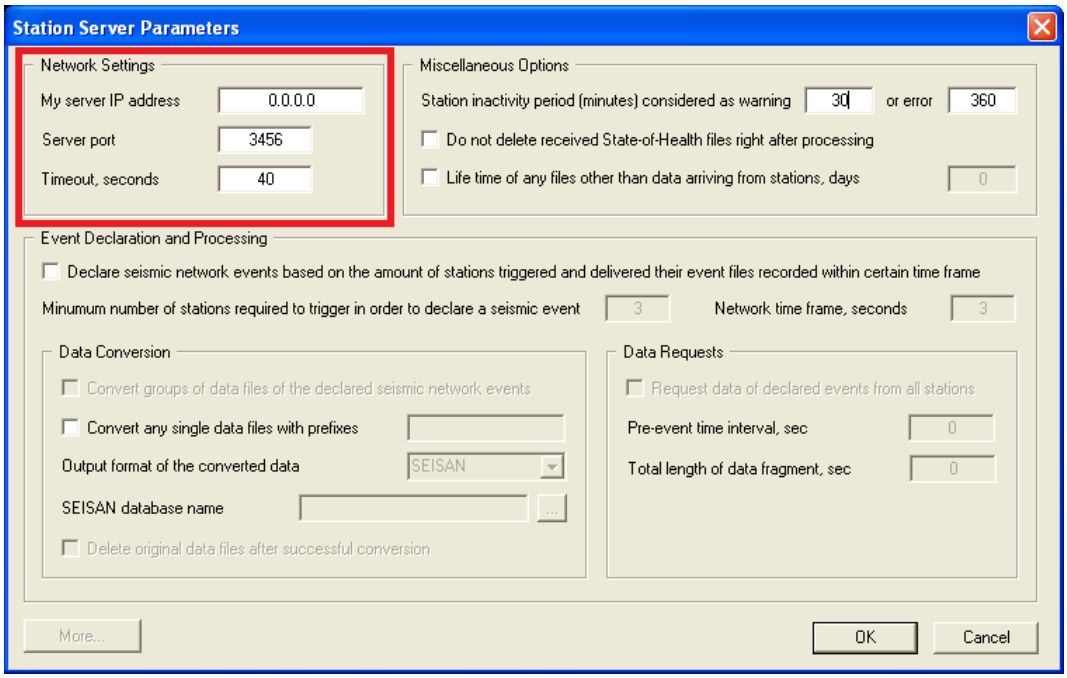
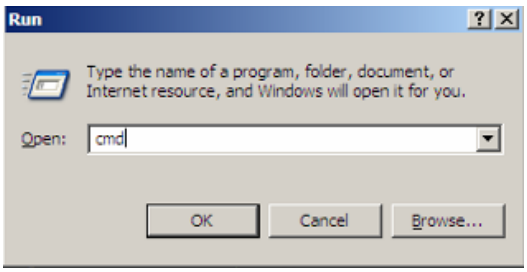
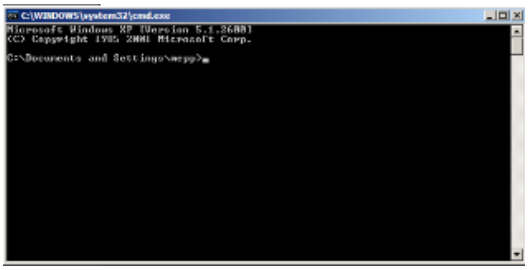


Figure 22: Data server parameter

In most cases you do not need to enter an IP address. It may only be needed if your computer has several network cards, and you would like to communicate to instruments connected only to one subnetwork. Otherwise you may leave the default zero IP address 0.0.0.0
If you don't know how to find out your IP address, follow these steps:
*- Click Start → Run → type **cmd**, then press **OK***





*- Enter the command '**ipconfig**', then your IP appears*

```
Ethernet adapter Local Area Connection:
        Connection-specific DNS Suffix  . :
        IP Address. . . . . . . . . . . . : 192.168.10.107
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 192.168.10.254
```

*- Type **exit***

- Write down the IP and port you have configured
- Press ***OK*** two times to exit again to the main window of GeoDAS

5.6 Basic Configuration of the Instrument

- In the window Stations: General Information make a ***right click*** on the station name and select ***Instrument Setup...***

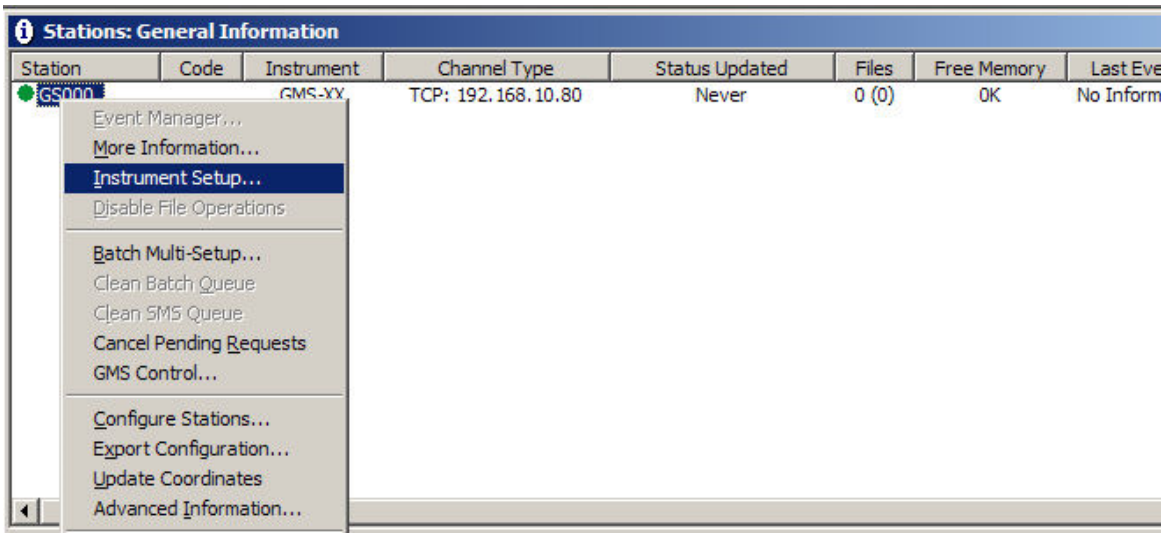


Figure 23: Instrument setup

- A window showing the Web Interface will appear.

Figure 24: Web Interface of the selected instrument

- To be able to adjust the configuration of the instrument it is required to authenticate oneself to the device. The default login credentials are: Username: ***admin***, password: ***123456***. Then press ***login***

- Go to ***Configuration → Communication Parameters***.

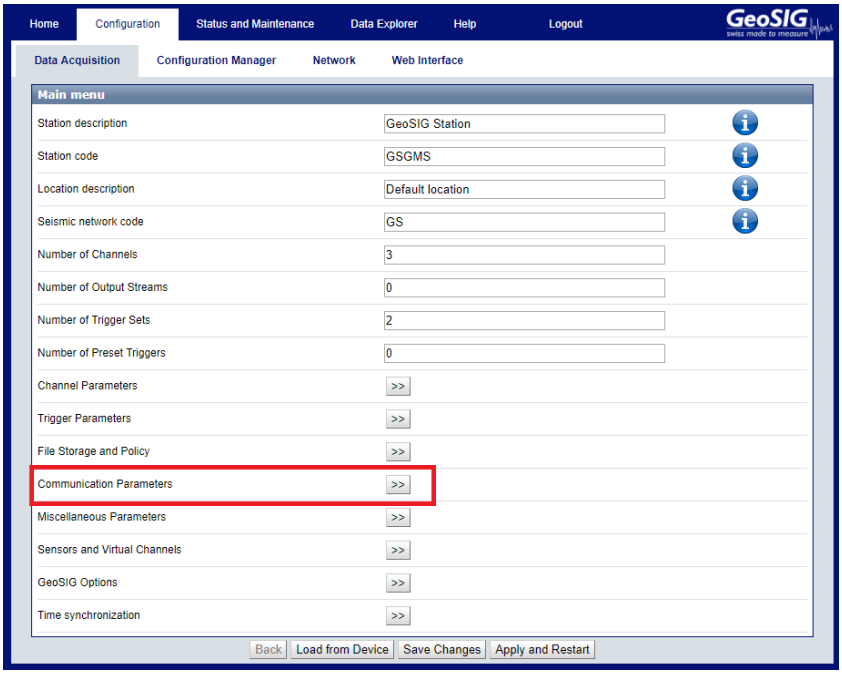


Figure 25: Communication parameters

- Tick the flag ***Contact Remote Servers*** to configure a connection to a remote server.
- Go to ***Server Parameters***

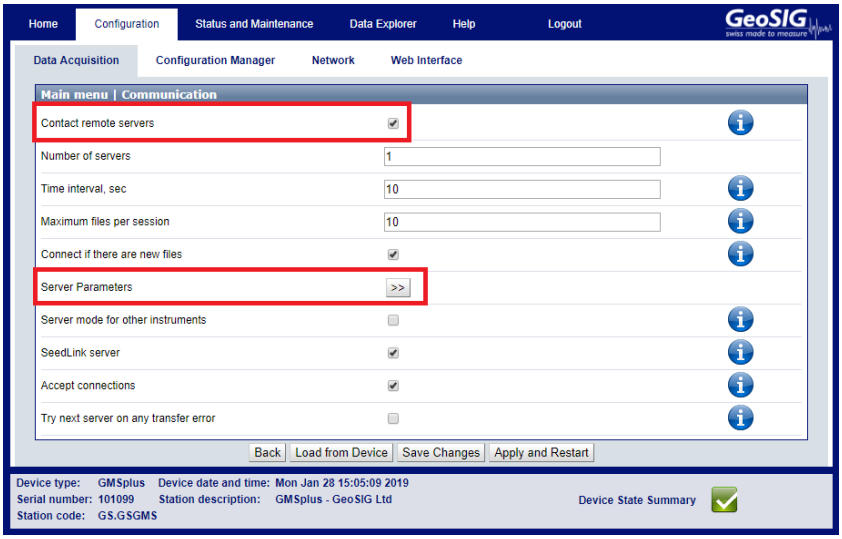


Figure 26: Edit Communication parameters

- Configure the ***Server IP address*** and press. The default *Server port* is ***3456*** and should be kept.
- Then press ***Save and Restart***.

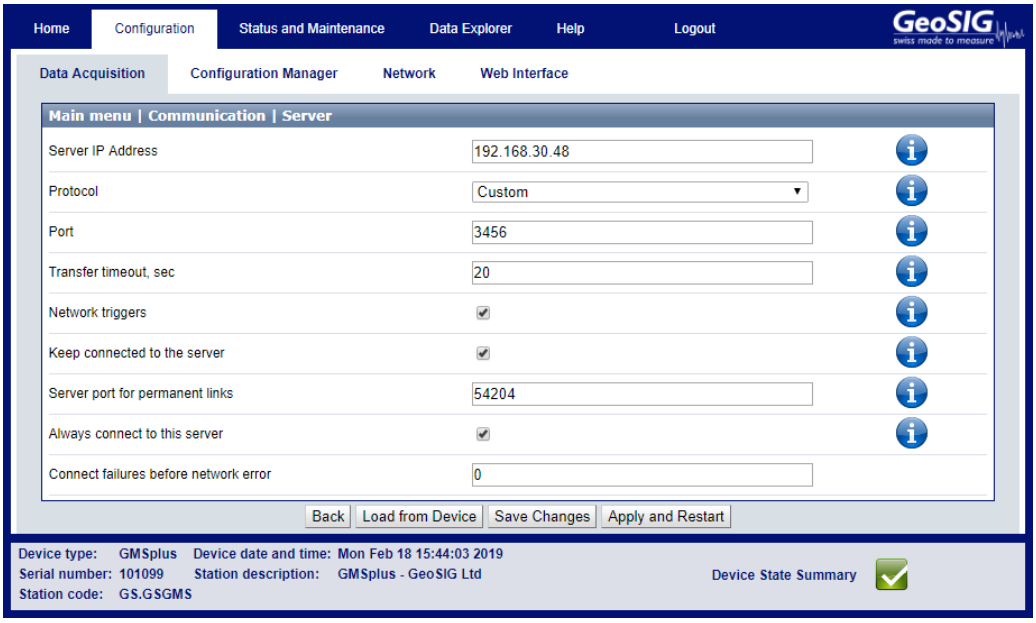


Figure 27: Edit Server parameters

- Under *Protocol*, select ***Custom*** and add the default *Port*: ***3456***.
- Then press ***Apply and Restart***.
- After the instrument has restarted it is ready for operation and can be configured according to chapters 8 and 9.

6 Principle of Operation of the Instrument

This chapter gives an overview of the normal operation of the instrument in a network or as a standalone unit.

6.1 Normal Operation

During normal operation the instruments are installed on sites and connected to a data server over Ethernet or Internet. The instrument checks in a defined interval whether there are any requests or firmware updates ready for pick up on the server. Additionally - and if configured - the instrument uploads the ringbuffer files (from continuous recording) and the state of health files to the data server.

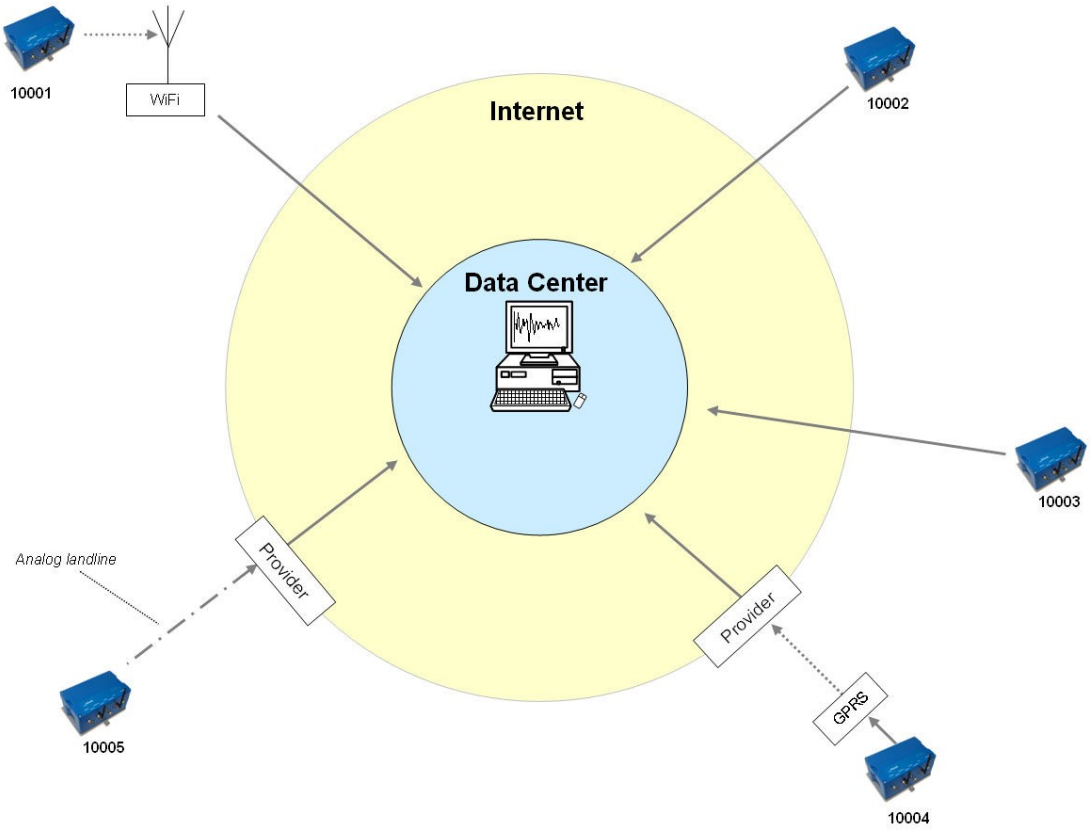


Figure 28: Normal operation in a network

6.2 Behaviour on a Seismic Event

In the event of an earthquake with vibrations above the trigger threshold, the instrument will record the event and immediately upload it to the data server (see Figure 29). In case some of the stations are too far away from the epicentre to trigger, the data can still be collected from all instruments:

- A data request will be placed on the server
- All instruments will download the request during the next time checking the server (see Figure 30)

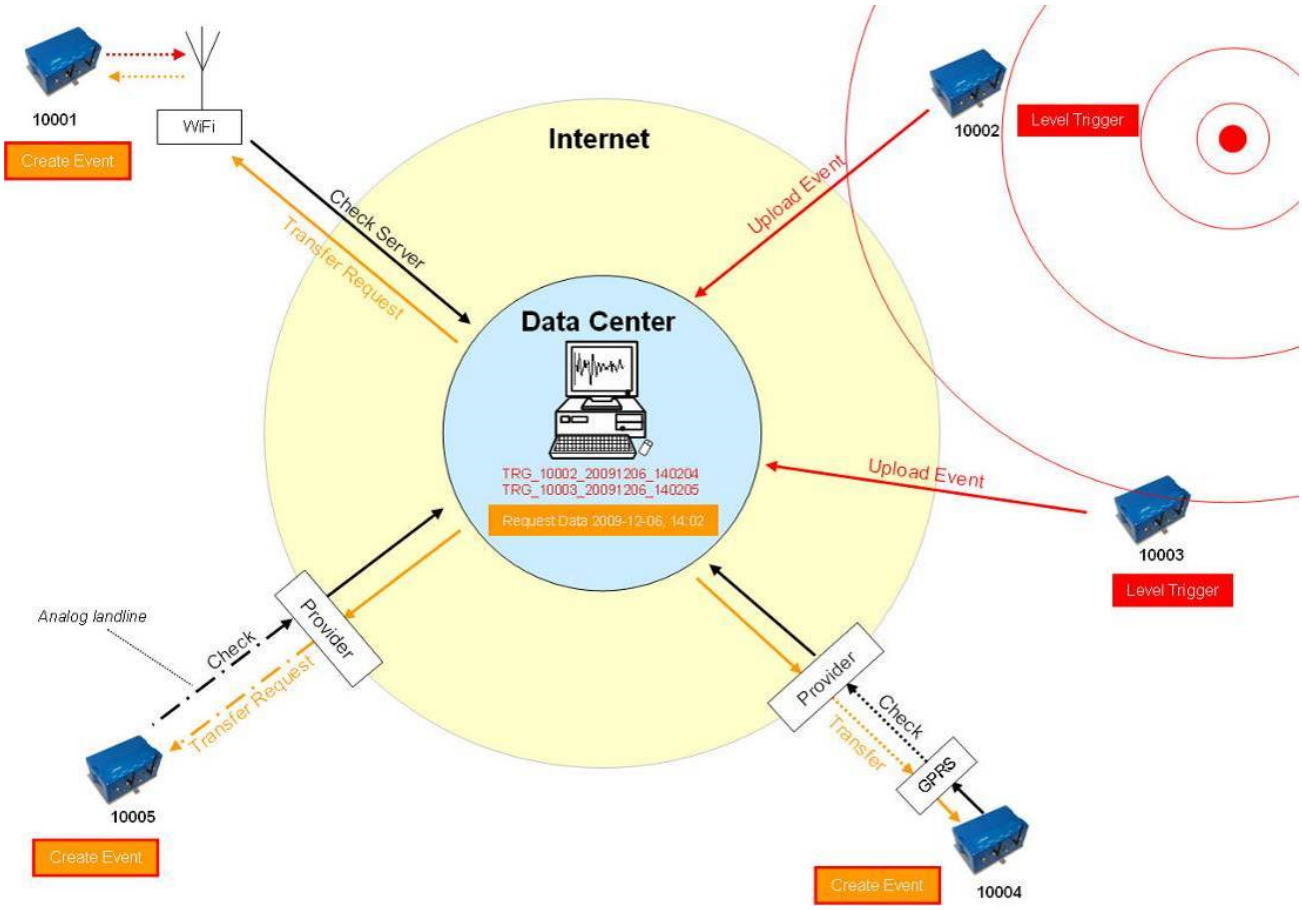


Figure 29: Upload of seismic events and download of requests from the server

- All instruments will create an event at the time listed inside the data request and extract these data out of the ringbuffer data.

- The extracted event file will be uploaded to the data server (see Figure 30)

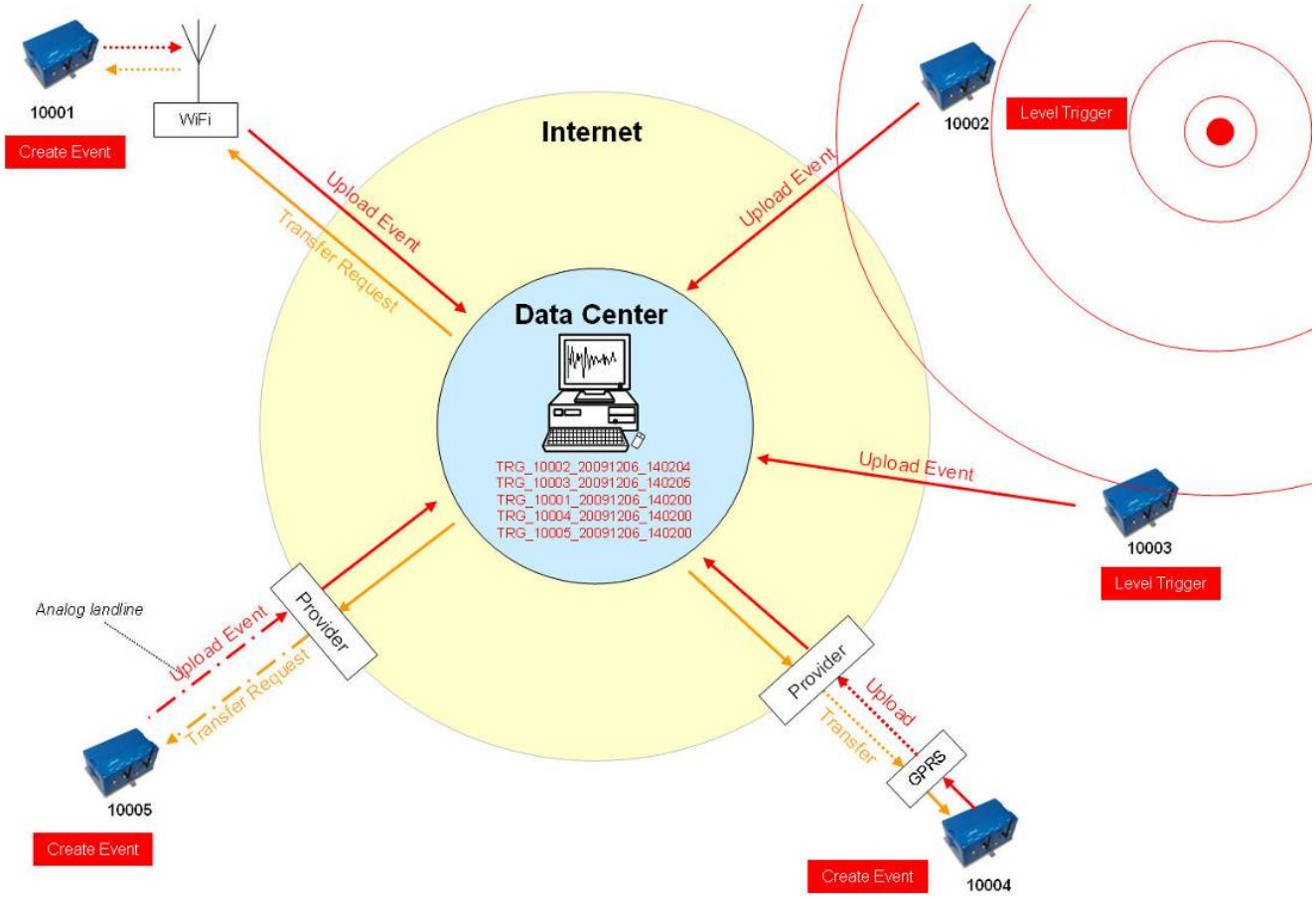


Figure 30: Behaviour on Events: Upload of extracted events

6.3 Firmware and Configuration Upgrade

In case of a firmware upgrade, the new firmwares can be easily put on the server. All instruments will recognise the new firmware during the next server checkup, download and install it. See chapter 11 for details about the firmware upgrade. The same happens also with new configurations. In case the option "Keep connection to the server" is enabled under Server Parameters (see chapter 9.8 for details), then the instrument will keep the channel open so that it is possible to configure the instrument via the Web Interface without knowing the IP address of the instrument. See chapter 8 for details.

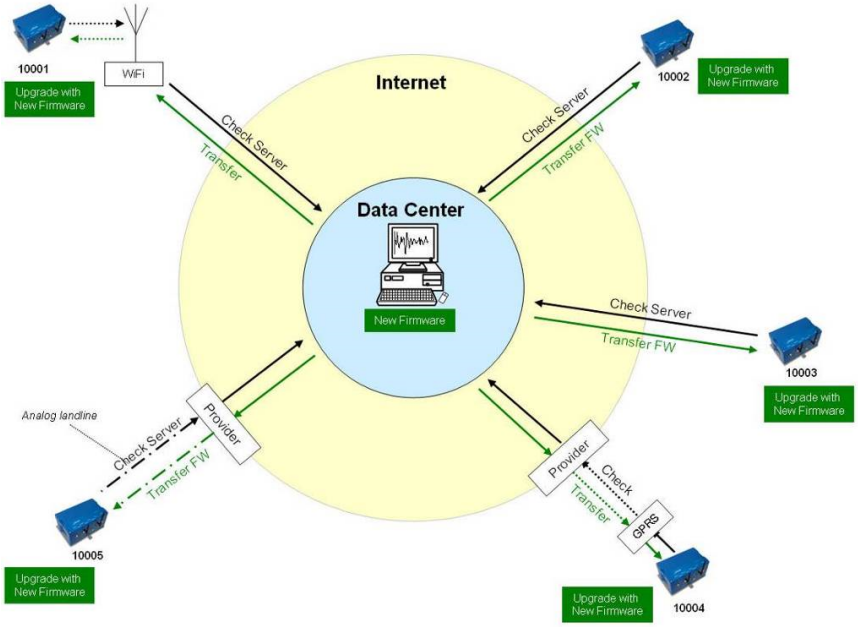


Figure 31: Firmware upgrade

6.4 Backup Server

It might be that the instrument is not able to contact the main data server anymore: either because it is down or a wrong server has been configured. For example, this can happen if a configuration file with wrong server settings is uploaded accidentally to an instrument. In this case the instrument will contact the backup server that has been configured in the test and configuration menu. Therefore the configuration of the backup server is very important and should not be ignored. For more information how to set the backup server see chapter 5.2.

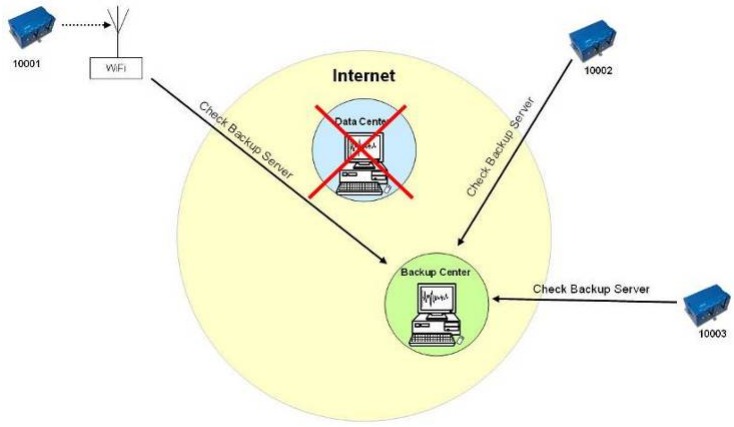


Figure 32: Connection to backup server in case connection to main server fails

7 Network Settings

The network configuration is the same whether using a wired network or wireless network. The specific settings related to the wireless network configuration via the local console are described in chapter 7.4.

7.1 Network Settings through the Web Interface

- To open the Web Interface please do one of the following two steps:
  - In the window Stations: *General Information of GeoDAS* make a ***right click*** on the station name and click on ***Instrument Setup...*** or
  - Open your browser and enter the IP address of the instrument (see chapter 7.5 for details) in the address bar of your browser.
- To be able to adjust the configuration of the instrument it is required to authenticate oneself to the device. The default login credentials are: Username: ***admin***, password: ***123456***
- Go to the tab ***Configuration*** → ***Network Configuration***. The following screen can be seen (pictured below).
- Adjust the wired Ethernet settings under *eth0*. In case the instrument has a second wireless Wi-Fi interface, then additionally available Wi-Fi networks can be scanned or all parameters can be manually adjusted.
- Click ***Save Network Configuration to Device***.

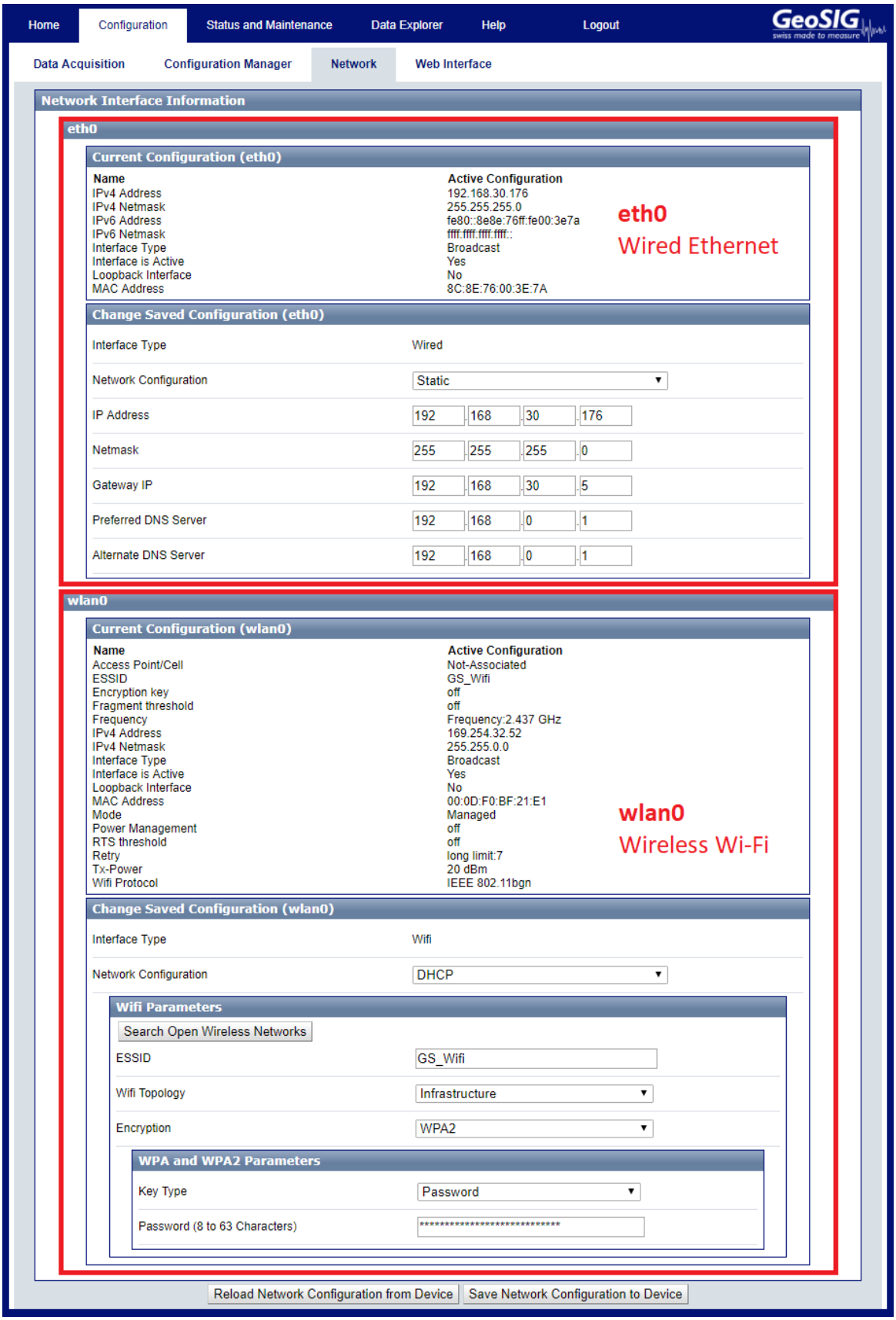


Figure 33: Configuration of network interface

7.2 Network Settings through GeoDAS

- Under ***Settings*** click on ***Configure Stations. . .***, the following window appears:

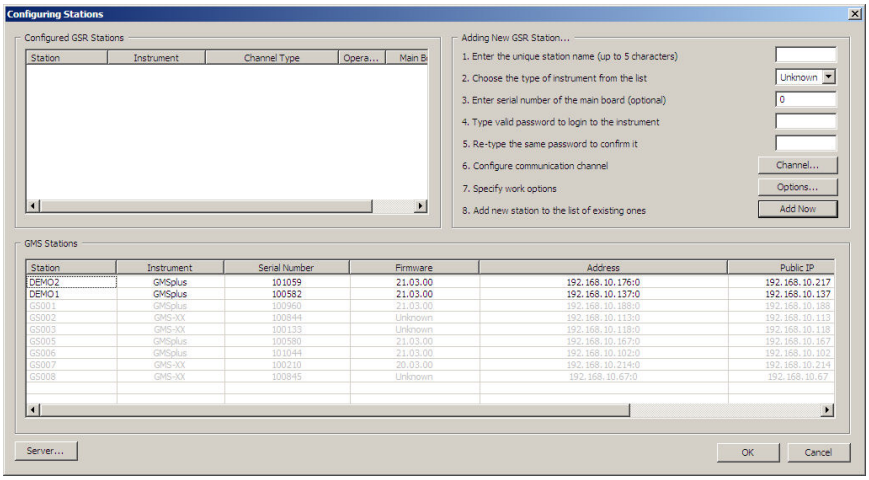


Figure 34: Configuring Stations screen

- Make a ***right click*** on the station name and choose ***Edit Network Settings of Instrument***

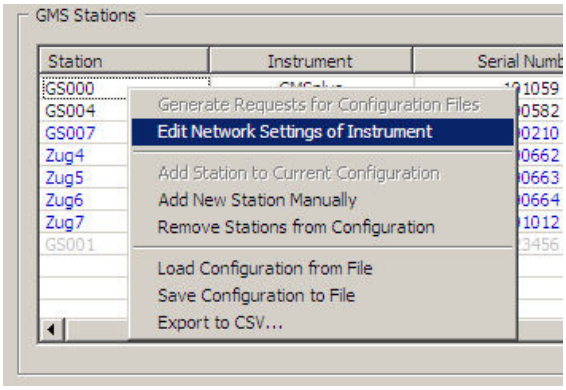


Figure 35: Edit Network settings

- Adjust all the network parameters in the following screen wherein the **Primary Network interface** is the wired Ethernet, and Embedded Wi-Fi interface is the wireless network interface.

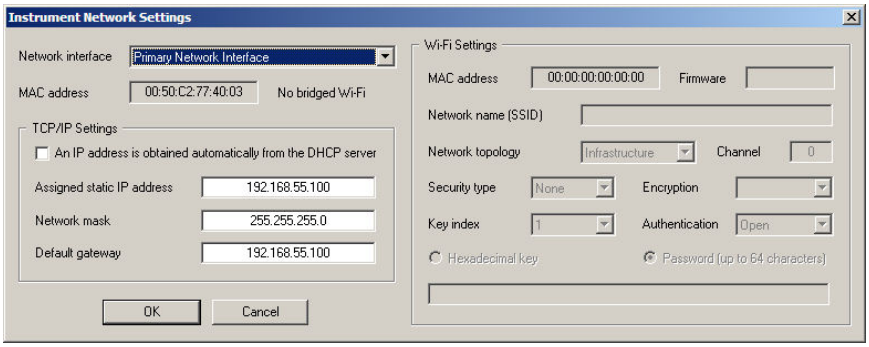


Figure 36: Configuration of wired Ethernet

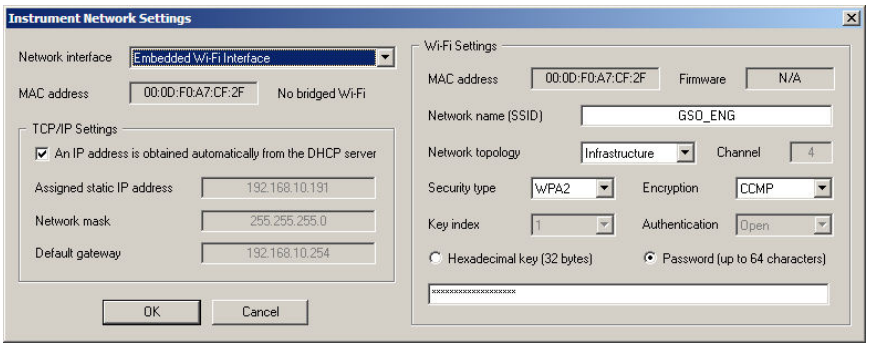


Figure 37: Configuration of wired Ethernet

7.3 Wired Ethernet settings through the local Console

Please see chapter 5.2 for details.

7.4 Wireless Settings through the local Console

- Switch on the instrument by pressing and holding the POWER button for 2 seconds.
- Press ***'Ctr + Z'*** as soon the following message appears on the console to enter the test mode.

```
################################################
###### Test and Initial Configuration Mode ######
################################################
Press Ctrl+Z to enter the test mode.....
```

The following menu will appear (see chapter 10 for details):

```
-------------------------------------------------------------------------------------------
Level          Shortcut Password Description
-------------------------------------------------------------------------------------------
User           Ctrl+U   None     Basic operations only
Powerful User Ctrl+W   None     Also hardware options and pre-selected tests
Administrator Ctrl+A   None     Also manual tests and altering the FLASH memory content
-------------------------------------------------------------------------------------------
Your level [U/W/A] or press B to boot now:
```

- By default, no passwords are set, so press ***'U'*** to enter the User Mode, and then ***'N'*** to enter the menu Network settings and proceed until the following menu appears:

```
---- Wireless network interface ----
Static IP address (1=YES, 0=AUTO)?
```

- Select if the instrument should have a static or a dynamic IP address by pressing ***'1'*** (Static) or ***'0'*** (Dynamic). If a dynamic IP address is chosen, a DHCP server must be available in the network to provide the IP address settings.
- If a static IP address is selected, an additional message will appear asking for the *Instrument IP address, Instrument network mask and Instrument gateway IP address*. If you don't know these parameters please ask your network administrator.
- By pressing ***'E'*** the instrument scans the available networks and lists them. Choose the network to connect by pressing the **number** next to the network SSID or press ***'C'*** to configure the network settings manually.

```
Scanning wireless networks.
-------------------------------------------------------------------------------
  N   Network SSID         Mode             Encryption   Channel   Level,%
-------------------------------------------------------------------------------
  1   GSO_ENG              Infrastructure   WPA2             1       81
-------------------------------------------------------------------------------
Enter the number of a network above, <S>can again or <C>onfigure manually:
```

- If the network is encrypted, please enter the network key.

```
Passphrase (8-63 ASCII) or a 64-character hex key (ad43Fd2d22):
```

- Adjust the other parameters concerning the SSH or recovery server if required.
- When the instrument tries to connect to the network, this can take a while. Please be patient until the following menu appears again:

```
Access level: User

 --- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
5 - Boot now
X - Reboot the instrument
Y - Power off

 --- Hardware Setup and Monitor ---
N - Network settings

 --- Security ---
O - Set password

-->
```

- Press ***'5'*** to continue the boot process of the instrument.

7.5 Get IP address from Instrument

- To get the IP address from the instrument please press ***'S'*** in the main user menu

```
Main menu:
C - Configuration
M - Messages ->
S - Shell command
L - List firmware images
X - Display errors (0) and warnings (0)
W - Clear errors and warnings
F - View/reset RTC trim values
T - File statistics
G - View RTC status
P - View GPS information
H - Set RTC time
U - User request
R - Restart
Q - Quit
```

- Enter the Linux command ***ifconfig*** and the following reply will be shown by the instrument
- Please see the IP addresses of the wired Ethernet *(eth0)* and the wireless Ethernet *(wlan0)* listed and marked here in red.

```
Linux Command: ifconfig
eth0      Link encap:Ethernet  HWaddr 00:50:C2:77:42:8E
          inet addr:192.168.10.133  Bcast:192.168.10.255  Mask:255.255.255.0
          inet6 addr: fe80::250:c2ff:fe77:428e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:71 errors:0 dropped:1 overruns:0 frame:0
          TX packets:16 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:6538 (6.3 KiB)  TX bytes:1678 (1.6 KiB)
          Interrupt:21 Base address:0x4000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:3 errors:0 dropped:0 overruns:0 frame:0
          TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:172 (172.0 B)  TX bytes:172 (172.0 B)

wlan0     Link encap:Ethernet  HWaddr 00:0D:F0:8E:05:DF
          inet addr:192.168.10.94  Bcast:192.168.10.255  Mask:255.255.255.0
          inet6 addr: fe80::20d:f0ff:fe8e:5df/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2333 errors:0 dropped:95 overruns:0 frame:0
          TX packets:636 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:271699 (265.3 KiB)  TX bytes:737148 (719.8 KiB)
```

8 The Web Interface

The instrument can be configured over a Web Interface. To be able to use the Web Interface, it is necessary that the following criteria are fulfilled:

- The IP address of the device has to be known or the flag *Keep connection to the server* under *Server Parameters* (see chapter 9.8 for details) must be enabled (set to Yes).
- In case the flag *Keep connection to the server* is disabled, the port 80 of the device has to be accessible, from the accessing computer. This usually means that the instrument is in the same network as the accessing computer and no firewall mechanism separates the two.
- A current browser version has to be available on the accessing computer.

8.1 Accessing the Web Interface

- To access the instrument please follow one of the following two steps.
  - In the window *Stations: General Information* of GeoDAS make a right click on the station name and click on ***Instrument Setup...***, as can be seen previously in Figure 23, or
  - Open your browser and enter the IP-Address (e.g. 192.168.30.176) of the device in the address bar of your browser.

Figure 38: The login screen of the instrument at 192.168.30.176

To be able to adjust the configuration of the instrument or access its data, it is required to authenticate oneself to the device. This can be done by entering a valid username and corresponding password in the fields of the same name and pressing the "login" button.

The default login credentials are:

- Username: admin
- Password: 123456

The default password can be changed as described in the chapter 8.3.4 of this manual. If the admin password is forgotten, please delete the webuser.txt file on the SD card of the instrument to restore the default password.

The Web Interface can be disabled under Network settings in the Administrator mode of the test and configuration menu. See chapter 10 for details.

8.2 The Home Panel and the General Navigation

After the login process has ended, the screen shown in Figure 39 becomes visible. The width of the Web Interface is optimised for a screen width of 1024 pixels. If the width of the browser window is smaller than that, it might be necessary to scroll horizontally.

Figure 39: The home panel of the web interface

As can be seen in Figure 39, each screen in the web interface is separated into three sections:

1. **The Navigation Bar:** The navigation bar allows accessing all screens within the web interface. The navigation bar is further separated into two parts. The top bar is the primary navigation panel which is visible from all screens. The currently active tab is marked white, while all other – inactive – tabs are blue. By changing from one tab to another, the secondary navigation panel becomes active. This secondary navigation tab allows to switch between the actual screens within a primary navigation bar.
2. **The Content Section:** This section will contain all information and configuration options. Most interaction will take place in this part.
3. **The Device State Summary:** On the left side the Station Description and Serial Number is displayed to identify the current instrument you are working on. On the right side the device state summary describes the overall status of the instrument. The states that are possible are listed in Table 7. By clicking on the overall state, information on the actual problems will be displayed. More detailed information on the error states are provided in the menu item "State of Health" as described in chapter 8.4.

Symbol	Meaning	Description
	No errors or warnings reported from the device.	As there seem to be no issues, no action is required.
	A warning is reported from the device	There seems to be an issue in this module. Although it seems not to be critical, it is recommended to check why this warning is displayed and take actions to resolve it.
	An error is reported from the device	An error has occurred and it is required to check for the cause of the problem and resolve it in order to avoid limited functionality.

Table 7: The overall error states shown in the Web Interface

8.3 Device Configuration

The configuration screen of the Web Interface gives access to all configuration options, the configuration management of the Data Acquisition Software as well as the Network Configuration and the Web Interface itself.

Loading the configuration can take a few seconds. During this time at the right corner of the browser ***Loading...*** is displayed. Please be patient till the screen shown in Figure 40 appears.

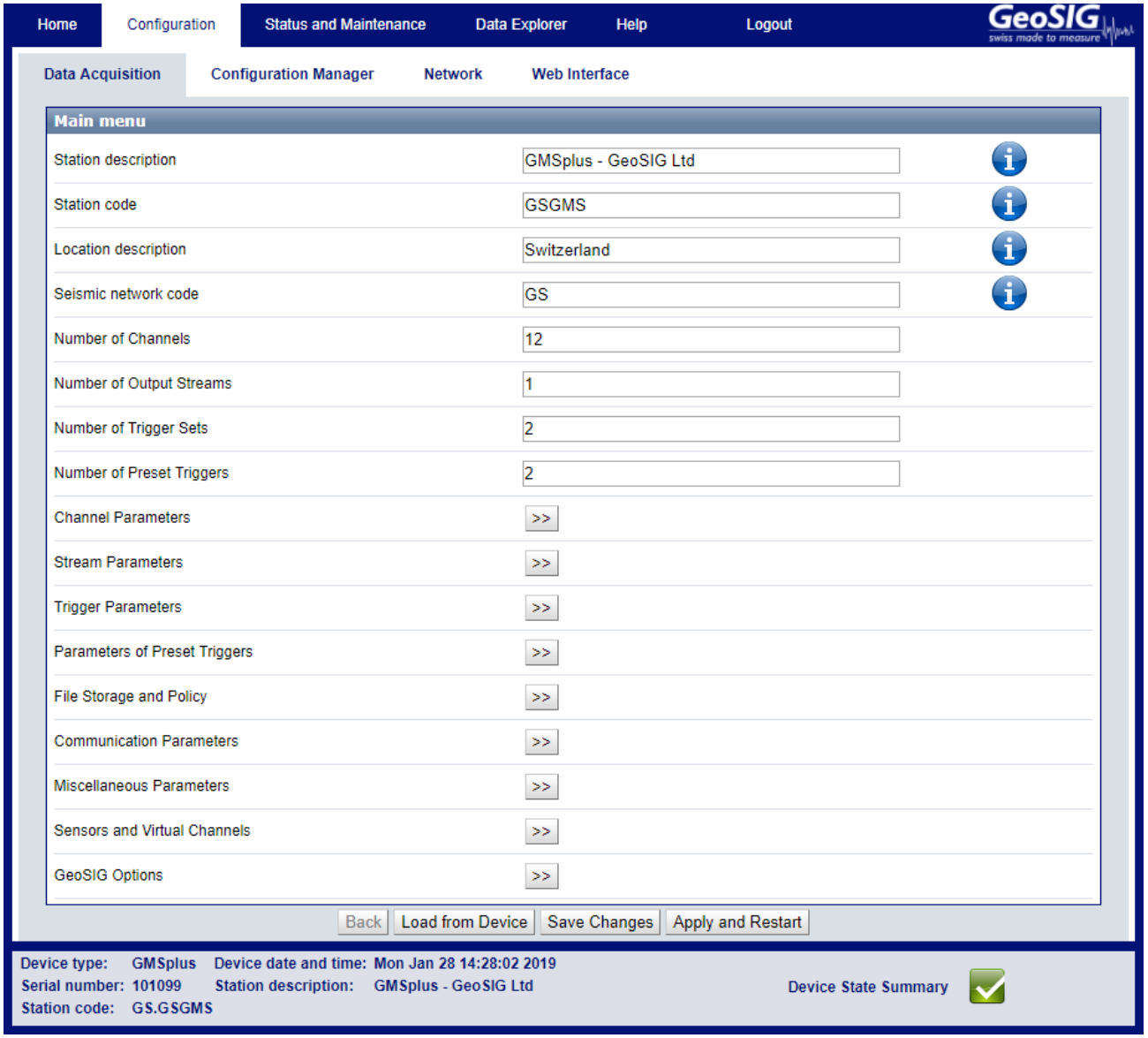


Figure 40: Configuration main menu

8.3.1 Data Acquisition Configuration

The **Data Acquisition** sub menu provides access to the data of the current configuration of the data acquisition software. As depicted in Figure 41, the content of this tab is divided into two sections:

1. **The Configuration Value Panel:** This is main part of the armdas Configuration screen. Within this part of the screen all the values of the configuration of the selected Configuration Menu Item can be adjusted. Most options will provide a help button in the form of white question mark on blue ground on the right part of this section. By clicking on it information will be displayed over the option. Please note that the only way to restore the original values of the fields after making changes to them is by using the *"Load from Device"* Button in the Action Panel.
2. **The Action Panel:** This panel is providing the option to either reload the current configuration from the device (to discard changes or load changes done by another user) or to save the edited configuration to the device or to save the edited configuration to the device and restart the data acquisition software. Saving and restarting will interrupt the current recording for about 20 seconds. During this time triggers will not be executed either. Please note that if the device is configured to use a DHCP server, the address might change during the saving of the configuration which will make the web interface inaccessible under the old address.

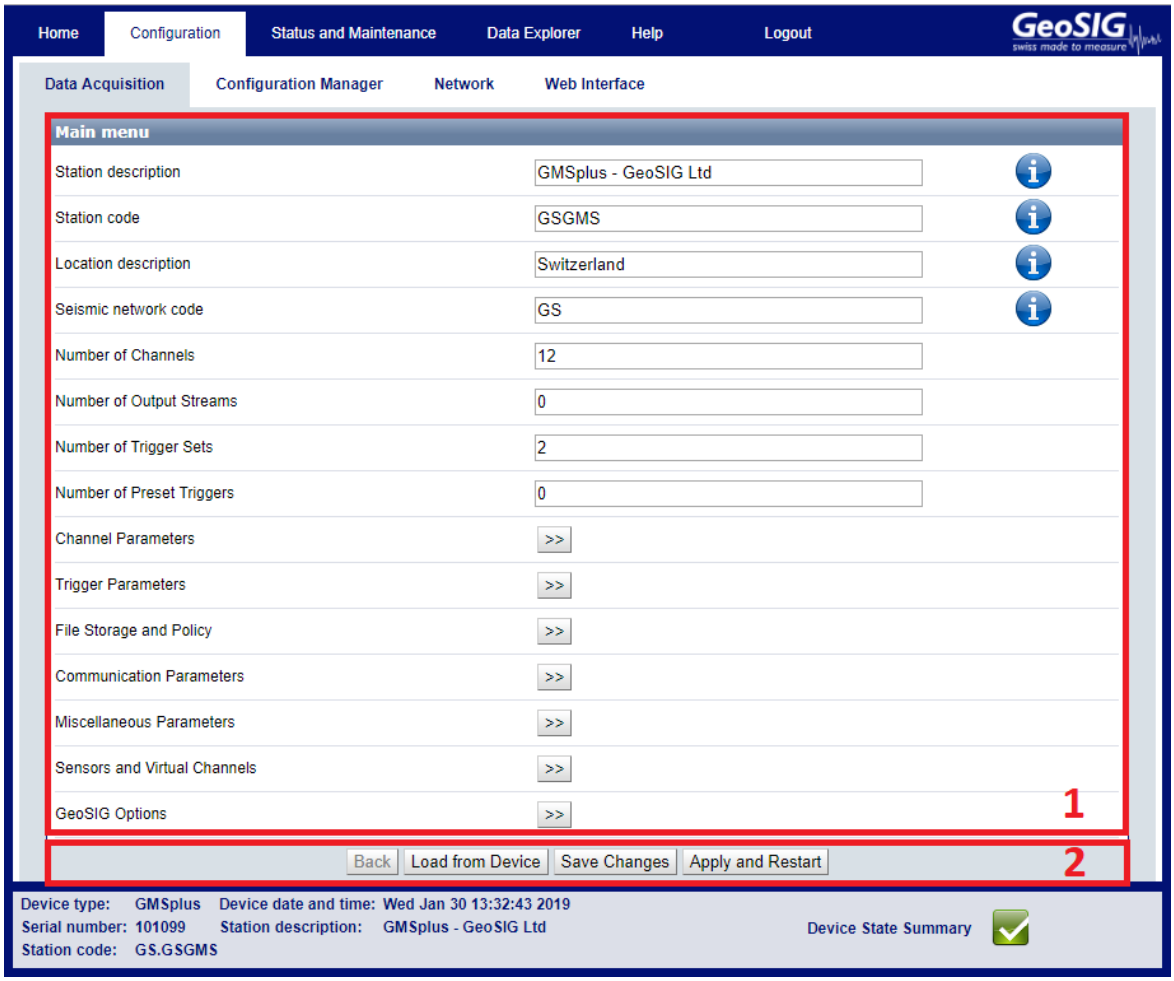


Figure 41: Configuration panels

8.3.2 Configuration Manager

As described in the previous chapter, the *Data Acquition* screen only allows configuring the currently used configuration. The ***Configuration Manager*** screen described in this chapter allows managing several configurations, changing the current configuration, uploading a new configuration and so on. As depicted in Figure 42, the screen is divided into three sections:

1. **The Configuration List:** This list contains all configurations currently available on the SD or CF card. The *Current Configuration* should always be listed in this list. This configuration can be copied and downloaded but not renamed, removed or made the current configuration (as it is already the current). As depicted in Figure 43, these options become available to other configurations stored on the SD card (in this example after uploading a file to the device). When pressing ***Use as Current Configuration*** it will store this configuration as the *Current Configuration*. The existing configuration will be overwritten and the instrument restarted. Note that only the *Current Configuration* can be edited in the *Firmware* screen. The other configuration files will remain untouched. The *Current Configuration* can be saved in a file by pressing ***Copy***.
2. **The Upload Panel:** While the *Configuration List* allows downloading configurations from the device by clicking on the name, this part of the screen provides the possibility to upload a configuration to the web interface by selecting a configuration on the PC and using the ***Upload*** Button. As can be seen in Figure 43, after a successful upload a new file is shown in the Configuration List and the name of the newly available configuration is written at the top of the list. (The name of new configuration will be created from a random string followed by "_config.xml"). The configuration can then be changed by clicking on ***Rename***. Note that the upload panel might look different depending on the browser in use.
3. **User Default Panel:** With the ***Reset To the User Default Config***, the *Current Configuration* will be overwritten by the user default (see command SETDEFCFG in the chapter 9.12.1) and the instrument will be restarted. The *Current Configuration* can be saved as the user default by pressing the button ***Make current Config the User Default Config***

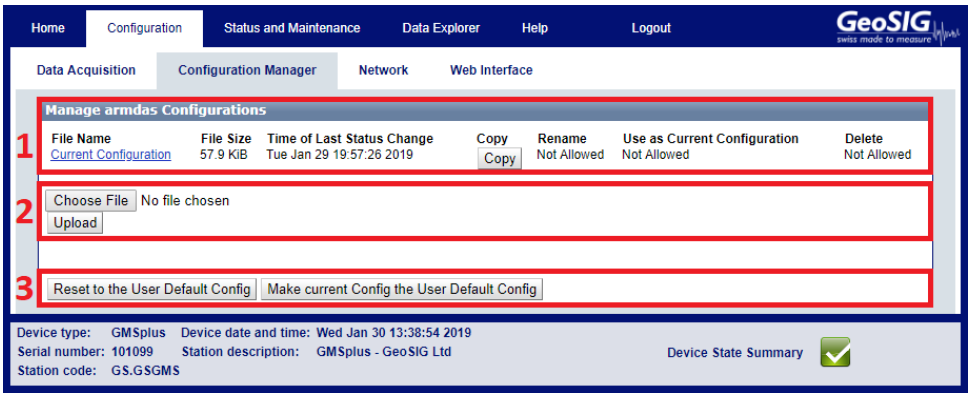


Figure 42: Configuration Manager screen

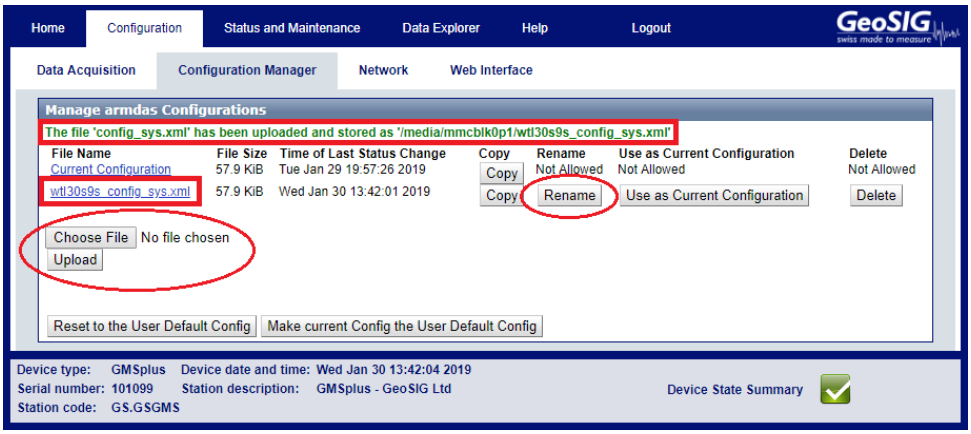


Figure 43: New file upload

8.3.3 Network Configuration

8.3.3.1 Wired Ethernet

The *Network Configuration* screen provides the possibility to change the network configuration of all network interfaces of the instrument. For the standard instrument only one network interface is available: the Ethernet interface, which is present in all devices. (This interface is marked as "LAN" in Figure 4). This interface can be configured in the section of the screen that is marked with the red number "1" in Figure 44. The top part of that framed, red section describes the current configuration of the interface. The part below allows changing this configuration. The name of this network interface is traditionally ***eth0***.

8.3.3.2 Wi-Fi Wireless Ethernet

Some devices contain an additional wireless interface (marked as "Wi-Fi" in Figure 4). If this is the case, a second configuration panel is shown in the Network Configuration screen as can be seen Figure 44 (marked with the red number "2"). As with the default Ethernet interface the section surrounded by the red frame is split in two parts, where the top part defines the current settings and the bottom part provides the possibility to change the configuration. Additionally to the standard network settings like IP Address, Netmask, Gateway and so on, the actual wireless settings can be adjusted and open wireless networks scanned. The name of this network interface is traditionally ***wlan0***.

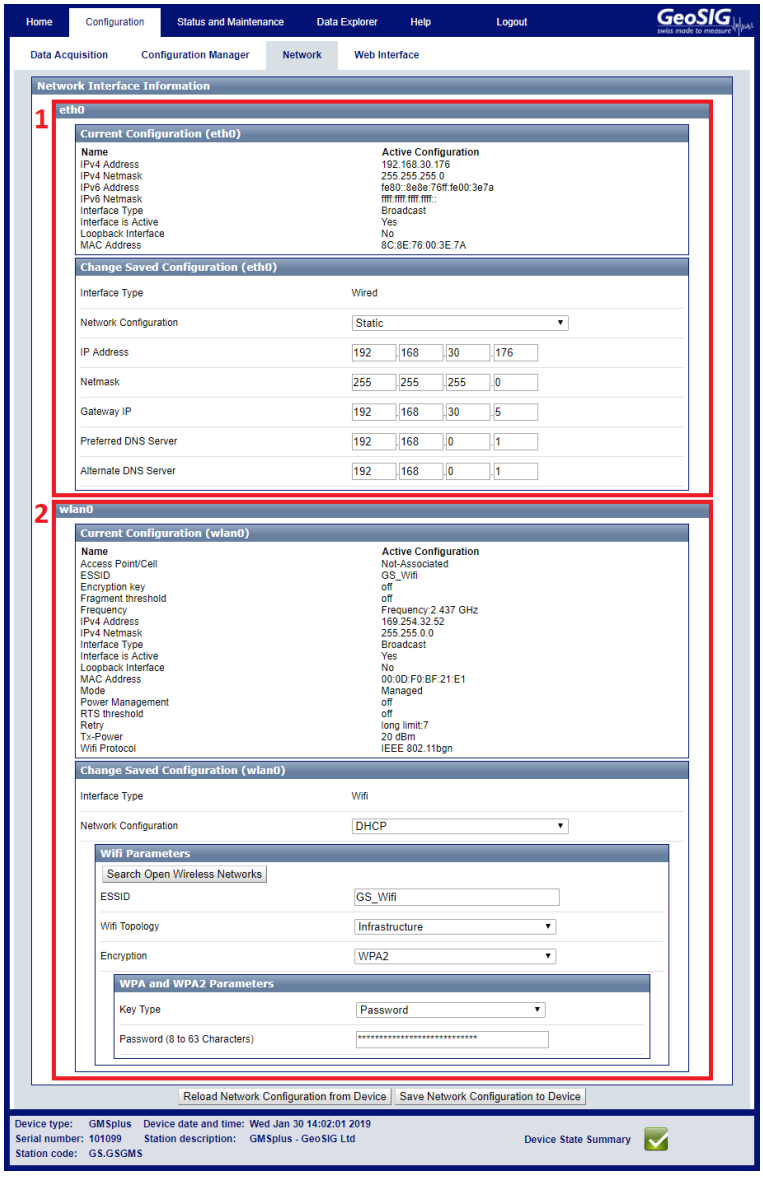


Figure 44: Network Configuration Screen

8.3.4 Web Interface Configuration

The *Web Interface Configuration* screen allows configuring all settings related to the Web Interface. At the moment, this solely consists of the possibility of changing the password for the login. To change the password press ***Change Password***. The current password has to be known.

The default login credentials are:

- Username: admin
- Password: 123456

If the admin password is forgotten, please delete the webuser.txt file on the SD or CF card and restart the instrument to restore the default password.

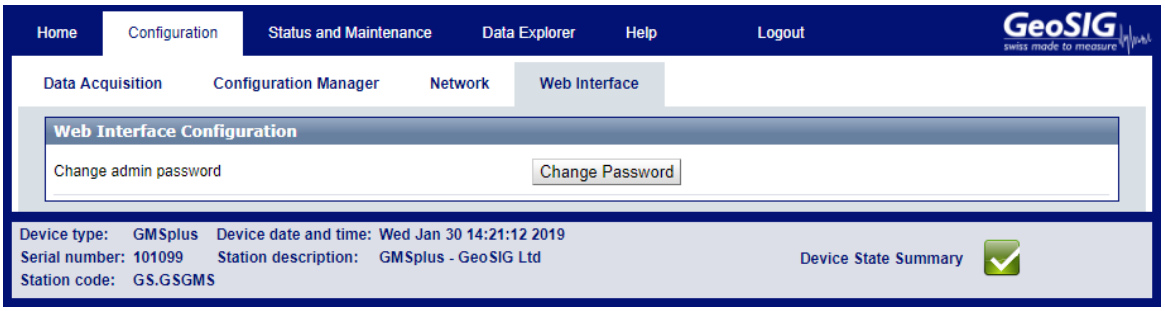


Figure 45: Web Interface Configuration Screen

8.4 State of Health

The State of Health (SOH) menu item provides all information related to the error status of the device as well as the status of the available hardware and software versions.

8.4.1 Error Status

As depicted in Figure 46, this screen provides basic information on the device at hand (area 2) as well as the error status for each module (area 3). The summary of this SOH information is visible at the bottom of each page as the Device State Summary, described in chapter 8.2. Additionally it is possible to download the State of Health information as a file in XML format – this is possible in all sub-menu items of the State of Health menu – and clear the errors (area 1).

Figure 46: Error Status Screen

The modules in area 3 can have one of the states defined in Table 7.

8.4.2 Recording Status

This screen provides all information on the recording and time synchronisation status of the device. As depicted in Figure 47, this screen contains information on the number of events, the timing and synchronisation status of the device, as well as information about the GPS quality and the GPS position of the instrument.

Figure 47: Recording Status Screen

8.4.3 Hardware Status

The ***Hardware Status*** provides such information as uptime, available disk space, the device temperature and so on. Information about the available hardware options in the instrument, such as Alarm Boards, Wi-Fi Modules and Modems can be found in the section ***Hardware Configuration Status***.

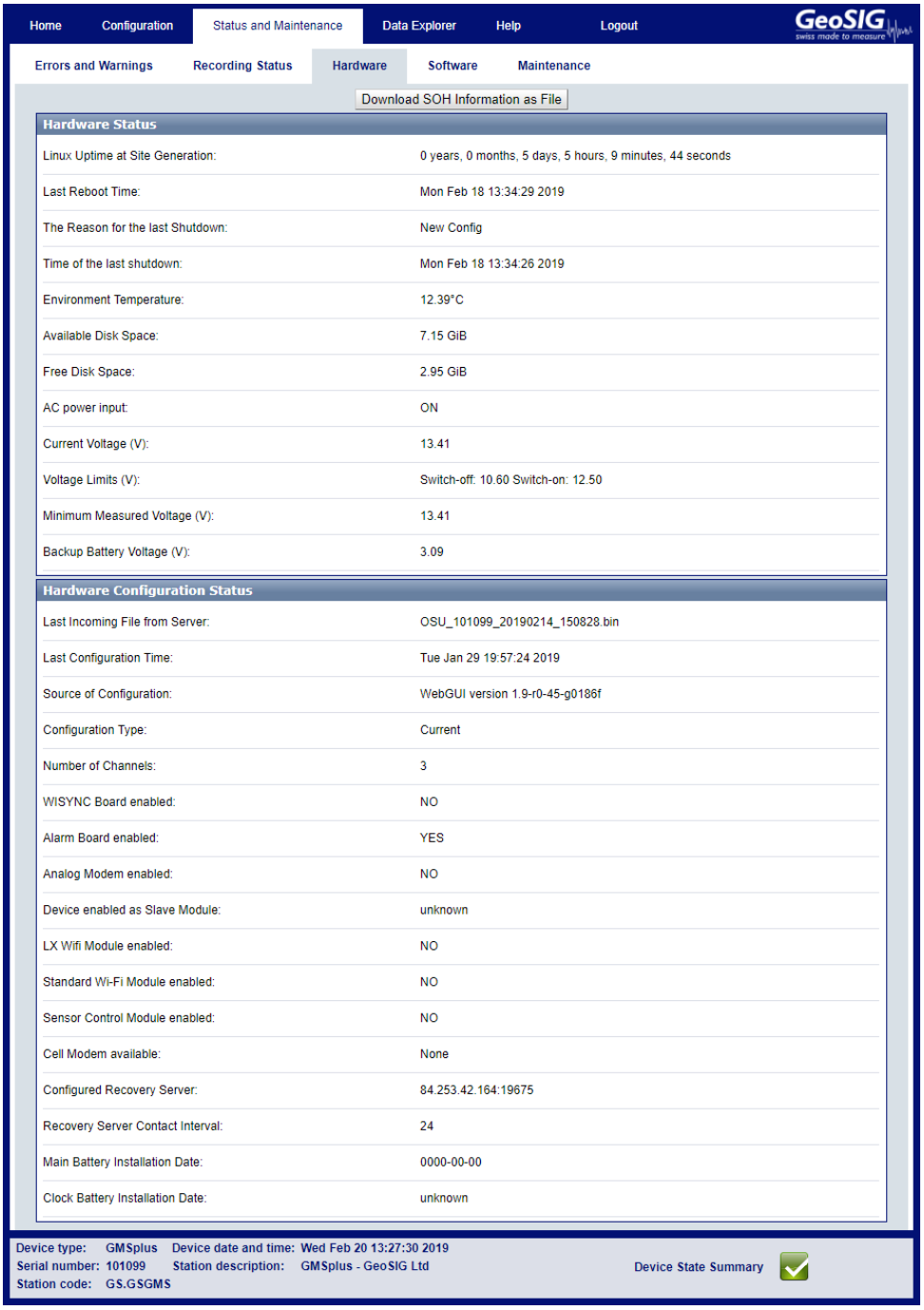


Figure 48: Hardware Status Screen

8.4.4 Software Status

The Software Status screen contains information on the ***Software Versions***.

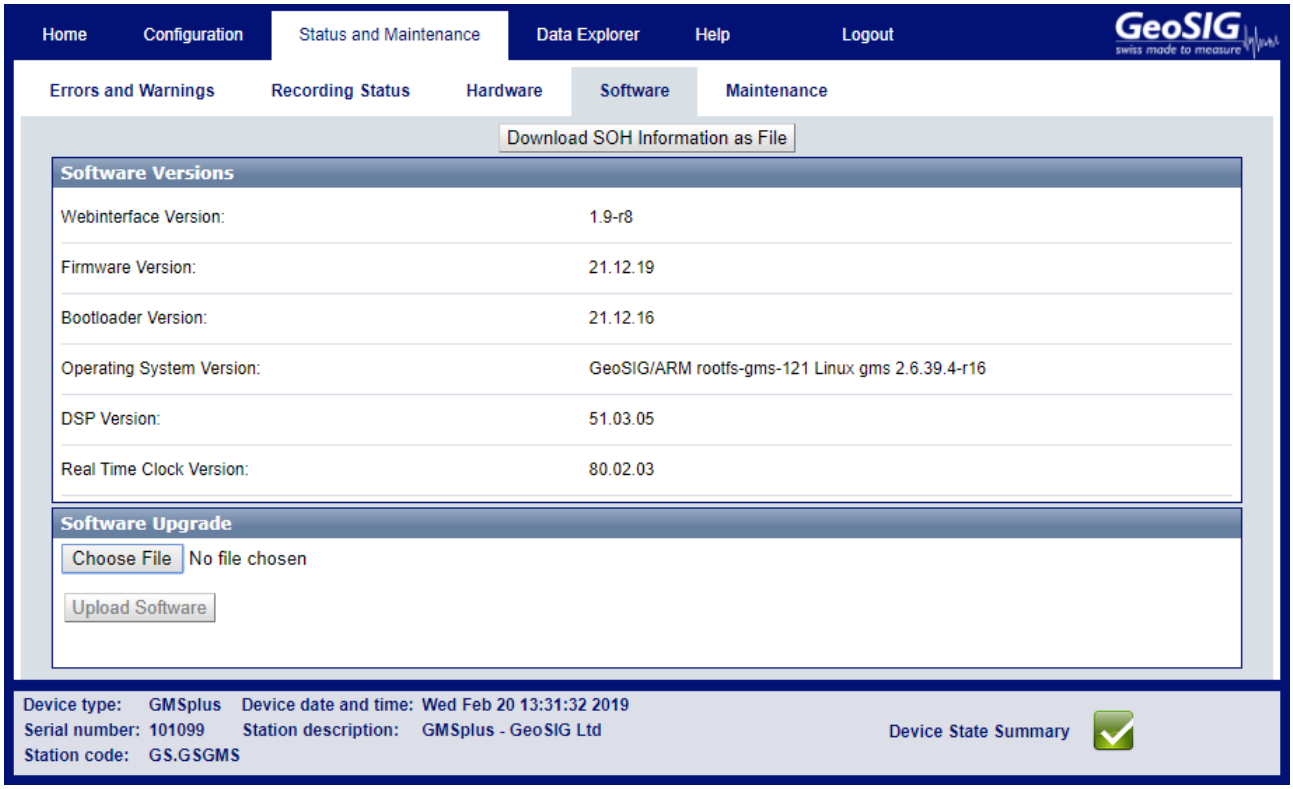


Figure 49: Software Status Screen

The section ***Software Upgrade*** allows to download firmware directly through the Web Interface.

- Click on ***Choose File***, select a firmware to upgrade and click on ***Upload Software***.

8.4.5 Maintenance

As shown in Figure 50, the Maintenance screen enables manage the data file, start a trigger, get SOH file and sending signal-related requests to the data acquisition software.

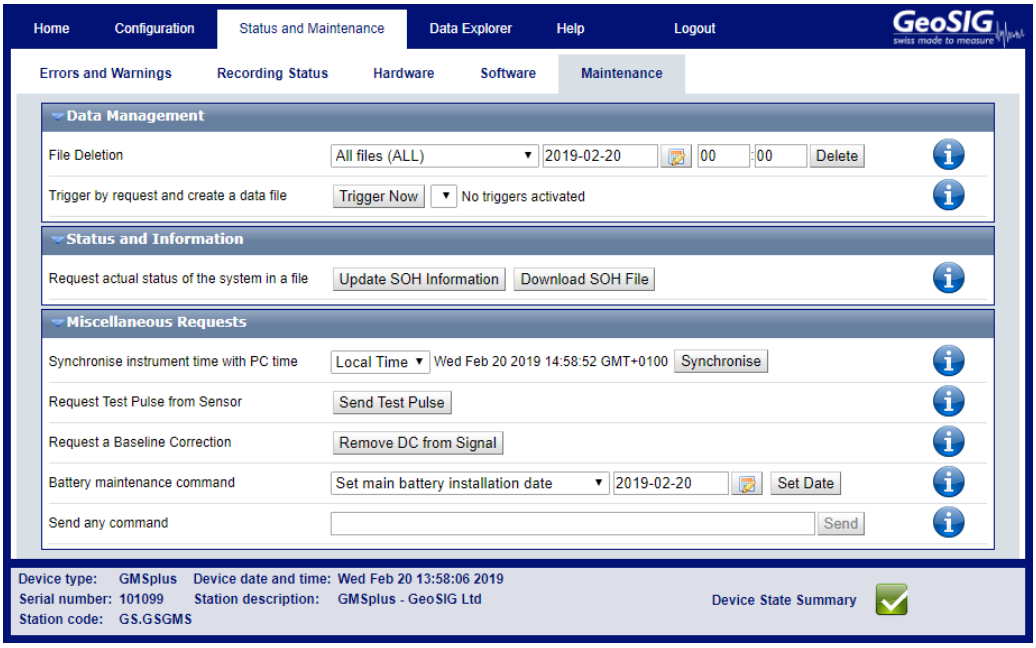


Figure 50: The Maintenance Screen

The ***Data Management*** allows to manage the files and start a trigger

- **File deletion** allows to user to delete all or a specific type of file.
- **Trigger by request and create a data file** can start a trigger by click on ***Trigger Now***.

The ***Status and information*** allows to update or download the SOH file.

- **Request actual status of the system in a file** allows to user to delete all or a specific type of file. It sends a request instrument to execute seflcheck and update its state of health. It may take a while to complete, and then you can download updated information in a SOH file.

The ***Miscellaneous Requests*** allows to do different tasks:

- **Synchronise instrument time with PC time:** If your instrument does not have a GPS and does not connect to NTP servers, you can set its time from your browser. The method is not very precise.
- **Send a Test Pulse:** By sending this request, a test pulse will be executed. The sensor should then respond accordingly and thus provide information about its status.
- **Remove DC from Signal:** By sending this request, a baseline correction will be applied to the signal and therefore remove the DC from the value, caused by e.g. a slight misalignment of the sensor.
- **Battery maintenance command:** if your instruemnt has internal battery, you must update this information every time when you replace it.
- **Send any command:** Type any known command supported by firmware and press ***Send***.

If the Seismometer Control option is available, it is possible to control the mass from this window as well as can be seen in Figure 51. The following commands are supported:

- **Lock:** Locks the seismometer.
- **Unlock:** Unlocks the seismometer. After unlocking, the sensor automatically centres its mass.
- **Center:** Centring of the mass

During all controls, the field *Current Mass Position* shows current pass positions of the channels East-West, North-South and Vertical in mV. Feedback about the progress and status information can be found under *Seismometer Control Output*.

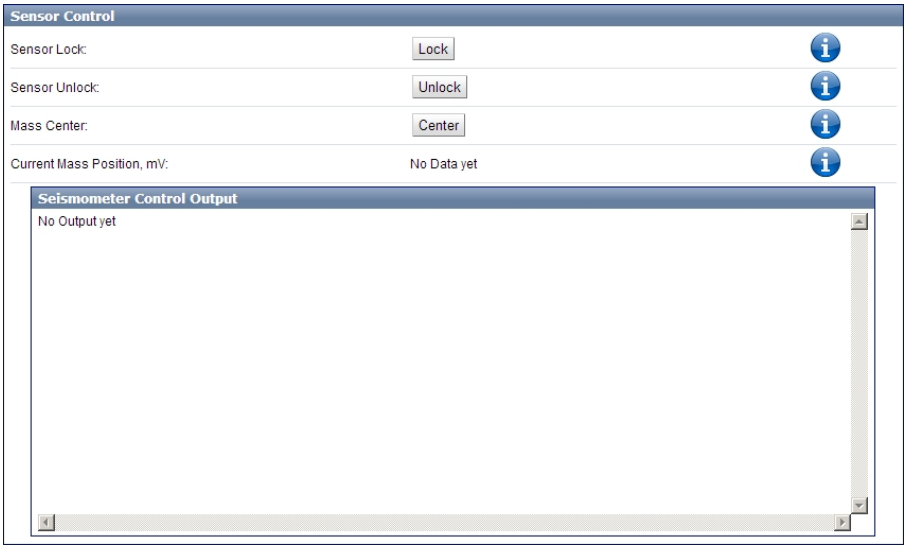


Figure 51: Seismometer Control

8.5 Data Explorer

The Data Explorer provides the possibility to gather information on the files stored on the SD or CF card. The file types are separated into three different file types:

- Automatically Detected Events (Event- and Calibration files)
- Manually Triggered Events and Request Data (Event- and Calibration files)
- Status and Information (SOH- and Log-files)
- Ringbuffers (Ringbuffer files)

With the menu at the top of the Data Explorer it is possible to switch between the file types listed above. For each listed file, the information on its file size and the last modification time are displayed. The files can be sorted according to the file name, size or modification date. By clicking on the file name, the file can be downloaded.

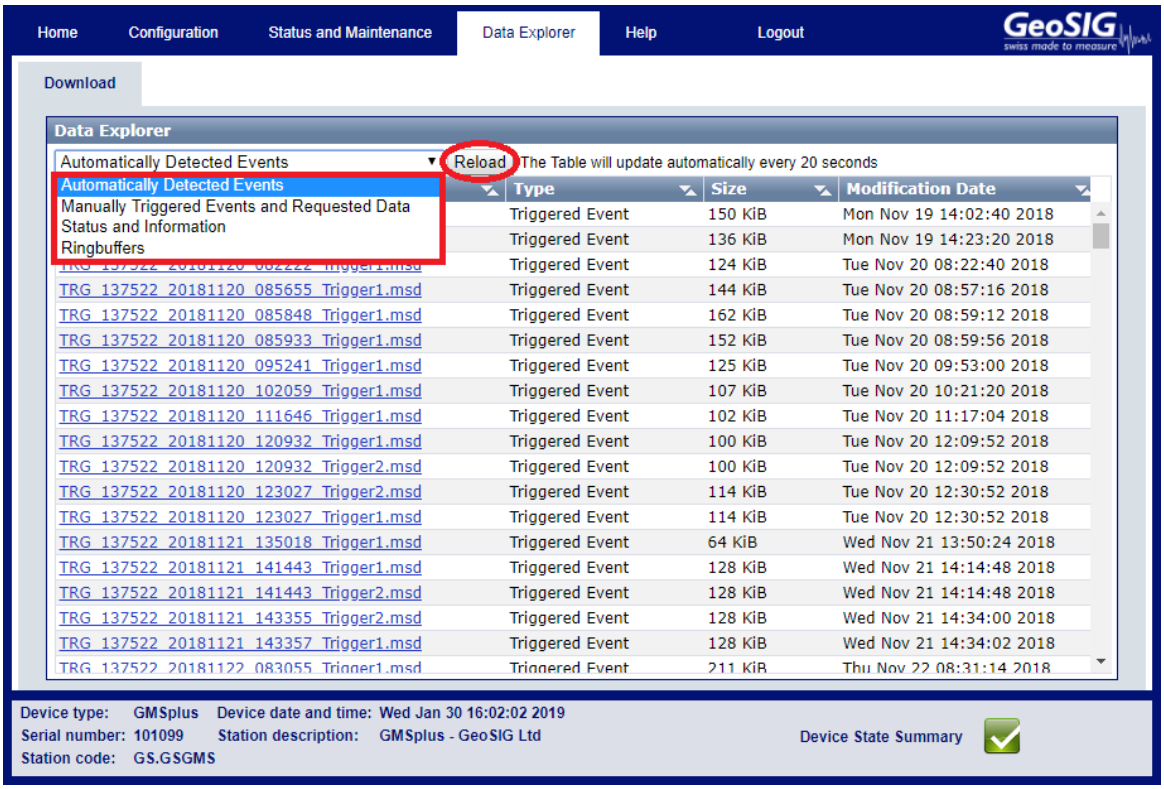


Figure 52: The Data Explorer Screen

8.6 Help

The Help Menu provides help if there are any problems with the device or the Web Interface.

8.6.1 Online Help

On this screen, the current version of the GMS[plus]User Manual can be downloaded from the device. This manual contains additional information on the instrument, which is not provided in the interface itself.

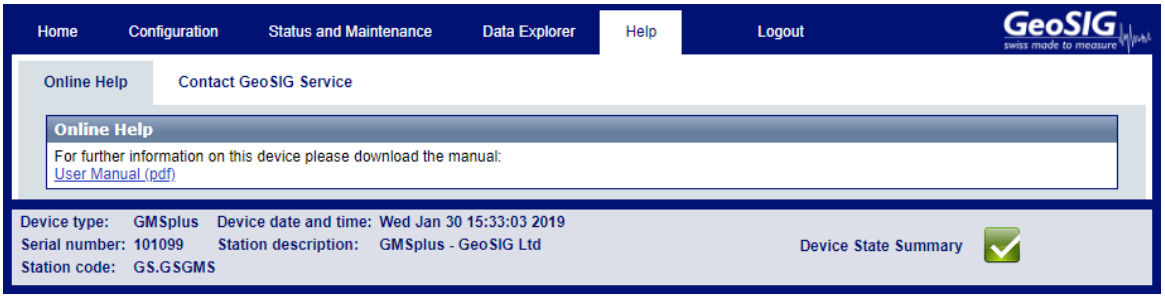


Figure 53: Download the GMS[plus]User Manual

8.6.2 Contact GeoSIG Service

This screen provides information on how to contact GeoSIG service in the case of problems. The links provided on this screen will only work if access to the Internet is available.

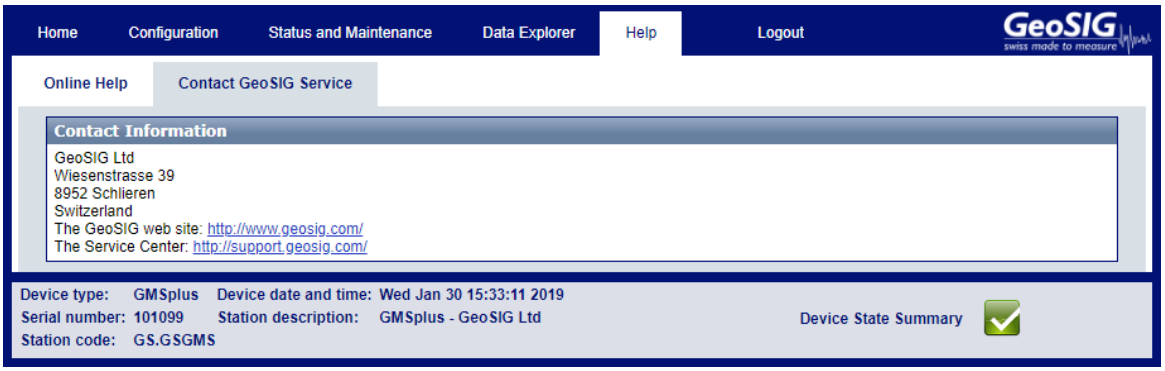


Figure 54: Contact information

9 Detailed Configuration of the Instrument

9.1 Switch ON and OFF the Instrument

The main power switch operates as follows:

- Open the housing lid of the instrument by removing the four screws in the corners.
- Press the *POWER* button for 2 seconds to switch the instrument **ON**.
- The *SYSTEM* indicator changes to solid white indicating that Linux OS is starting up and then it is flashing white indicating that the data acquisition software is starting up. If *POWER* indicator is flashing red instead, the instrument is not turning on because of low battery voltage. If *SYSTEM* indicator is flashing red instead, the instrument is not turning on because of high temperature (See Table 1 for details). It is possible to force the instrument to turn on neglecting the battery voltage and the temperature by pressing the *POWER* button for 10 seconds.
- To turn the instrument **OFF**, press the power button for a minimum of 2 seconds and wait for the operating system to shutdown properly. It is possible to force an immediate power off by pressing the *POWER* button for 10 seconds.

9.2 General Comments to the Configuration

All the configuration changes can be done either over the network by the Web Interface and GeoDAS or on the instrument itself using a standard Micro USB patch cable on the internal Micro USB connector and a terminal program.

9.2.1 Change Configuration by the Web Interface

- Open an Internet browser and enter the IP address of the device in the address bar of your browser.
- Login with the username: *admin* and the password: *123456*

See chapter 8 for the full explanation of the Web Interface.

9.2.2 Change Configuration by GeoDAS

- In the window *Stations: General Information* make a ***right click*** on the station name.

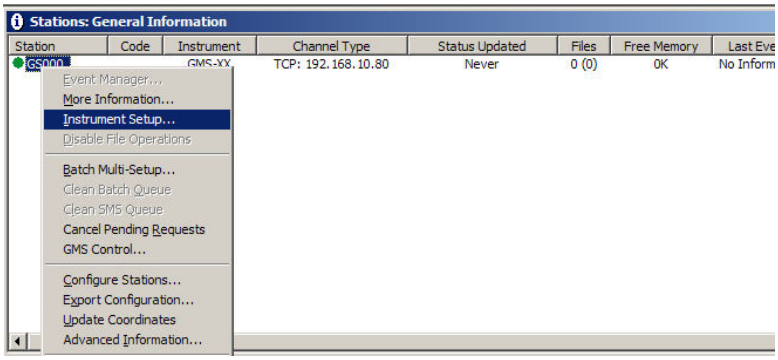


Figure 55: Instrument setup

- GeoDAS is opening the default Internet browser. The Web Interface of the instrument will appear. See chapter 8 for the full explanation of the Web Interface.

9.2.3 Changing Configuration by the Console

- Connect the GMS^{plus} to a serial port of your computer and switch on the instrument if not already done.
- In GeoDAS go to ***Tools*** → ***Terminal...*** and choose your COM Port. As Baud rate select ***115200***. Then Press ***Connect***. Any terminal application of your choice can be used alternatively.
- Press ***<Enter>*** the following menu appears:

```
Main menu:
C - Configuration
M - Messages ->
S - Shell command
L - List firmware images
X - Display errors (0) and warnings (0)
W - Clear errors and warnings
F - View/reset RTC trim values
T - File statistics
G - View RTC status
P - View GPS information
H - Set RTC time
U - User request
R - Restart
Q - Quit
```

- To configure armdas, from GMS^{plus} console, press **'C'** and ***<Enter>***. If you are asked, select ***Edit current configuration***, by pressing **'C'** again.
- Change the configuration as described in the following chapters, always type first the desired function and confirm with <Enter>.
- Press ***<Esc>*** to leave the configuration menu. If asked, select ***save as current configuration***, by pressing **'C'**

9.2.4 Explanation of the Structure in the Manual

As the parameters in the configuration sometimes depend on each other, not all parameters are shown all the time. The configuration is also sorted in several sub-menus. Therefore the menu is explained as following:

Parameter in the menu			***Possible selections*** or 'User selectable'	Explanation
Switch-Parameter			***Possible selections*** or 'User selectable'	Explanation: The following three lines depend on the selection and are only visible if not set to **'No'**
	This Parameter is only visible if Switch-Parameter has been set to Yes		***Possible selections*** or 'User selectable'	Explanation
	This Parameter is only visible if Switch-Parameter has been set to Yes		***Possible selections*** or 'User selectable'	Explanation
	Submenu, only visible if Switch-Parameter has been set to Yes	***Parameter in the Submenu***	***Possible selections*** or 'User selectable'	Explanation
		Parameter in the Submenu	***Possible selections*** or 'User selectable'	Explanation
Submenu	***Parameter in the Submenu***		***Possible selections*** or 'User selectable'	Explanation
	Parameter in the Submenu		***Possible selections*** or 'User selectable'	Explanation
	Switch-Parameter in the Submenu		***Possible selections*** or 'User selectable'	Explanation
		This Parameter is only visible if Switch-Parameter has been set to Yes	***Possible selections*** or 'User selectable'	Explanation

Table 8: Explanation table structure

9.3 Configuration of the Channels

9.3.1 In the Web Interface or by GeoDAS

- In the field ***Configuration*** → ***Number of Channels*** the total number of channels must be configured first.

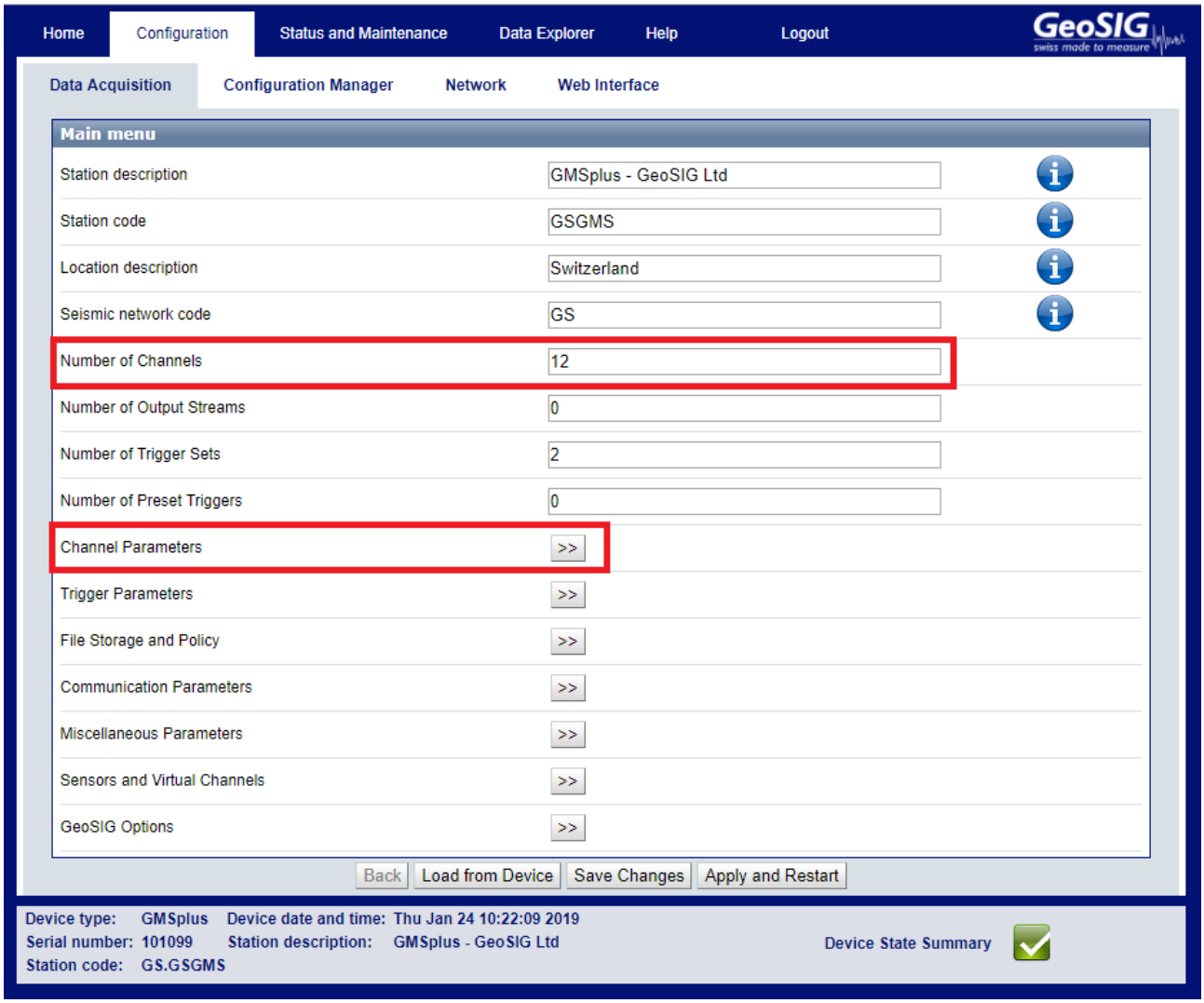


Figure 56: Configure Number of Channels

- Go to ***Configuration*** → ***Channel Parameters*** to edit the channel parameters. See Table 9 for additional information.

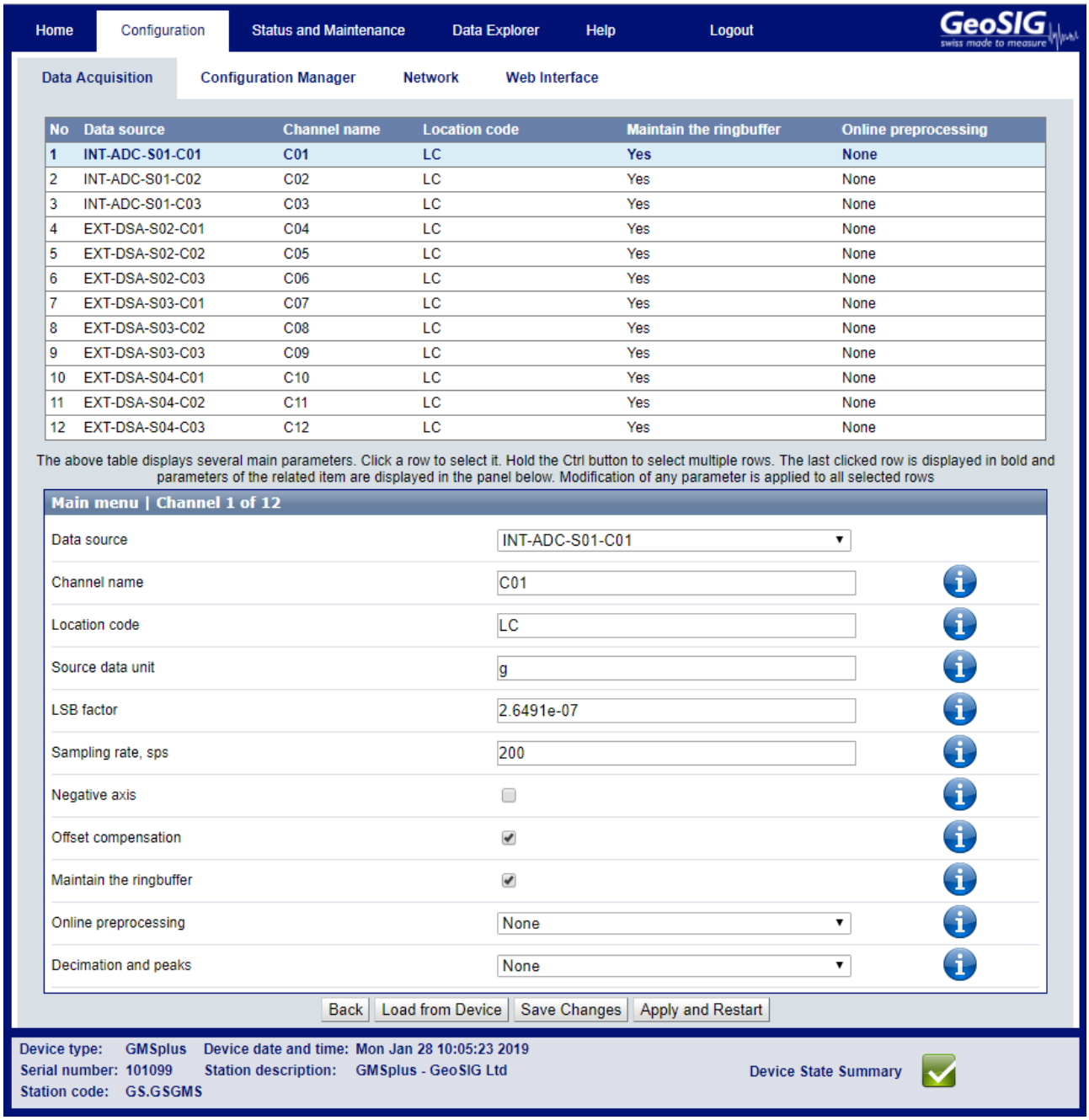


Figure 57: Edit Channel Parameters

9.3.2 Via Local Serial Console

- Press ***'E'*** to select the number of channels. By default three channels are configured as most sensors have three channels normally.

```
Configuration
  A) Station description ............. GeoSIG Station
  B) Station code .................... GSGMS
  C) Location description ............ Default location
  D) Seismic network code ............ GS
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 0
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 0
  I) Channel Parameters .............. ->
  K) Trigger Parameters .............. ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- Press ***'I'*** to get to the *Channel Parameters* menu to adjust the settings of the channels. The following menu appears:

```
Configuration | Channel 1 of 3
  A) Data source ..................... INT-ADC-S01-C01
  E) Channel name .................... C01
  F) Location code ................... LC
  G) Source data unit ................ g
  H) LSB factor ...................... 2.50986e-07
  I) Sampling rate, sps .............. 1000 (0x3E8)
  K) Negative axis ................... No
  L) Offset compensation ............. Yes
  N) Maintain the ringbuffer ......... Yes
  O) Online preprocessing ............ None
  S) Decimation and peaks ............ None
```

- Each channel can be adjusted according to your wishes. To change the channels press ***'+'*** or ***'-'***. The following parameters can be adjusted:

'+' and ***'-'*** can be used to change between the channels			
Data source		The source of the channel can be defined	
		INT-ADC-Sxx-Cxx	See chapter 9.3.4
		EXT-ADC-Sxx-Cxx	
		DATACHAN	Virtual channels
		DATAVSUM	Vector sum of two channels
		DATAVSU3	Vector sum of three channels
	Source channel name	User selectable	The source of the virtual channel can be any other channel
	Second source channel	User selectable	In case of the vector sum a second or third source has to be selected
	Third source channel	User selectable	
Channel name		User selectable	The channel name in the record is a combination of the location code and channel name
Location code		User selectable	
Source data unit		User selectable	Data unit of the selected channel
LSB factor		User selectable	LSB factor, depending on the connected sensor. See chapter 9.3.3 for details and Table 10 for the specific values of the sensors.
Sampling rate, sps		***50, 100, 200, 250, 500, 1000****	Sampling rate of the selected channel * 1000 SPS only valid with 3 channels or less.
Negative axis		***Yes***	Inversion of the axis is enabled
		No	Inversion of the axis is disabled
Offset compensation		***No***	Compensation is disabled, fill out offset value
		Yes	Compensation is enabled
	Fixed offset value (units)	User selectable	If ***No*** is selected, this value will be deducted at all time from the recorded sensor signal. This is helpful if the sensor produces a fixed, static offset which is present all the time.
Maintain ringbuffer		***Yes***	Permanent recording is enabled
		No	Permanent recording is disabled
Online processing		***None***	No online processing
		Filtering	Use an online filtering with filter parameters
		Integration	Use an online integration with filter parameters
		Double-integration	Use an online double-integration with both filters parameters
		Pre-filtering	Use an online pre-filtering with filter parameters
	Filter parameters ***Filter type***	***Highpass***	A Highpass will attenuate all frequencies below a defined frequency.
		Lowpass	A Lowpass will attenuate all frequencies above a defined frequency.
		Bandpass	A Bandpass will attenuate all frequencies below a defined frequency and above a defined frequency.
	Filter order	User selectable	Defines how much the attenuation increases per decade below the Low Frequency Corner respectively above the High Frequency Corner. The attenuation increases by the filter order multiplied with 20 dB. User can choose between these values: [2-4-6-8-10-12]

Filter parameters	***Flow, Hz***	User selectable	The Low Frequency Corner of the filter is the point where the attenuation is 3 dB. Below this frequency, attenuation will increase depending on the Filter Type
	Fhigh, Hz	User selectable	The High Frequency Corner of the filter is the point where the attenuation is 3 dB. Above this frequency, attenuation will increase depending on the Filter Type
Second filter parameters	***Filter type***	***Highpass***	A Highpass will attenuate all frequencies below a defined frequency.
		Lowpass	A Lowpass will attenuate all frequencies above a defined frequency.
		Bandpass	A Bandpass will attenuate all frequencies below a defined frequency and above a defined frequency.
	Filter order	User selectable	Defines how much the attenuation increases per decade below the Low Frequency Corner respectively above the High Frequency Corner. The attenuation increases by the filter order multiplied with 20 dB. User can between this value: 2-4-6-8-10-12
	Flow, Hz	User selectable	The Low Frequency Corner of the filter is the point where the attenuation is 3 dB. Below this frequency, attenuation will increase depending on the Filter Type
	Fhigh, Hz	User selectable	The High Frequency Corner of the filter is the point where the attenuation is 3 dB. Above this frequency, attenuation will increase depending on the Filter Type
Post-integration filtering		***Yes***	The post-integration is enabled
		No	The post-integration is disabled
Processing data unit		User selectable	This will often be identical to the 'Unit of the data', but may differ if e.g. an integration is performed.
Decimation and peaks		***None***	No decimation
		Decimation	Additional down sampling of the data
		Peak Values	Peak values of the data within a certain interval
		Average Values	Average values of the data within a certain interval
Decimation factor		User selectable	The signal will be decimated by the selected factor. E.g. if the sample rate is 50 and the decimation factor 10, then the output sample rate is 5 SPS. Be aware that no anti-aliasing filtering is done prior to decimation!
Interval of calculation, sec		User selectable	The Peak or Average values of the signal within the time defined in the Interval of averaging will be written into the ringbuffer with the specified Output sampling interval in [seconds]. Interval of averaging should be equal or higher than the Output sampling interval.
Output sampling		User selectable	The Peak or Average values of the signal within the time defined in the Interval of averaging will be written into the ringbuffer with the specified Output sampling interval in [seconds]. Interval of averaging should be equal or higher than the Output sampling interval.

Table 9: Channel configuration menu structure

9.3.3 Calculation of the LSB factor

This section defines the calculation of the LSB value for the GMS[plus] that has to be configured in the Channel Parameters.

In the Web Interface, the conversion from LSB to Full Scale and backwards is done automatically. In case the instrument is configured over GeoDAS or the console, the LSB value must be entered.

9.3.3.1 Overview

The LSB values of all GeoSIG sensors for the GMS[plus] can be found in the following table

Sensor type	Full Scale	Output Voltage Range	LSB
AC-xx	+/-0.5 g	+/- 10 V	0.662’274e-7 g/count
	+/- 1 g	+/- 10 V	1.324’548e-7 g/count
	+/- 2 g	+/- 10 V	2.649’095e-7 g/count
	+/- 3 g	+/- 10 V	3.973’643e-7 g/count
	+/- 4 g	+/- 10 V	5.298’191e-7 g/count
VE-13 VE-23	1 mm/s	+/- 10 V	1.324’548e-7 mm/s/count
	10 mm/s	+/- 10 V	1.324’548e-6 mm/s/count
	100 mm/s	+/- 10 V	1.324’548e-5 mm/s/count
VE-33	**Sensitivity:** 27.3 V/m/s (27.3 V/m/s)		4.851’822e-8 m/s/count 4.851’822e-5 mm/s/count
VE-53	**Sensitivity:** 1000 V/m/s (2x 500 V/m/s)		1.324’548e-9 m/s/count 1.324’548e-6 mm/s/count
	Sensitivity: 200 V/m/s (2x 100 V/m/s)		6.622’738e-9 m/s/count 6.622’738e-6 mm/s/count

Table 10: LSB of all GeoSIG sensors

If you have a different kind of sensor, the LSB can be calculated according to the following chapters.

9.3.3.2 Calculate LSB from Sensors with given Full Scale

Output Voltage of the sensor and input range of the recorder is +/- 10 V (GeoSIG Standard)

$$LSB = \frac{FullScale}{0.9 \cdot 2^{23}} = \frac{FullScale}{7\,549\,747.2}$$

Example, 3 g sensor

$$LSB = \frac{3\,\mathrm{g}}{0.9 \cdot 2^{23}\,\mathrm{counts}} = \frac{3\,\mathrm{g}}{7\,549\,747.2\,\mathrm{counts}} = 3.973\,643\mathrm{e}{-7}\,\mathrm{g/count}$$

Output Voltage of the sensor and input range of the recorder is <u>not</u> +/- 10 V

$$LSB = \frac{FullScale}{0.9 \cdot 2^{23}} \cdot \frac{RecorderFullScale(V)}{SensorFullScale(V)}$$

Example, 3 g sensor

$$LSB = \frac{3\,\mathrm{g}}{0.9 \cdot 2^{23}\,\mathrm{counts}} \cdot \frac{10\,\mathrm{V}}{2.5\,\mathrm{V}} = 1.589\,457\mathrm{e}{-6}\,\mathrm{g/count}$$

9.3.3.3 Calculate LSB from Sensors with given Sensitivity

Input range of the recorder is +/- 10 V (GeoSIG Standard)

$$LSB = \frac{\frac{RecorderFullScale(V)}{Sensitivity}}{0.9 \cdot 2^{23}\,\mathrm{counts}} = \frac{\frac{10\,\mathrm{V}}{Sensitivity}}{0.9 \cdot 2^{23}\,\mathrm{counts}} = \frac{1.324\,547\mathrm{e}{-6}\,\frac{\mathrm{V}}{\mathrm{count}}}{Sensitivity}$$

Example, 1000 V/m/s sensor

$$LSB = \frac{\frac{10\,\mathrm{V}}{1000\,\frac{\mathrm{V}}{\mathrm{m/s}}}}{0.9 \cdot 2^{23}} = \frac{1.324\,547\mathrm{e}{-6}\,\frac{\mathrm{V}}{\mathrm{count}}}{1000\,\frac{\mathrm{V}}{\mathrm{m/s}}} = 1.324\,547\mathrm{e}{-9}\,\frac{\mathrm{m}}{\mathrm{s}}\mathrm{/count}$$

9.3.4 Channel Naming

The naming of the channels is organised as following: all internal sensors start with **INT-ADC**, all external sensors with **EXT-ADC**.

xxx-ADC-Syy-Czz			
xxx	Source	INT	Internal Sensor
		EXT	External Sensor
yy	Sensor	3ch: S01	
		6ch: S01,S02	
zz	Channel	C01 . . . C03	

For example if there are two external sensors connected, the following channels are available:

EXT-ADC-S01-C01	EXT-ADC-S02-C01
EXT-ADC-S01-C02	EXT-ADC-S02-C02
EXT-ADC-S02-C03	EXT-ADC-S02-C03

9.4 Configuration of Data Streams

9.4.1 In the Web Interface or by GeoDAS

- In the field ***Configuration → Number of Output Streams*** the total number of output streams must be configured first so that the ***Stream Parameters*** menu appears.

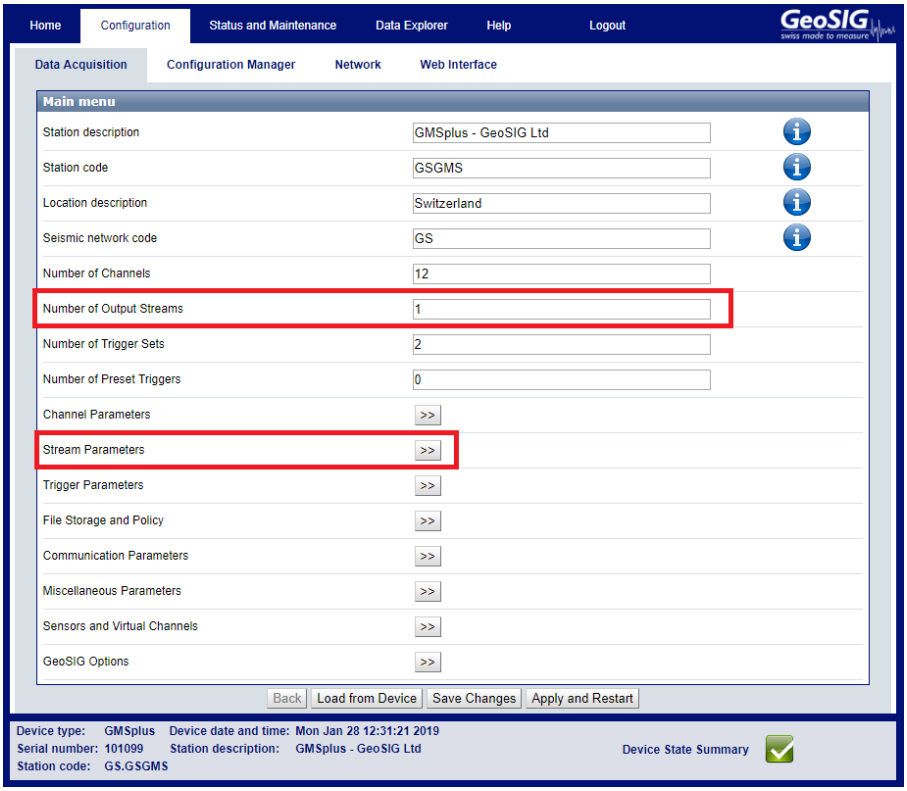


Figure 58: Configure number of Output Streams

- Go to ***Configuration → Stream Parameters*** to edit the stream parameters. See Table 11 for additional information.

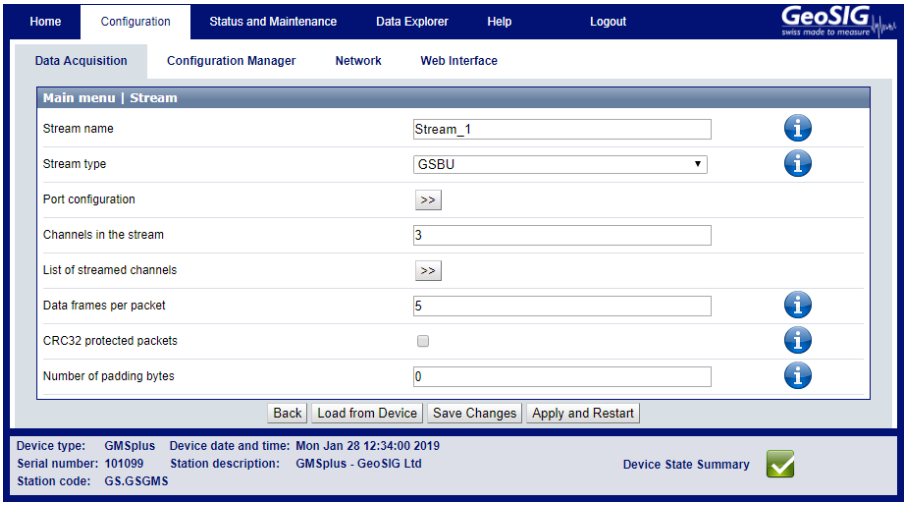


Figure 59: Edit Stream Parameters

9.4.2 Via Local Serial Console

- Press ***'F'*** to select the *Number of Output Streams*. One output stream can have several channels.

```
Main Menu
  A) Station description ..... Demo GMSplus
  B) Station code ..... DEMO
  C) Location description ..... Switzerland
  D) Seismic network code ..... CH
  E) Number of Channels ..... 3
  F) Number of Output Streams ..... 1
  G) Number of Trigger Sets ..... 1
  H) Number of Preset Triggers  ..... 0
  I) Channel Parameters ..... ->
  J) Stream Parameters ..... ->
  K) Trigger Parameters ..... ->
  M) File Storage and Policy ..... ->
  N) Communication Parameters ..... ->
  O) Miscellaneous Parameters ..... ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options ..... ->
```

- Press ***'J'*** to get to the *Stream Parameters* menu to adjust the settings of the output streams. The following menu appears:

```
Main Menu | Stream
  A) Stream name ..... Stream_1
  B) Stream type ..... GSBU
  C) Port configuration ..... ->
  D) Channels in the stream ..... 3
  E) List of streamed channels ... ->
  F) Data frames per packet ..... 5 (0x05)
  G) CRC32 protected packets ..... No
  H) Number of padding bytes ..... 0 (0x00)
```

- Each output stream can be adjusted according to your wishes. To change the output stream press ***'+'*** or ***'-'***. The following parameters can be adjusted:

'+' and ***'-'*** can be used to change between the channels			
Stream name		User selectable	Name of the output stream
Stream type		***GSBU***	Streaming possibly in GSBU format only
Port configuration	***Communication Port***	***TCP/IP***	Streaming over the network
	Protocol	***TCP(SERVER)***	GeoDAS software or any other client supporting the selected protocol connects to the IP address configured under 'IP Address' for data streaming
	Network Port	User selectable	Server port listening for incoming connections
	Baud Rate	***1200*** ***2400*** ***4800*** ***9600*** ***19200*** ***38400*** ***57600*** ***115200***	Baud rate of the serial data stream. Make sure that the serial port of the computer is configured to the same baud rate.
Channels in the stream		User selectable	Number of channels which should be streamed
List of streamed channels	***'+'*** and ***'-'*** can be used to change the channels		
	Assigned channel name	User selectable	Depending on the number of channels, for every channel a different source can be selected; the source can be selected by pressing ***'A'***.
Data frames per packet		User selectable	Specifies the packet length of the streams (one data frame is equal to 200 ms). For example if ***'5'*** is selected, then every second a packet with the last second of data will be sent.
CRC32 protected packets		***Yes*** ***No***	Enable CRC32 protection for the stream Disable CRC32 protection for the stream
Number of padding bytes		User selectable	Add the specified number of padding bytes to the stream

Table 11: Data streaming configuration menu structure

9.4.3 Set up of Data Streams

This chapter will describe how to set up an instrument for data streaming.

9.4.3.1 In the Web Interface or by GeoDAS

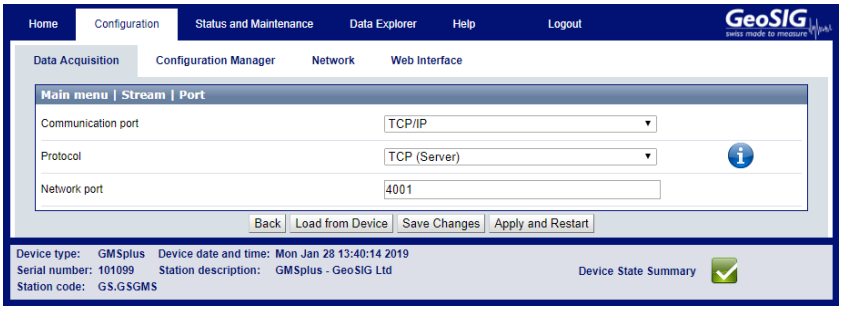
- Connect to the Web Interface and configure the number of the Data Streams in the field ***Configuration*** → ***Number of Output Streams***. One output stream can have several channels.
- Go to ***Configuration*** → ***Stream Parameters*** to adjust the settings of the output streams.

9.4.3.2 Via Local Serial Console

- Connect to the instrument and press ***'F'*** to select the *Number of Output Streams*. One output stream can have several channels.
- Press ***'J'*** to get to the *Stream Parameters* menu to adjust the settings of the output streams.
- Adjust the settings according to chapter 9.4. Carefully select the settings in the *Port Configuration*. If you want to stream over Ethernet, choose ***TCP/IP*** and ***TCP (Server)***.

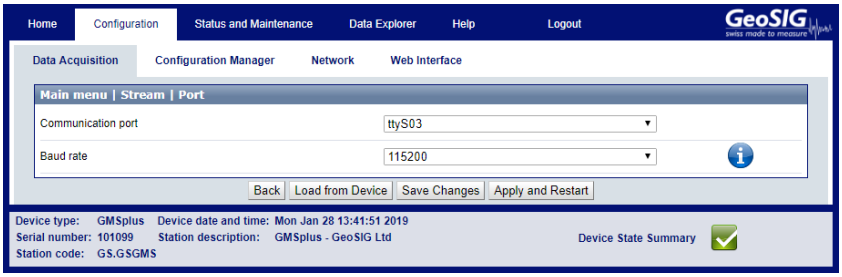
Not more than three channels could be streamed though the same port.
Important: If multiple streams are configured, they must have different **network ports**
(e.g. 4002 as default port is 4001)

```
Main Menu | Stream | Port
  A) Communication port ... TCP/IP
  C) Protocol ............. TCP (Server)
  E) Network port ......... 4001 (0xFA1)
```



- If you want to stream over the SERIAL port on the front of the instrument, choose ***ttyS03***.

```
Main Menu | Stream | Port
  A) Communication port ... ttyS03
  B) Baud rate ............ 115200
```



- Open ***GeoDAS*** and go to the menu ***Settings*** → ***Channels of Digitizers...*** The following window appears:
- Adjust the ***Name***, choose any three-letter code for the data stream
- Select as ***Type*** the ***GeoSIG Packet Digitizer***
- Press ***Add/Modify***
- Make sure the selected ***Sample rate*** is the same as in the instrument.

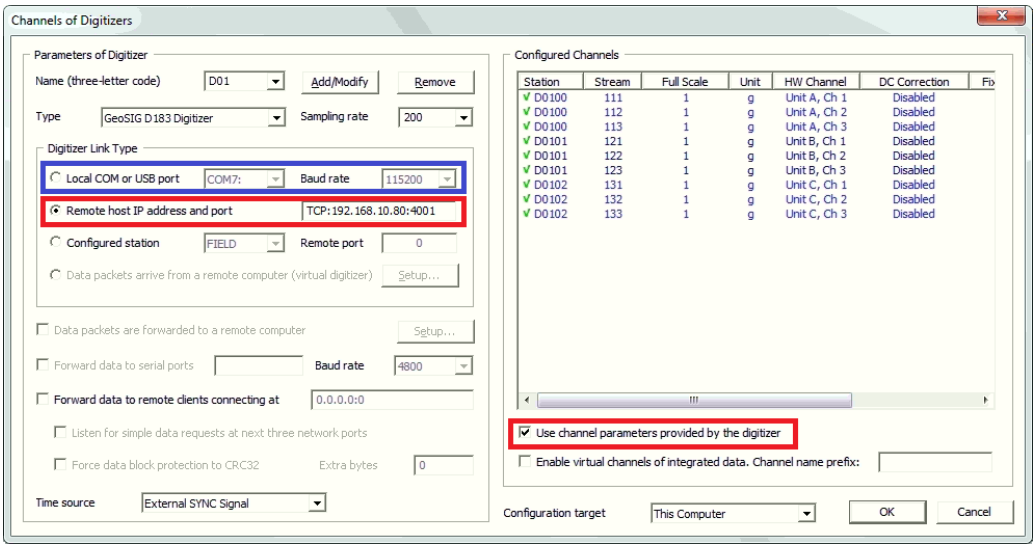


Figure 60: Channels of Digitizers

- Choose either the ***Local COM port*** (if connected over RS-232) or the ***Remote host IP address and port*** (if connected over Ethernet). The instrument's IP address must be known.
- Check the flag ***Use channel parameters provided by the digitizer.***
- Press ***OK.***
- After a restart of *GeoDAS*, the window *Stations: Data Streams appears:*

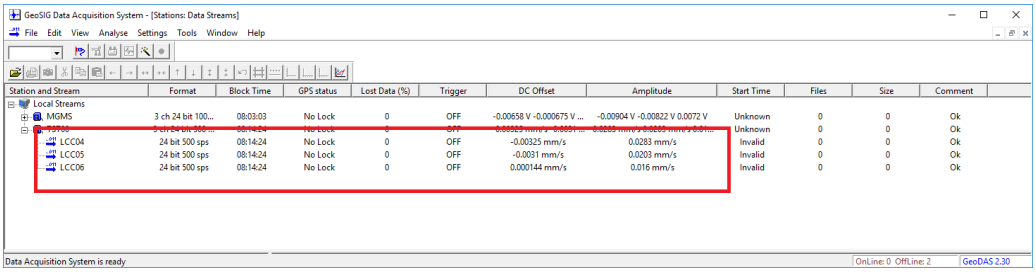


Figure 61: Stations: Data Streams

- To view the data make a right click on the station name (here TST00) and select ***Data Monitor***

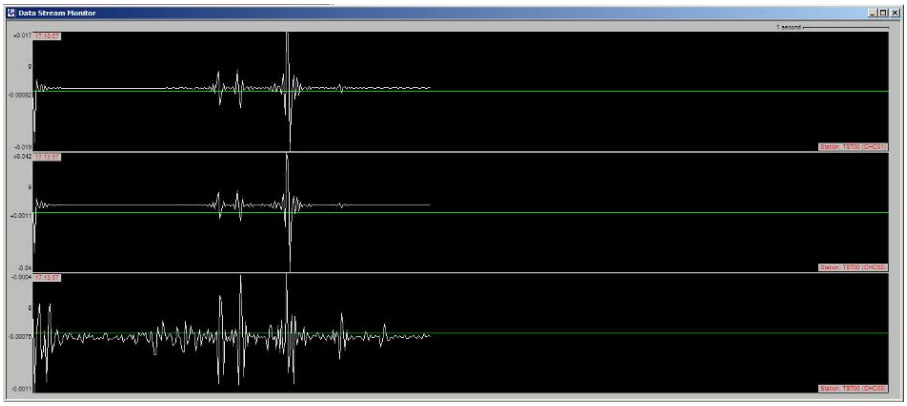


Figure 62: Data stream window

9.5 Trigger Settings

The instrument allows having several triggers with independent sources in parallel.

9.5.1 In the Web Interface or by GeoDAS

- Go to ***Configuration*** → ***Number of Trigger Sets*** and configure the number of the desired Trigger Sets.

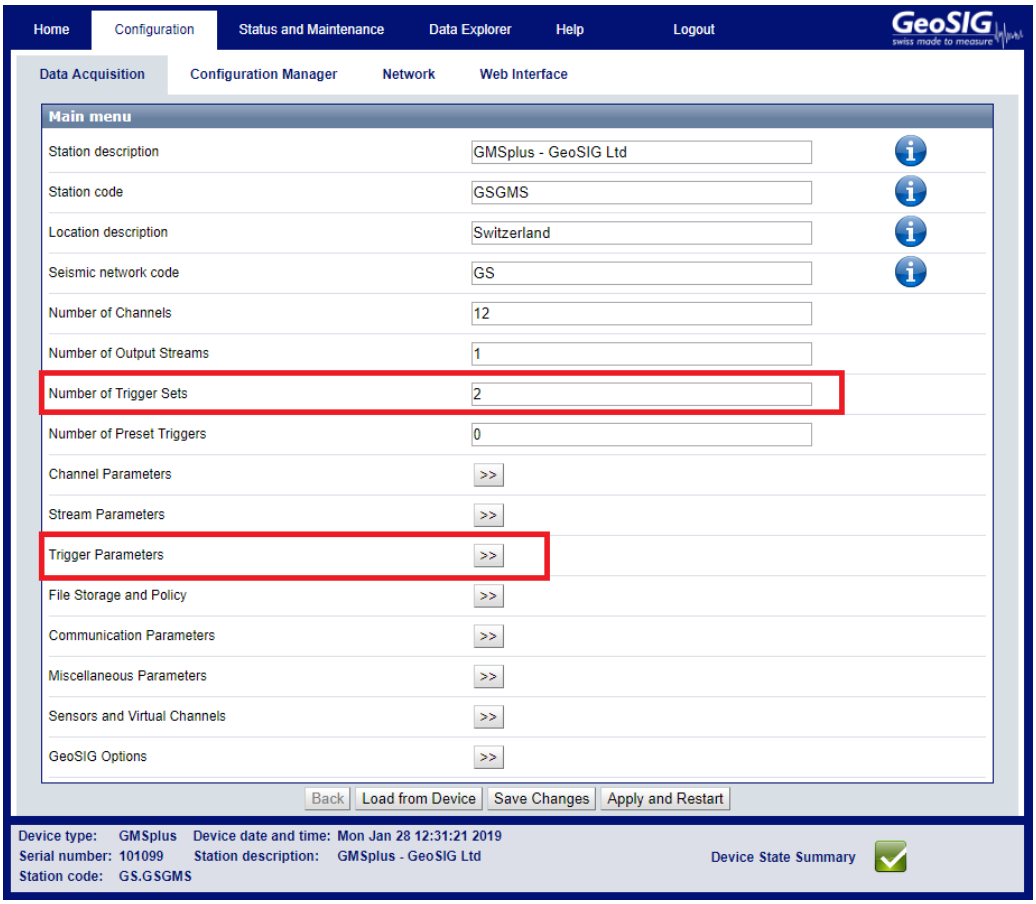


Figure 63: Trigger settings

- To edit a trigger go to ***Configuration*** → ***Trigger Parameters***. See Table 12 for additional information.

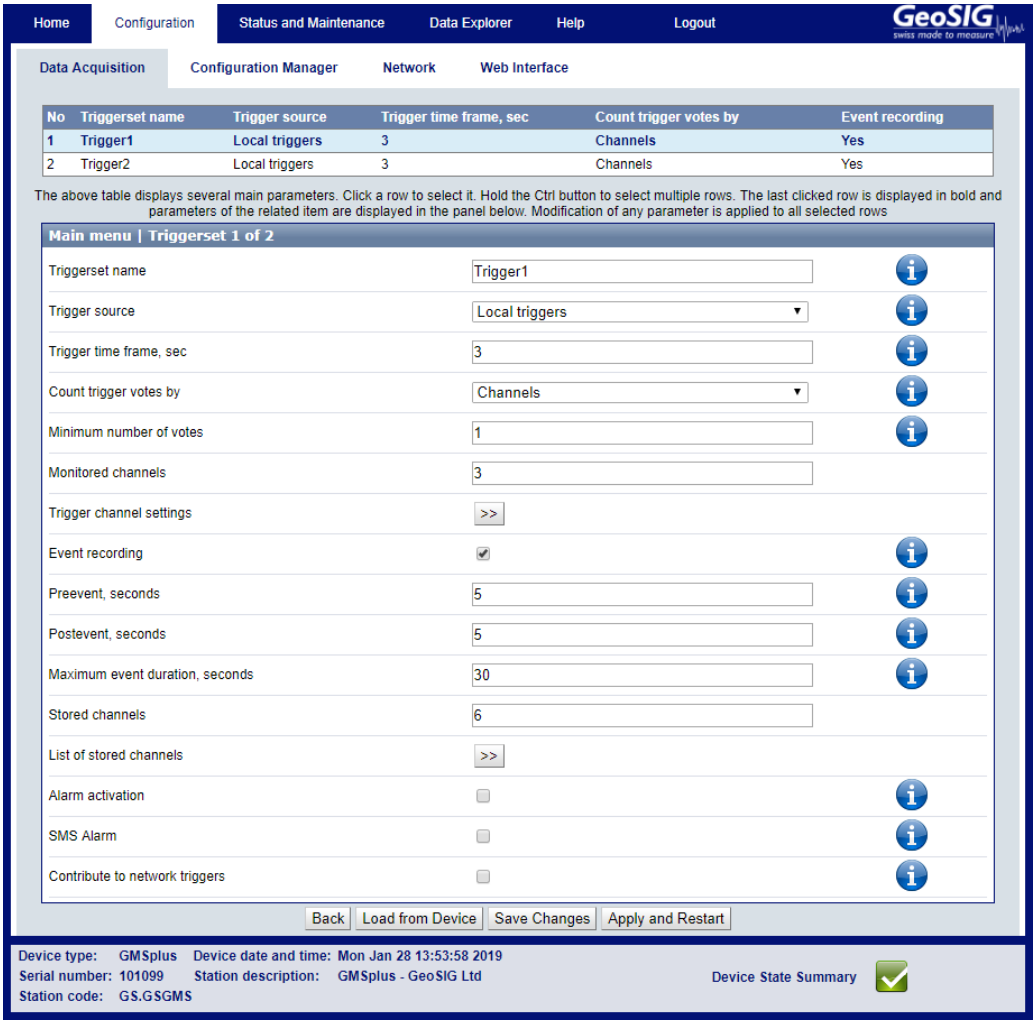


Figure 64: Edit Trigger Parameters

9.5.2 Via Local Serial Console

- Press ***'G'*** to select the *Number of Trigger Sets*

```
Main Menu
  A) Station description ..... Demo GMSplus
  B) Station code ..... DEMO
  C) Location description ..... Switzerland
  D) Seismic network code ..... CH
  E) Number of Channels ..... 3
  F) Number of Output Streams ..... 1
  G) Number of Trigger Sets ..... 1
  H) Number of Preset Triggers  ..... 0
  I) Channel Parameters ..... ->
  J) Stream Parameters ..... ->
  K) Trigger Parameters ..... ->
  M) File Storage and Policy ..... ->
  N) Communication Parameters ..... ->
  O) Miscellaneous Parameters ..... ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options ..... ->
```

- Press ***'K'*** to get to the *Trigger Parameters* menu to adjust the settings of the triggers. The following menu appears. In case the number of trigger sets is set to '0' this menu can not be selected.

```
Main Menu | Triggerset
  A) Triggerset name ..... Trigger1
  B) Trigger source ..... Local triggers
  D) Trigger time frame, sec ..... 3 (0x03)
  E) Count trigger votes by ..... Channels
  F) Minimum number of votes ..... 1 (0x01)
  G) Monitored channels ..... 9
  H) Trigger channel settings ..... ->
  J) Event recording ..... No
  R) Alarm activation ..... No
  V) SMS Alarm ..... No
  X) Contribute to network triggers ..... No
```

- Each trigger set can be adjusted according to your wishes. To change the trigger set press ***'+'*** or ***'-'***. The following parameters can be adjusted:

'+' and ***'-'*** can be used to change between the channels			
Triggerset name		User selectable	Name of the trigger set
Trigger time frame, sec		User selectable	See chapter 9.5.5 for details
Trigger source		***Network voting logic*** ***Local triggers***	Choose the trigger source
	Support triggers through Interconnection	***Yes*** ***No***	This recorder will broadcast a Network Trigger Alert (in case the instrument is interconnected over RS-485 with other instruments) as soon as this triggerset becomes active. No trigger through interconnection
	Serial numbers of networked instruments	User selectable	Whitespace or comma separated list of instruments which contribute to the Network voting logic.
	Contribute to network triggers	User selectable	If this option is active, this recorder will broadcast a Network Trigger Alert
	Monitored channels	User selectable	Number of channels which will be monitored by the selected trigger set
	Count trigger votes by	***Channels*** ***Channel weight*** ***Sensor*** ***Station***	Choose one trigger vote in this list
		Minimum number of votes	User selectable	Define the number of incoming network triggers of the same name that have to be observed in order to make this device trigger
Trigger channel settings	***Assigned channel name***		User selectable	Configure the first Data Source for this channel.
	Trigger filter		***Yes*** ***No***	Trigger filter is used as defined under Filter Parameters Trigger filter is not used
	Filter parameters	***Filter type***	***Highpass*** ***Lowpass*** ***Bandpass***	A Highpass will attenuate all frequencies below a defined frequency. A Lowpass will attenuate all frequencies above a defined frequency. A Bandpass will attenuate all frequencies below a defined frequency and above a defined frequency.
		Filter order	User selectable	Defines how much the attenuation increases per decade below the Low Frequency Corner respectively above the High Frequency Corner. The attenuation increases by the filter order multiplied with 20 dB. User can choose between these values: [2-4-6-8-10-12]
		Flow, Hz	User selectable	The Low Frequency Corner of the filter is the point where the attenuation is 3 dB. Below this frequency, attenuation will increase depending on the Filter Type
		Fhigh, Hz	User selectable	The High Frequency Corner of the filter is the point where the attenuation is 3 dB. Above this frequency, attenuation will increase depending on the Filter Type

Trigger channel settings (continued)	***Level Trigger***		***Yes*** ***No***	Level trigger is enabled Level trigger is disabled
		Threshold (channel units)	User selectable	As soon the data is above the configured threshold the trigger is activated
		Min. level exceedance, sec	User selectable	The threshold or STA/LTA ratio has to be exceeded at least for the configured time in seconds to active the trigger
	STA/LTA Trigger		***Yes*** ***No***	STA/LTA trigger is enabled STA/LTA trigger is disabled
		STA time frame, sec	User selectable	Length of STA time window, seconds
		LTA time frame, sec	User selectable	Length of LTA time window, seconds
		STA/LTA trigger ratio	User selectable	As soon the data is above the configured STA/LTA ratio the trigger is activated
		STA/LTA detrigger ratio	User selectable	As soon the data is below the configured STA/LTA ratio again the trigger is deactivated
		Min. ratio exceedance, sec	User selectable	The threshold or STA/LTA ratio has to be exceeded at least for the configured time in seconds to active the trigger
		Clamp LTA during event	***Yes*** ***No***	As soon the data is below the configured STA/LTA ratio again the trigger is deactivated
	Channel trigger weight, %		User selectable	See chapter 9.5.4 for details
Event recording			***Yes*** ***No***	An event file will be recorded on a trigger No event file will be recorded on a trigger
	Pre-event		User selectable	Pre-Event time, seconds
	Post-event		User selectable	Post-Event time, seconds
	Max. event duration, sec		User selectable	Maximum duration of an event in seconds. After this time, an event file will be closed
Event Processing			***PGM parameters*** ***No***	An event file will be processed and a summary report will be created The event file will not be processed
Stored channels			User selectable	Number of channels, which should be stored into an event file in case of a trigger
List of stored channels	*'+'* and *'-'* can be used to change the channels			
	Assigned channel name		User selectable	Depending on the number of channels, for every channel a different source can be selected; the source can be selected by pressing ***'A'***.

Alarm activation (Only visible in case alarm relay card is installed)		***Yes*** ***No***	An alarm relay will be activated on a trigger No alarm relay will be activated on a trigger This option has an effect only in case the instrument has internal alarm relays
	Alarm output to activate	***AL1, AL2,*** ***AL3*, AL4****	select the alarm output you want to activate in case of a trigger. (*) Not available in all models
	Alarm deactivation delay	User selectable	Time in seconds the alarm relay deactivates again after the signal falls below the trigger threshold. Can be compared to the post event time for the recording
	Alarm acknowledge	User selectable	Digital input to acknowledge and reset the alarm. See appendix A
	Send SOH upon alarm activation	***Yes*** ***No***	Defines whether a SOH information will be cre- ated and transferred to the server upon alarm deactivation
SMS Alarm		***Yes*** ***No***	An SMS will be sent upon a trigger No SMS will be sent upon a trigger
SMS Alarm Configuration	(This option is available only in case an external cellular modem is connected to the instrument.)		
	Number of Recipients	User selectable	The number of recipients of the SMS alarm can be selected
Recipient	***'+'*** and ***'-'*** can be used to change the channels		
	Recipient	User selectable	Phone number of the recipient. Use numbers only, no '+' or any other character allowed. The recipient can be selected by pressing 'A'.

Table 12: Trigger settings configuration menu structure

9.5.3 STA/LTA trigger

The STA/LTA (Short Time Average/Long Time Average) ratio trigger computes the short term and long term averages of the input (sensor) signal. When the STA exceeds a pre-selected multiple of the LTA (STA/LTA ratio), the instrument begins to record data. The advantage of this trigger type is that the trigger sensitivity adapts to the seismic background signal. With an increasing noise level the trigger sensitivity decreases. The probability of having a false trigger due to noise will be minimised if a long STA averaging time is selected. Obviously, the STA should not be chosen longer than the shortest event of interest. In addition, the STA should be shorter than the pre-event time. If not, the initial portion of an event may not be recorded. During the steady state of the system, the STA and the LTA will be nearly equal. The shorter STA averaging period, the more quickly it will change with the input.

9.5.4 Trigger Weight

To activate a trigger the total trigger weight must be equal or bigger than 100%. By default all channels have a weight of 100%, which means if a threshold is exceeded on one channel only, then the trigger is activated. If the trigger weight were reduced on all channels to 50%, then at least on two channels the threshold would have to be exceeded to reach 100% (50% + 50%) and activate the trigger. See Figure 65 for details.

9.5.5 Trigger Time Frame

Depending on the settings, it can be that threshold must be exceeded on two or more channels to activate the trigger. The time of the threshold-exceedances might be slightly different on the channels, especially if two

sensors are connected and installed on different places. To make sure that even due to this time difference the trigger is working a *trigger time frame* can be defined. See Figure 65 for details.

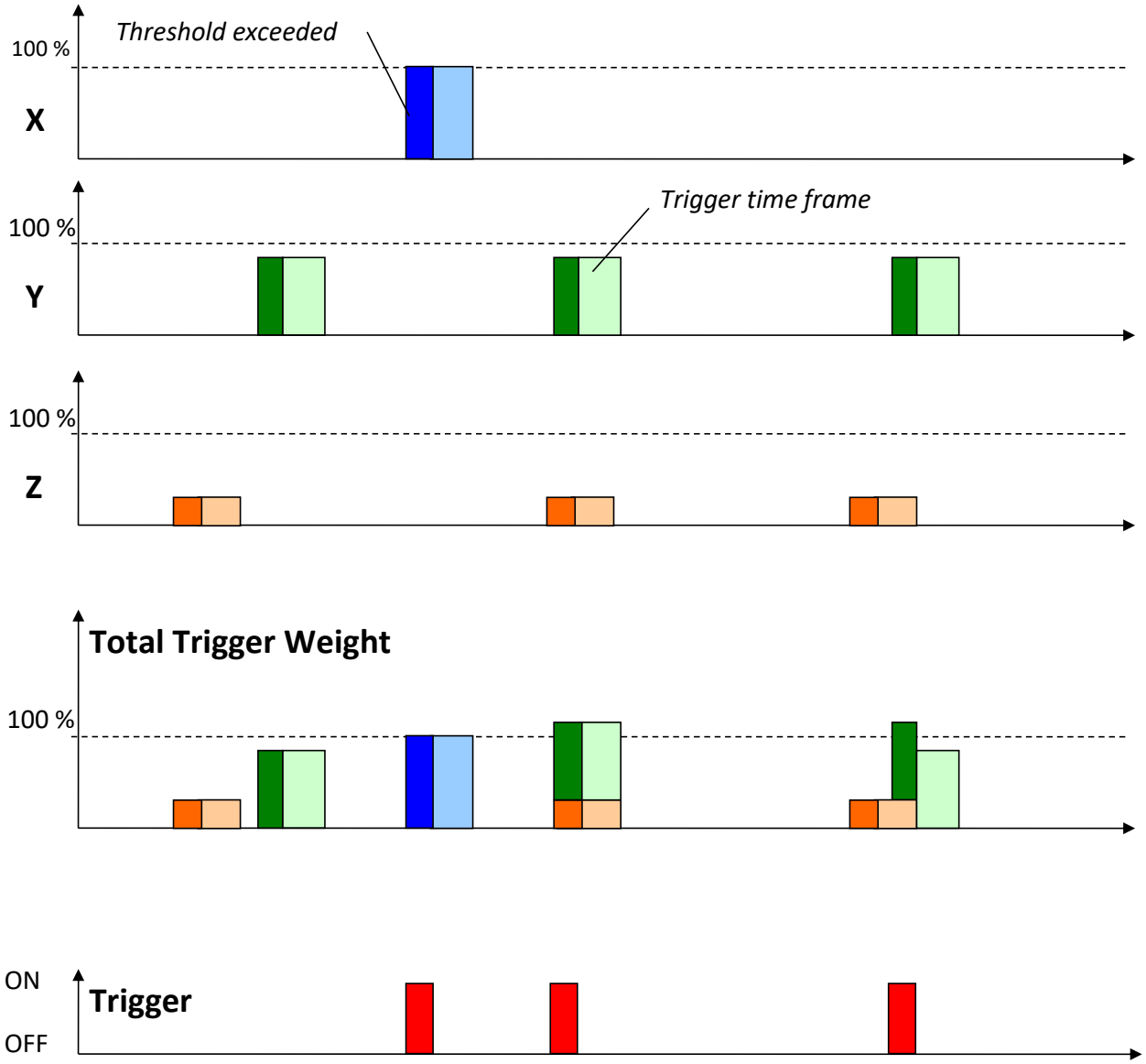


Figure 65: Overview of trigger weight and trigger time frame

9.5.6 Trigger Interconnection over LAN (example of 2 out of 3 stations logic)

If there are several instruments in the same LAN, they can be interconnected over Ethernet for common triggering.

In each instrument has to be enabled a local trigger and a network trigger. Every instrument in the network can be configured as trigger source or accept a trigger from another device.

These following setups should be done on all of the instruments (3 instruments in this example).

9.5.6.1 Setup Server Configuration for instruments

- Press ***'N'*** to enter the menu *Communication Parameters* and press ***'A'*** activate the *Contact remote servers*

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 1
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  L) Parameters of Preset Triggers ... ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- Adjust the number of server in the parameter *Number of servers*.
- Press ***'G'*** to go in *Server Parameters*

```
Main Menu | Communication
  A) Contact remote servers .................. Yes
  B) Number of servers ....................... 1
  C) Time interval, sec ...................... 10 (0x0A)
  D) Maximum files per session ............... 10 (0x0A)
  E) Connect if there are new files .......... Yes
  G) Server Parameters ....................... ->
  H) Server mode for other instruments ....... No
  M) SeedLink server ......................... Yes
  N) Accept connections ...................... Yes
  O) Try next server on any transfer error ... No
```

- IP address and Port from server must be adjusted in the field *Server IP Address* (in this example: 192.168.30.487) and *Port* (use ***3456*** as default). Make sure the *Network triggers* are activated by putting ***Yes***

```
Main Menu | Communication | Server
  A) Server IP Address ..................... 192.168.30.48
  B) Protocol .............................. Custom
  C) Port .................................. 3456 (0xD80)
  H) Transfer timeout, sec ................. 20 (0x14)
  I) Network triggers ...................... Yes
  J) Connect through PPP link .............. No
  N) Keep connected to the server .......... Yes
  O) Server port for permanent links ....... 54204 (0xD3BC)
  P) Always connect to this server ......... No
  Q) Connect failures before network error ... 0 (0x00)
```

9.5.6.2 Setup Trigger parameters for instruments

- Make sure on all instruments that the *Number of Trigger Sets* is to 2 (more can be set but to work minimum two trigger is necessary, one for a local triger and one for the network trigger)
- press ***'K'*** to enter in the menu *Trigger Parameters*.

```
Main Menu
  A) Station description ............ GMSplus - GeoSIG Ltd
  B) Station code ................... GSGMS
  C) Location description ........... Switzerland
  D) Seismic network code ........... GS
  E) Number of Channels ............. 3
  F) Number of Output Streams ....... 0
  G) Number of Trigger Sets ......... 2
  H) Number of Preset Triggers  ..... 0
  I) Channel Parameters ............. ->
  K) Trigger Parameters ............. ->
  M) File Storage and Policy ........ ->
  N) Communication Parameters ....... ->
  O) Miscellaneous Parameters ....... ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options ................. ->
```

Configure the first trigger to allow the local trigger.
In this example, the trigger votes is based on the *Channel weight*.

Make sure that on all the instruments that the name of triggers are exactly the same for *local triggers*.

- Be sure that the *Triggerset name* is ***Trigger1*** and that the ***Trigger source*** is *Local Triggers*.
- Be sure that the *Contribute to network triggers* is enabled (***Yes***), if not press on ***'X'*** to activate it.
- Press ***'H'*** to enter in the Trigger channel settings.

```
Main Menu | Triggerset 1 of 2
  A) Triggerset name ........................... Trigger1
  B) Trigger source ............................ Local triggers
  D) Trigger time frame, sec ................... 3 (0x03)
  E) Count trigger votes by .................... Channel weight
  G) Monitored channels ........................ 3
  H) Trigger channel settings .................. ->
  J) Event recording ........................... Yes
  K) Preevent, seconds ......................... 5 (0x05)
  L) Postevent, seconds ........................ 10 (0x0A)
  M) Maximum event duration, seconds ........... 60 (0x3C)
  N) Stored channels ........................... 3
  O) List of stored channels ................... ->
  V) SMS Alarm ................................. No
  X) Contribute to network triggers ............ Yes
```

- For **each channel**, be sure that the *Level Trigger* is activated (***Yes***) .
- Adjust if necessary the following parameters:
  - *Threshold (channel units)*
  - *Min. level exceedance*
  - *STA/LTA Trigger*
  - *Channel trigger weight*

```
Main Menu | Triggerset | Trigger Channel 1 of 3
  A) Assigned channel name ........ X0HLE
  B) Trigger filter ............... Yes
  C) Filter parameters ............ ->
  D) Level Trigger ................ Yes
  E) Threshold (channel units) .... 0.005
  F) Min. level exceedance, sec ... 0.01
  G) STA/LTA Trigger .............. No
  N) Channel trigger weight, % ....  50 (0x64)
```

*In this example, all the **trigger weight** are set to 50%, that means that minimum two channels need to go over the threshold to activate a local trigger.*

Configure the second trigger to allow the network triggering. In this example, the trigger votes is based on the *Station*.

Make sure that on all the instruments that the name of triggers are exactly the same for *Network voting logic*.

- Come back to Triggerset menu.
- Go to the second triggerset, press on ***'+'***.
- Be sure that the *Triggerset name* is ***Trigger2*** and that the ***Trigger source*** is *Network voting logic*.
- Choose the *Count trigger votes by*,
  in this example ***Stations*** is selected.
- Choose the ***Minimum number of votes*** who is necessary to send a network trigger.
  In this example, minimum **2** stations must be triggered to send a network trigger alarm.
- Fill out all the serial numbers of the instruments to configure under *Serial numbers of networked instruments*.
  In this example there is 3 instruments with the following serial numbers: **102406 102746 102409**.

```
Main Menu | Triggerset 2 of 2
  A) Triggerset name ........................... Trigger2
  B) Trigger source ............................ Network voting logic
  D) Trigger time frame, sec ................... 3 (0x03)
  E) Count trigger votes by .................... Stations
  F) Minimum number of votes ................... 2 (0x02)
  I) Serial numbers of networked instruments .... 102406 102746 102409
  J) Event recording ........................... Yes
  K) Preevent, seconds ......................... 5 (0x05)
  L) Postevent, seconds ........................ 10 (0x0A)
  M) Maximum event duration, seconds ........... 60 (0x3C)
  N) Stored channels ........................... 3
  O) List of stored channels ................... ->
  V) SMS Alarm ................................. No
```

Don't forget to save and restart the instruments.

9.6 Preset Trigger Settings

The instrument allows having several predefined triggers, e.g. time triggers in parallel.

9.6.1 In the Web Interface or by GeoDAS

- In the field ***Configuration → Number of Preset Triggers*** the total number of the preset triggers must be configured first so that the ***Parameters of Preset Triggers*** menu appears.

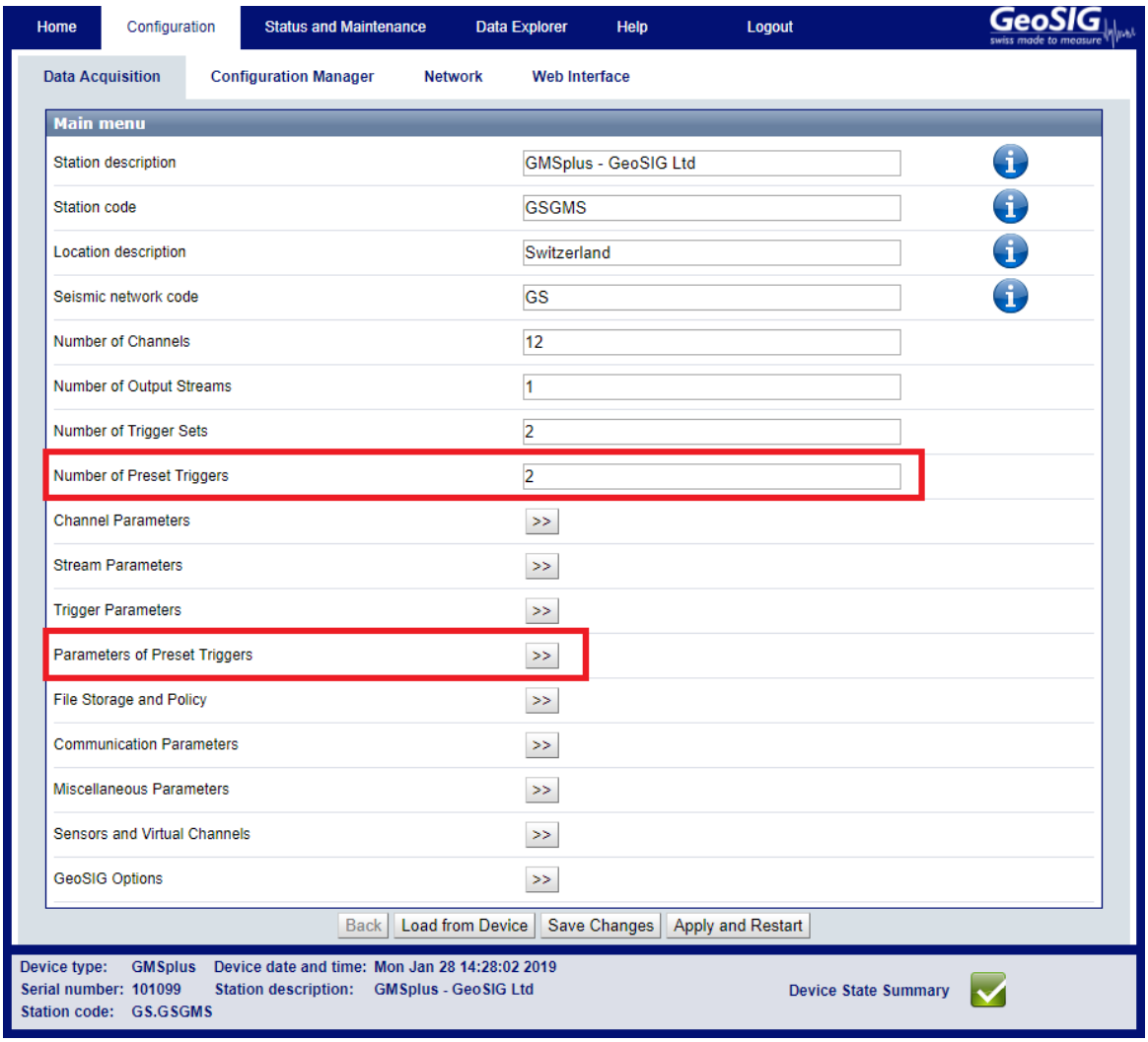


Figure 66: Configure number of Preset Triggers

- Go to ***Configuration → Parameters of Preset Triggers*** to adjust the parameters of the preset triggers. See Table 13 for additional information.

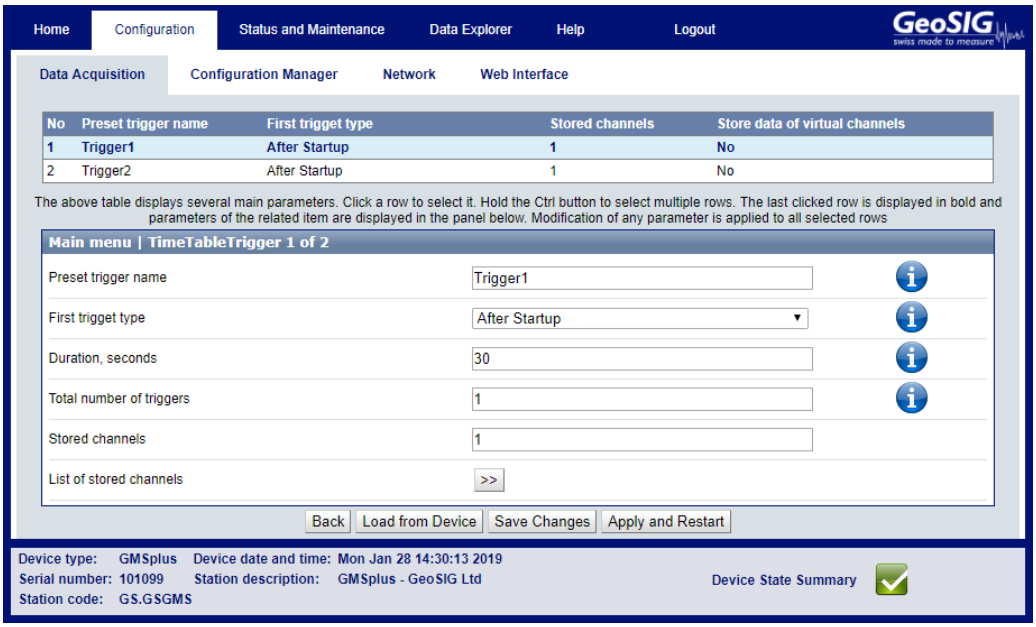


Figure 67: Edit Preset Triggers

9.6.2 Via Local Serial Console

- Press ***'H'*** to select the Number of Preset Triggers

```
Main Menu
 A) Station description ............. Demo GMSplus
 B) Station code .................... DEMO
 C) Location description ............ Switzerland
 D) Seismic network code ............ CH
 E) Number of Channels .............. 3
 F) Number of Output Streams ........ 1
 G) Number of Trigger Sets .......... 1
 H) Number of Preset Triggers  ...... 1
 I) Channel Parameters .............. ->
 J) Stream Parameters ............... ->
 K) Trigger Parameters .............. ->
 L) Parameters of Preset Triggers ... ->
 M) File Storage and Policy ......... ->
 N) Communication Parameters ........ ->
 O) Miscellaneous Parameters ........ ->
 Q) Sensors and Virtual Channels .... ->
 S) GeoSIG Options .................. ->
```

- Press ***'L'*** to get to the *Parameters of Preset Triggers* menu to adjust the settings of the preset triggers. The following menu appears only if the *number of preset triggers* is higher than ***'0'***.

```
Main Menu | TimeTableTrigger
  A) Preset trigger name ......... Trigger1
  B) First trigger type .......... After Startup
  H) Duration, seconds ........... 30 (0x1E)
  I) Total number of triggers ..... 1 (0x01)
  O) Stored channels ............. 1
  P) List of stored channels ...... ->
```

- Each trigger set can be adjusted according to your wishes. To change the preset trigger set press ***'+'*** or ***'-'***. The following parameters can be adjusted:

'+' and ***'-'*** can be used to change the preset triggers			
Preset trigger name		User selectable	Name of the preset trigger set
First trigger type		***Manual Trigger***	A trigger is activated/stopped by the user command TRIGGERNOW/STOPTRIGGER sent either from the console or remotely from a server
		After Event	A trigger is activated after recording of any event file
		After Startup	First trigger is activated after the instrument startup
		Date and Time	First trigger is activated at the defined date/time
		Hardware Trigger	The trigger is activated by hardware
	Duration, sec	User selectable	The duration the scheduled trigger will be active
	Delay after event, sec	User selectable	If After Event is selected, then the time between the end of the event to the beginning of the activation of the preset trigger can be configured
	Pre-event, sec	User selectable	If After Event is selected, duration of the pre-event
	Post-event, sec	User selectable	If After Event is selected, duration of the post-event
	First trigger time, year	User selectable	Date and time of the first trigger
	First trigger time, month	User selectable	
	First trigger time, day	User selectable	
	First trigger time, hour	User selectable	
	First trigger time, minute	User selectable	
	Total number of triggers	User selectable	After reaching the configured number of triggers the preset trigger will not be activated anymore
Stored channels		User selectable	Number of channels which should be stored into an event file in case of a trigger
List of stored channels	***'+'*** and ***'-'*** can be used to change the preset triggers		
	Assigned channel name	User selectable	Depending on the number of stored channels different sources can be selected. Select the source by pressing ***'A'***.

Table 13: Preset trigger configuration menu structure

9.7 File Storage and Policy

It can be configured in the instrument how all the files should be treated.

9.7.1 In the Web Interface or by GeoDAS

- Go to ***Configuration → File Storage and Policy***

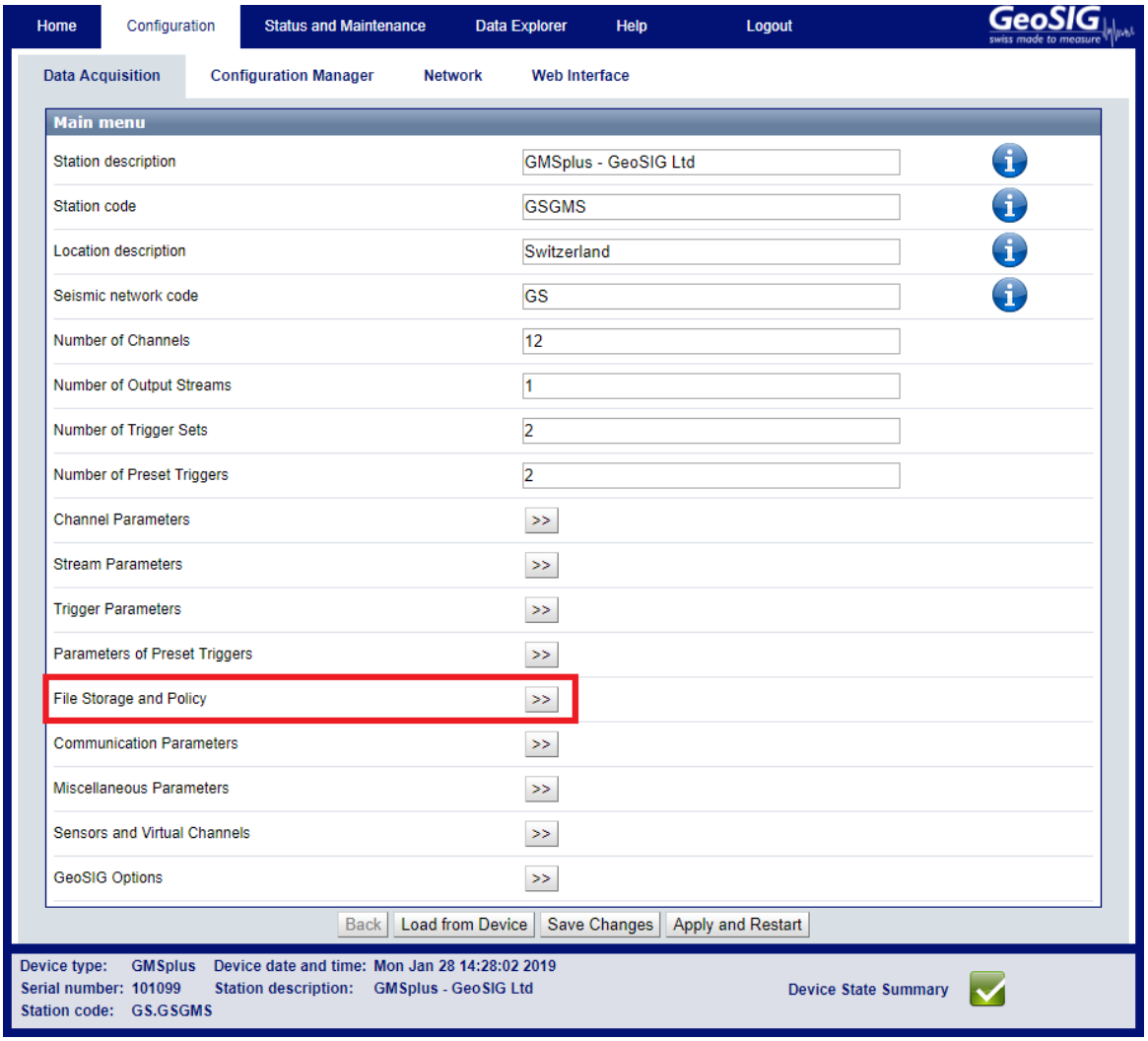


Figure 68: File Storage Settings

- Parameters for the following file types can be configured (see Filetypes in Table 14)
  - SOH - State of health information and requested data files
  - LOG - System log files
  - TRG - Events and PGM files
  - RBF - Ringbuffer files
  - MAN - Scheduled manual recordings
  - MSC - Miscellaneous files
- See Table 14 for more information about the parameters which can be configured.

9.7.2 Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 1
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  L) Parameters of Preset Triggers ... ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- To adjust the settings of the file storage, press ***'M'***; the *File Storage and Policy* menu will appear.

```
Configuration | File Storage
  A) System reserved space, Mb ........ 12 (0x0C)
  B) Length of one RB file, minutes ... 10 (0x0A)
  C) SOH and requested data files ..... ->
  D) System log files ................. ->
  E) Events and PGM files ............. ->
  F) Ringbuffer files ................. ->
  G) Scheduled manual recordings ...... ->
  H) Miscellaneous files .............. ->
```

- Parameters for the following file types can be configured (see Filetypes in Table 14)
  - SOH - State of health information and requested data files
  - LOG - System log files
  - TRG - Events and PGM files
  - RBF - Ringbuffer files
  - MAN - Scheduled manual recordings
  - MSC - Miscellaneous files
- See Table 14 for more information about the parameters which can be configured.

System reserved space		*User selectable*	Amount of memory reserved for the operating system in [Mb]. Keep **12** Mb by default.
Length of one RB file		*User selectable*	Permanent data will be stored in ringbuffer files; here the length of one ringbuffer file in minutes can be specified. After this time the file will be closed and a new one started.
Filetypes	***Disk space quota***	*User selectable*	Reserved memory on the SD/CF-Card for the SOH files in [%]
	If over quota	***Delete oldest files***	In case the reserved memory is full the oldest files will be deleted first
	Life time	*User selectable*	After the configured time in [days] the files will be deleted from the SD/CF-Card
	Transfer priority	***Never Transfer*** ***Low*** ***Mid*** ***High*** ***Highest***	In case a lot of files have to be transferred, the priority of the file upload can be configured here. If Never Transfer is configured, then no files will be uploaded.
	Transfer order	***Newest first*** ***Oldest first***	Most recent files are transferred first Most old files are transferred first
	Delete transferred	***Yes*** ***No***	Files will be deleted after upload to the server Files will be not deleted after upload to the server

Table 14: File Storage and Policies menu structure

- Additionally the system log files can be compressed. This can be separately enabled under the menu point D) *System log files*:

Compress files	***Yes*** ***No***	Files will be sent gzip-compressed (.gz) Original text files will be sent (default)

- State of health and event files have two more configuration options:

Transfer protocol	Standard (Custom) HTTPS	Default option. This protocol also is used to transfer any other types of files. This option can be used to upload data files to the HTTPS servers only. Downloads are not supported.
Directory for uploads	User selectable	Name of the directory on the HTTPS server where uploaded files will be placed

9.8 Communication Parameters

This chapter explains how to set up the server parameters.

9.8.1 In the Web Interface or by GeoDAS

- Go to ***Configuration → Communication Parameters***

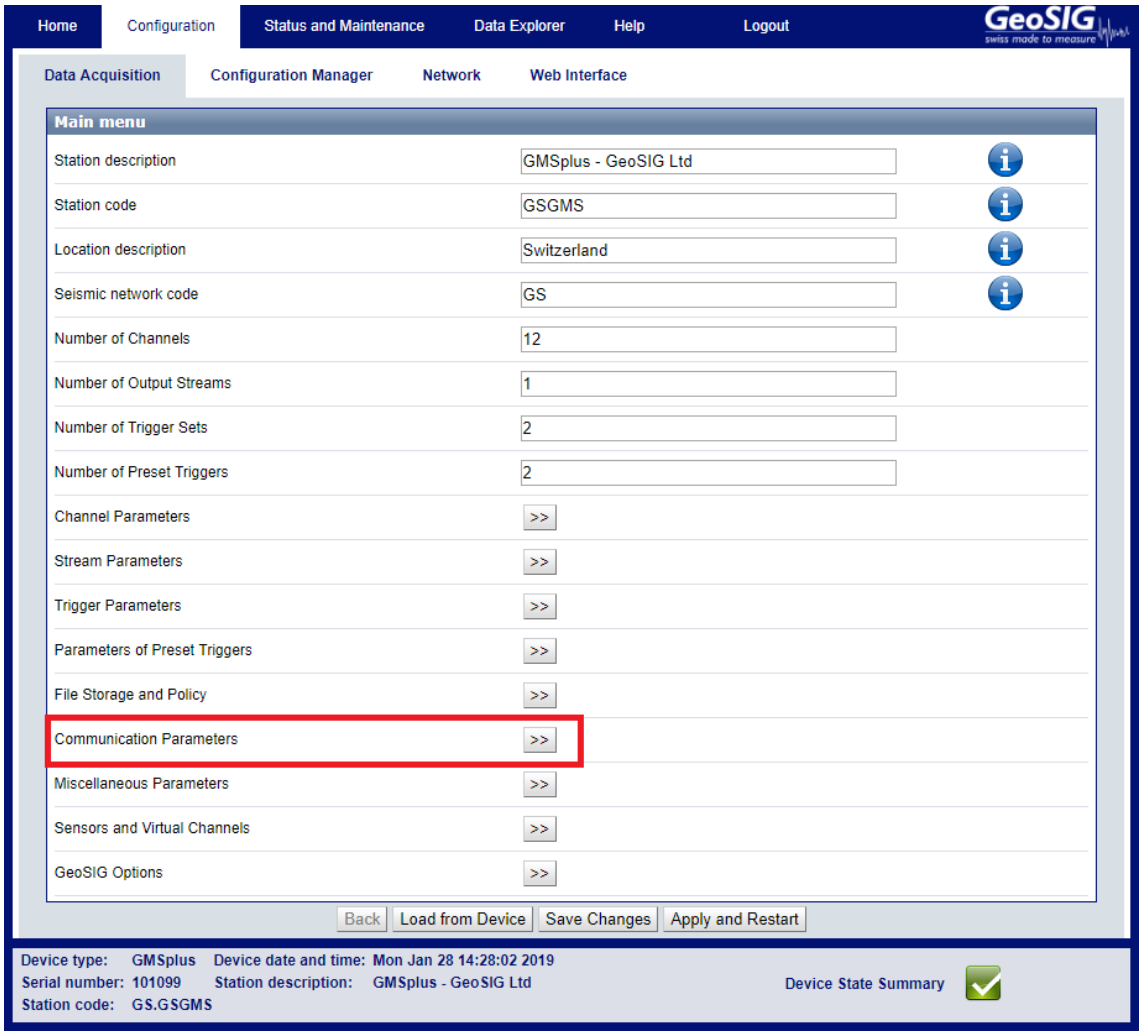


Figure 69: Server parameters

- Tick the flag ***Contact remote servers*** to configure a connection to a remote server.
- Configure the number of servers to contact in the field ***Number of servers***
- Then go to ***Server Parameters*** to adjust the parameters as shown in the Table 15.
- In case the instrument should act as Server for other GMS instruments, tick the flag ***Server mode for other instruments*** and follow the steps as described in chapter 9.8.2.1

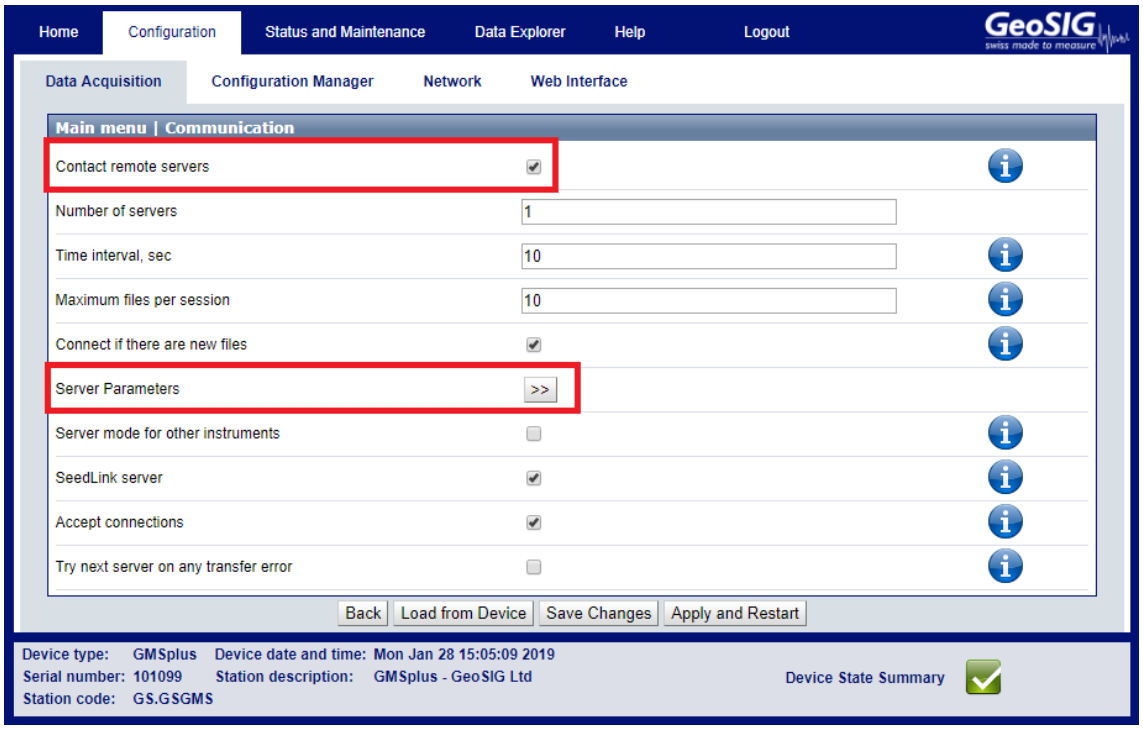


Figure 70: Edit Communication Parameters

9.8.2 Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 0
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- Press ***'N'*** to get to the *Communication Parameters* menu to adjust the settings of the file storage. The following menu appears:

```
Main Menu | Communication
  A) Contact remote servers .................. Yes
  B) Number of servers ....................... 1
  C) Time interval, sec ...................... 10 (0x0A)
  D) Maximum files per session ............... 10 (0x0A)
  E) Connect if there are new files .......... Yes
  F) Connect by requests from clients ........ Yes
  G) Server Parameters ....................... ->
  H) Server mode for other instruments ....... Yes
  I) Port for incoming connections ........... 3456 (0xD80)
  J) Secure authentication ................... No
  K) Number of clients ....................... 1
  L) Clients Parameters ...................... ->
  M) SeedLink server ......................... Yes
  N) Accept connections ...................... Yes
  O) Try next server on any transfer error ... Yes
```

- The following parameters can be adjusted:

Contact remote servers		***Yes***	The instrument connects to the configured data server(s)
		No	The instrument does not connect to any data servers
	Number of servers	User selectable	Number of data servers. If the instrument cannot connect to the first data server it will connect to the second data server; if this one is down it connects to the third and so on. Scanning of servers stops after first successful connection.
	Time interval, sec	User selectable	Interval of connection to data servers in seconds
	Maximum files per session	User selectable	Maximum number of files, which will be uploaded during one session. Although data servers support concurrent connections, this parameter helps distributing the load of data processing by the server among several instruments.
	Connect if there are new files	***Yes***	Instrument connects to the server if there are new files recorded and ready to be transmitted.
		No	Instrument connects to the server if there are new files recorded and ready to be transmitted. Instrument does not connect to the server if there are new files. It just connects periodically as defined with the parameter **Time interval**.
Server Parameters	***Server IP Address***	User selectable	IP address of the data server
	Protocol	***Custom***	Default protocol of communication
		HTTPS	This protocol can be selected only if you upload SOH and/or EVT files to HTTPS servers
	Port	User selectable	If Custom: Communication port of the data server
	Transfer timeout, sec	User selectable	Instrument gives up trying to contact the server after the configured timeout in seconds.
	Network triggers	***Yes***	Triggers are sent to the server for event detection as described in chapter C.2
		No	Triggers are not sent to the server
	Connect through PPP link	***Yes***	Instrument connects to the data through PPP link
		No	Instrument does not connect to the data server through PPP
	Number of failures to give up	User selectable	Number of trials until giving up
	Keep connected to the server	***Yes***	Instrument connects to the data through PPP link
		No	
	Server port for permanent links	User selectable	The port which should be used to keep the connection between the server open
	Always connect to this server	***Yes***	Instrument will always try connecting to this server, even if a file has already been delivered to another server
		No	Disable this function
	Connect failures before network error	User selectable	Number of failure before displays network error

Server mode for other instruments		***Yes***	The instrument acts as a data server for other instruments. See chapter 9.8.2.1 for more details
		No	The instrument does not act as a data server.
	Connect by requests from clients	***Yes***	Instrument connects to the server if there are new files recorded and ready to be transmitted.
		No	Instrument doesn't connect to the server if there are new files recorded and ready to be transmitted.
	Port for incoming connections	User selectable	Port for incoming connections. Other instruments have to set the same port under Server parameters
	Secure authentication	***Yes***	Secure authentication (SSL encryption) enabled.
		No	Secure authentication (SSL encryption) disabled
	Number of clients	User selectable	Number of clients that this server can used
	Clients Parameters	***'+'*** and ***'-'*** can be used to change between the servers	
		Client IP Address	User selectable	IP of the client instrument which connects to this instrument.
		Client serial number	User selectable	Serial number of the client instrument. Use 000000 to allow instruments with any serial numbers to connect.
		Transfer timeout, sec	User selectable	Network timeout in seconds.
		Data forwarding	***Yes***	Data from the data server will be forwarded to the client instruments and the other way round.
			No	Data will not be forwarded.
		Network triggers	***Yes***	Triggers are sent to the server for event detection as described in chapter C.2
			No	Triggers are not sent to the server
SeedLink server			***Yes***	SeedLink server is enabled for all data channels, and data streams can be received by any SeedLink client from the instrument's IP.
			No	The instrument does not act as a Seedlink server.
Accept connections			***Yes***	Allows GeoDAS to connect to the instrument. Works only if the IP address of the instrument is known and reachable.
			No	Do not accept connections from new clients
Try next server on any transfer error			***Yes***	If Yes, In case of communication error contact the next server out of the list of Configured Servers.
			No	Don't try to contact the next server

Table 15: Communication Parameters menu structure

9.8.2.1 Instrument acts in the Server Mode

The instrument can be configured to act as a server. In this case other instruments can upload their files to this instrument. The server-instrument can then forward the data to a main server by another communication medium. For example, two instruments (clients) upload their files to the instrument-server, which forwards the data to a GeoDAS server by the cellular modem.

The serial numbers and IP addresses of all client instruments must be configured in the server so that requests from GeoDAS can be correctly forwarded.

This setup is not recommended, as it creates a big load for the server instrument. Special care must be taken during design and setup. Whenever possible, all instruments shall have a direct communication path to the GeoDAS server.

9.8.3 Connection over PPP (Cellular Modem or Analog Phone Line)

If it is required to use a PPP link for communication of the instrument with the GeoDAS server, then the configuration must be set accordingly in armdas (see chapter 9.8). It is also required to configure PPP for selected ISP (Internet Service Provider). The ISP configuration settings are described in the following chapters.

The GeoDAS server must have a real static IP-address (please, consult with ISP to obtain such a service). In this example, 62.15.87.98 IP-address will be used for the GeoDAS server. Server parameters must be configured as described in chapter 9.8.3.3.

Automatic Detection of a Cellular Modem

This chapter can be skipped in case the PPP connection shall be done by the internal analog landline modem.

- Switch on the instrument by pressing and holding the POWER button for 2 seconds.
- Press ***<Ctr> + 'Z'*** as soon the following message appears on the console to enter the test mode:

```
GMSplus s/n 100582. Firmware in the Linux image: 21.11.00
################################################
###### Test and Initial Configuration Mode ######
################################################
Press Ctrl+Z to enter the test mode.....
```

The following menu will appear (see chapter 10 for details):

```
-------------------------------------------------------------------------------
Level         Shortcut Password Description
-------------------------------------------------------------------------------
User          Ctrl+U   None     Basic operations only
Powerful User Ctrl+W   None     Also hardware options and pre-selected tests
Administrator Ctrl+A   None     Also manual tests and altering the FLASH memory content
-------------------------------------------------------------------------------
Your level [U/W/A] or press B to boot now:
```

- By default, no passwords are set, so press ***'W'*** to enter the Powerful User, and then ***'K'*** to enter the menu Instrument hardware parameters.
- The instrument will start the automatic detection of an external cellular modem. Please wait 10 seconds till it is completed.

```
Loading hardware configuration...
Querying devices...
External modem power has been switched on
Please wait 10 seconds while the instrument tries to detect a cell modem
External modem power has been switched off
```

- Depending on the connected cellular modem, one of the following messages appears:

```
Fast USB Cell Modem detected (SIMCOM_SIM5216E), IMEI = 359769031661413
```

```
Basic Serial Cell Modem detected (Teltonika TM2), IMEI = 353976014060325
```

Depending on the configuration, a combination of both is also possible, for example:

```
Fast USB Cell Modem detected (SIMCOM_SIM5216E), IMEI = 359769031661413
Basic Serial Cell Modem is configured but Fast USB Cell Modem is detected.
Update configuration (Y/N)?
```

- If the modem is currently not present, but will be used later then the configuration can also be adjusted manually in the following menu by pressing ***'H'***. Besides the two types listed above, an instrument may have also an internal 3G modem, which is also found automatically.

```
Hardware Configuration Menu
  A) Number of sensors ........... 1
  B) Sensor parameters ........... ->
  C) Standard Wi-Fi module ....... No
     Lantronix Wi-Fi module ...... No
     Rack mounted slave board .... No
     Wireless time sync module ... No
     Internal analog modem ....... No
  H) Cellular Modem .............. Fast USB Cell Modem
     Alarm interface ............. No
     Seismometer control ......... No
  K) Interconnection interface ... Disabled
```

- Leave the menu by pressing **<ESC>** and **<Enter>**, then ***'S'*** to save the configuration.

9.8.3.1 The ISP Configuration for PPP

- To enter the APN, login and password of your mobile phone provider press ***'N'*** to enter the menu *Network settings*.
- Press ***'N'*** until the following message appears to adjust the ISP settings for the internal analog phone line (only if installed):

```
---- PPP Communication ----
Edit Analog Modem settings (Y/N)?:
```

- Press ***'Y'*** and enter the phone number, login and password given by your internet service provider. Add a **T** in front of the number for tone dial, or a **P** for pulse dial.

```
Edit Cell Modem settings (Y/N)?
```

- Enter the APN, login and password provided by our mobile phone provider.

```
APN of the service provider  [gprs.swisscom.ch]:
Login  []:
Password  []:
Updating configuration...
PPP settings have been updated
```

- By entering a blank space '␣' the field will be cleared.

- Press ***<Enter>*** till the following menu appears and then press ***'5'*** to start the instrument:

```
Bootloader Menu of the GMSplus s/n 100582
Access level: Powerful User

 --- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
5 - Boot now
X - Reboot the instrument
Y - Power off

 --- Hardware Setup and Monitor ---
K - Instrument hardware parameters
N - Network settings
T - Battery installation dates
G - Signal strength of GSM network
 --- Security ---
O - Set password
J - Reset all passwords

-->
```

 *In case of troubles with connection to the ISP, please contact the ISP support service.*

9.8.3.2 In the Web Interface or by GeoDAS

- Go to ***Configuration → Communication Parameters → Server Parameters***

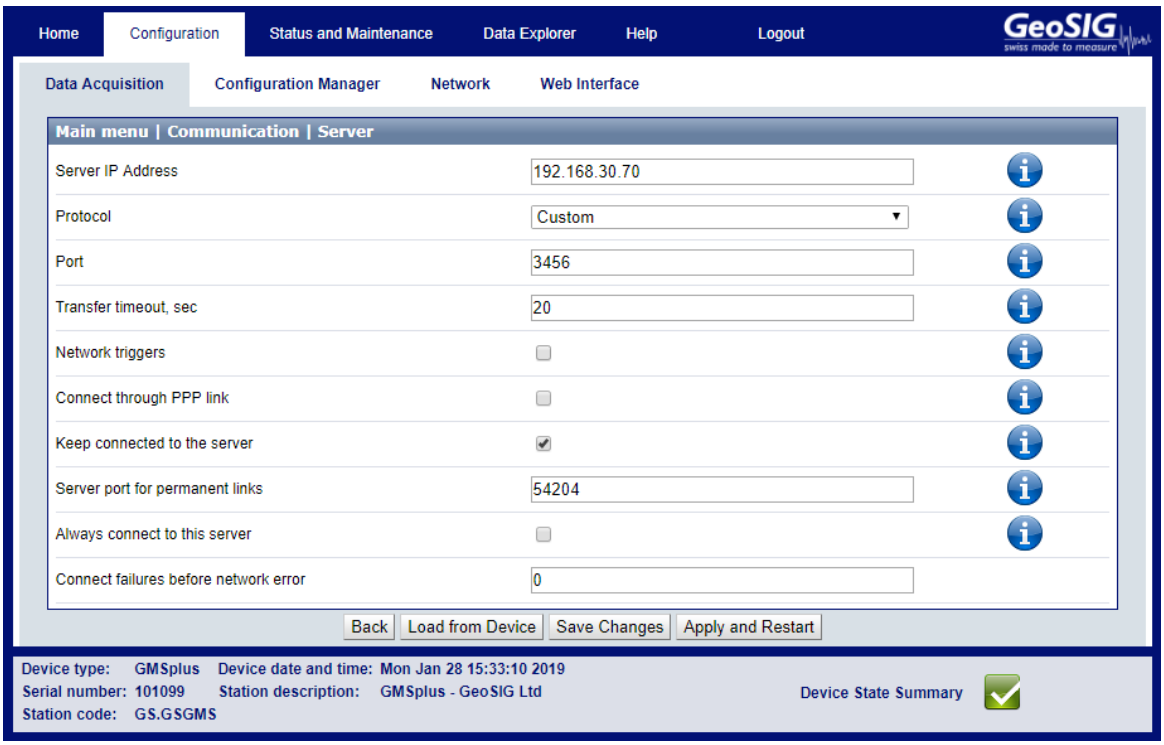


Figure 71: Server parameters

- Tick the flag ***PPP Enabled*** to configure a connection to a remote server via the external cellular or internal analog modem.

9.8.3.3 armdas Configuration

To configure armdas, connect to instrument through serial console or from GeoDAS as described in chapter 9.

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 0
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
```

- Press ***'N'*** to enter the Communication Parameters

```
Main Menu | Communication
  A) Contact remote servers ............. Yes
  B) Number of servers .................. 1
  C) Time interval, sec ................. 60 (0x3C)
  D) Maximum files per session .......... 10 (0x0A)
  E) Connect if there are new files ..... Yes
  G) Server Parameters .................. ->
  H) Server mode ........................ No
  M) SeedLink server ..................... Yes
  N) Accept connections .................. Yes
```

- Change *Contact remote servers* to ***Yes***, then adjust the *Server Parameters* by pressing ***'G'***

```
Main Menu | Communication | Server
  A) Server IP Address ...................... 62.15.87.98
  B) Protocol ............................... Custom
  C) Port ................................... 3456
  H) Transfer timeout, sec .................. 40 (0x28)
  I) Network triggers ....................... No
  J) Connect through PPP link ............... Yes
  L) Number of failures to give up .......... 3 (0x03)
  N) Keep connected to the server ............ Yes
  O) Server port for permanent links ......... 54204 (0xD3BC)
  P) Always connect to this server ........... Yes
  Q) Connect failures before network error ... 0 (0x00)
```

- GeoDAS server IP address must be set as *Server IP Address* and port number for *Port* parameter such as for server in GeoDAS configuration (see Figure 22).
- *Connect through PPP* link should be ***Yes***.
- If the user wants to use two modems (analog and GSM) together, one of which is in a role of an alternate link, then it is required to set *Try alternate PPP link on failure* to ***Yes***. In this case, if the preferred modem will fail after the *Number of failures to give up*, then alternate modem will be used to establish link.
- After these adjustments, exit from submenus by ***<ESC>*** key, save configuration with ***'C'*** and restart armdas by pressing ***'R'***.

After the modem is powered it takes a while till it finds the network, therefore we recommend to set the 'Startup time for cell modem' 16 to 60 seconds.

9.9 Miscellaneous Parameters

The Baseline Correction, State of Health files, messaging and debugging can be adjusted in this menu.

9.9.1 In the Web Interface or by GeoDAS

- Go to ***Configuration*** → ***Miscellaneous Parameters***

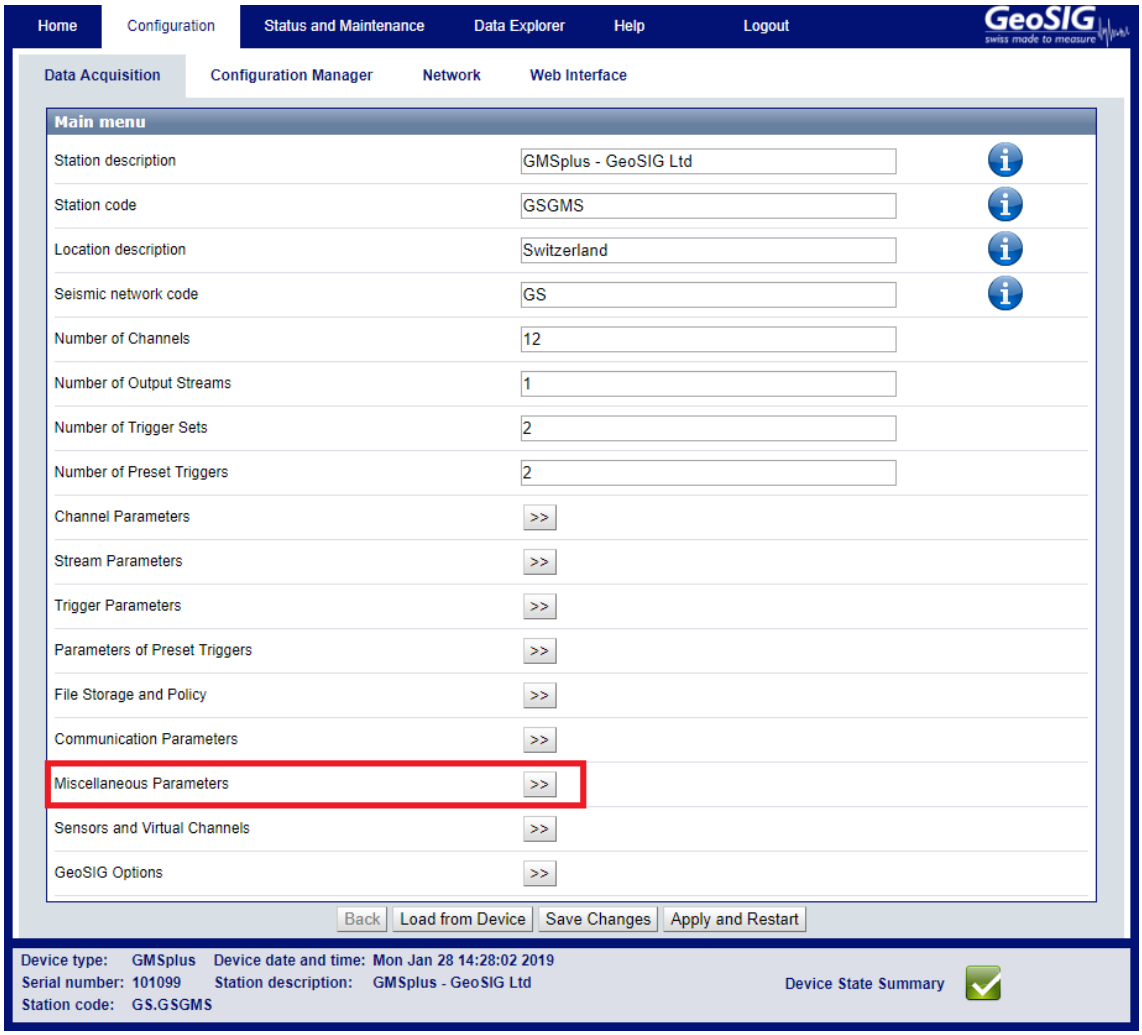


Figure 72: Miscellaneous Parameters

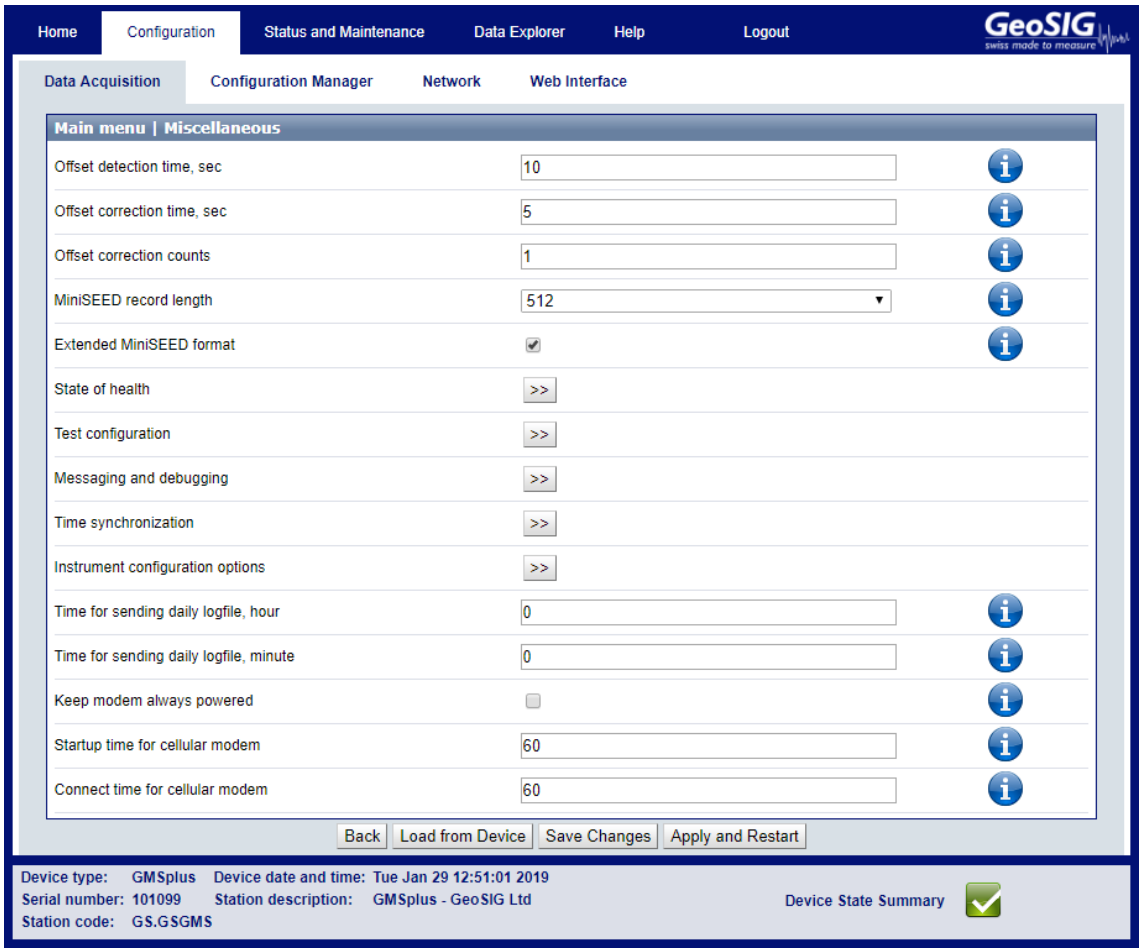


Figure 73: Edit Miscellaneous Parameters

Adjust the parameters as shown in the Table 16.

9.9.2 Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 1
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  L) Parameters of Preset Triggers ... ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- Press ***'O'*** to get to the *Miscellaneous Parameters* menu to adjust time synchronisation, offset detection, and other settings. The following menu appears:

```
Main Menu | Miscellaneous
  A) Offset detection time, sec ............... 10 (0x0A)
  B) Offset correction time, sec .............. 5 (0x05)
  C) Offset correction counts ................. 1 (0x01)
  D) MiniSEED record length ................... 512
  E) Extended MiniSEED format ................. Yes
  H) State of health .......................... ->
  I) Test configuration ....................... ->
  J) Messaging and debugging .................. ->
  K) Time synchronization ..................... ->
  L) Instrument configuration options ......... ->
  M) Time for sending daily logfile, hour ..... 0 (0x00)
  N) Time for sending daily logfile, minute ... 0 (0x00)
```

- The following parameters can be adjusted in the Table 16.

Offset detection time, sec	User selectable	Time in seconds, which the input values is measured after startup to define the offset. This 'static' offset will then compensate all channels with activated offset compensation.
Offset correction time, sec	User selectable	The instrument continuously takes the average over the number of seconds specified. If this value is positive it will subtract the number of Offset Correction Counts defined below. If the value is negative, the Offset Correction Counts will be added to the signals. This is only active for channels where the offset compensation is activated and is used to compensate 'dynamic' offset which changes over time (E.g. because of temperature changes).
Offset correction counts	User selectable	The number of counts which will be added to the signal, respectively removed from the signal, depending on the signum of the continuously calculated average over the Offset Correction Time
MiniSEED record length	User selectable	Length of one data block inside the miniSEED file. In most applications, the default value 512 shall be kept.
Extended MiniSEED format	***No***	MiniSEED files do not include any additional information. This option shall be used only if you face any problems in reading extended format of miniSEED files with your customized software.
	Yes *(default)*	MiniSEED files include configuration and state of health information, which is encapsulated into the blockettes 2000. When you open such files with GeoDAS, there is no need to enter LSB factors and units. This feature is supported from GeoDAS version 2.21.
Include SOH information in miniSEED	***Yes***	Include SOH information in each MiniSEED file as Blockette 2000 record.
	No (default)	Do not include SOH information in each MiniSEED file as Blockette 2000 record.
Include configuration in miniSEED	***Yes***	Include current config.xml information in each MiniSEED file as Blockette 2000 record
	No (default)	Do not include current config.xml information in each MiniSEED file as Blockette 2000 record

State of health	***SOH report type***	***None***	No SOH file will be created
		Standard	SOH files will be created and uploaded to the server according to the settings in chapter 9.7
	SOH reporting interval, days	User selectable	If Standard selected, defines the interval between the SOH reports in days, hours and minutes
	SOH reporting interval, hours	User selectable	
	SOH reporting interval, minutes	User selectable	
	Time of the first SOH report	***Startup***	First SOH report will be created at startup
		Random	Time of the first SOH is random. This is to avoid all instruments using the network at the same time.
		User defined	First SOH report will be created at the user defined time.
	First SOH report time, hours	User selectable	If *User defined* is selected, defines the hour and minute of the first SOH report
	First SOH report time, minutes	User selectable	
	Activate alarm on errors or Activate alarm when system is inactive	***Yes***	Activates an alarm relay in case of an error.
		No	Alarm relay will not be activated in case of an error.
		Yes	Alarm relay is activated in case armdas is not running.
		No	Alarm relay will not be activated.
	Error and inactivity alarm output	***AL1***	Select the alarm relay if at least one of the condition above is ***Yes***
		AL2	
		AL3	
		AL4	

State of health (continued)	***Activate alarm on errors***	***Yes***	Alarm relay is activated in case armdas is not running.
		No	Alarm relay will not be activated.
	Activate alarm on selected error only	***Yes***	Selected alarm relay is activated on selected errors only. See below options
		No	Selected alarm relay is activated on all errors.
	Alarm on file-system errors	***Yes***	Enable the alarm of filesystem errors
		No	Disable the alarm of filesystem errors
	Alarm on memory errors	***Yes***	Enable the alarm of memory errors
		No	Disable the alarm of memory errors
	Alarm on timing errors	***Yes***	Enable the alarm of timing errors
		No	Disable the alarm of timing errors
	Alarm on DSP errors	***Yes***	Enable the alarm of DSP errors
		No	Disable the alarm of DSP errors
	Alarm on network errors	***Yes***	Enable the alarm of network errors
		No	Disable the alarm of network errors
	Alarm on disk errors	***Yes***	Enable the alarm of disk errors
		No	Disable the alarm of disk errors
	Alarm on aux errors	***Yes***	Enable the alarm of aux errors
		No	Disable the alarm of aux errors
	Alarm on processing errors	***Yes***	Enable the alarm of processing errors
		No	Disable the alarm of processing errors
	Alarm on misc hardware errors	***Yes***	Enable the alarm of misc hardware errors
		No	Disable the alarm of misc hardware errors
	Monitor state of current loop sensors	***Yes***	It monitors the sensor offset for its valid range. If sensor offset is outside of its valid range a sensor failure error message will be issued.
		No	Disable the monitor state of the current loop sensor
	Send SOH on changing error state	***Yes***	Enable send SOH on changing error state.
		No	Disable send SOH on changing error state
	Send SOH on changing warning state	***Yes***	Enable send SOH on changing warning state
		No	Disable send SOH on changing warning state

Test Configuration	***Type of periodic sensor test***	***None***	No test pulse is generated
		Pulse	Test pulse is generated periodically and automatically, depending on the following settings
	Sensor test interval, days	User selectable	Interval between two sensor tests
	Time of the first test	***Startup***	First test will be done at start-up, next after the defined interval.
		Random	Time of the fist test is random. This is to avoid, that all instruments in a network are doing the test in exactly the same moment and are not able to record events normally at the same time.
		User defined	First test will be done at the user defined time.
	First test report time, hours	User selectable	If *User defined* is selected, defines the hour and minute of the first test report
	First test report time, minutes	User selectable	
	Activate alarms on sensor test	***Normal***	An alarm is activated only if an amplitude of the test pulse is above the related threshlold.
		Never	The alarms are not activated on tests
		Always	An alarm is activated upon every test.
	Record test files	***Normal***	A file is recorded only if an amplitude of the test pulse is above the trigger threshlold.
		Never	Test files are not recorded
		Always	A file is recorded upon every test.
	Prefix for names of test files	***CAL_***	Test files will be created with this prefix
		TRG_	

Messaging and debugging	***Console messages***	***Yes***	Enable console message
		No	Disable console message
	Debug: memory allocation	***Yes***	Enable debug message: memory allocation
		No	Disable debug message: memory allocation
	Debug: system and processes	***Yes***	Enable debug message: system and processes
		No	Disable debug message: system and processes
	Debug: flash memory	***Yes***	Enable debug message: flash memory
		No	Disable debug message: flash memory
	Debug: configuration	***Yes***	Enable debug message: configuration
		No	Disable debug message: configuration
	Debug: network links	***Yes***	Enable debug message: network links
		No	Disable debug message: network links
	Debug: data streams	***Yes***	Enable debug message: data streams
		No	Disable debug message: data streams
	Debug: data sources	***Yes***	Enable debug message: data sources
		No	Disable debug message: data sources
	Debug: ring buffers	***Yes***	Enable debug message: ring buffers
		No	Disable debug message: ring buffers
	Debug: event triggers	***Yes***	Enable debug message: event triggers
		No	Disable debug message: event triggers
	Debug: time synchronisation	***Yes***	Enable debug message: time synchronisation
		No	Disable debug message: time synchronisation
	Debug: file manager	***Yes***	Enable debug message: file manager
		No	Disable debug message: file manager
	Debug: cryptographic info	***Yes***	Enable debug message: cryptographic info
		No	Disable debug message: cryptographic info
	Debug: hardware related info	***Yes***	Enable debug message: hardware related info
		No	Disable debug message: hardware related info
	Debug: external hardware	***Yes***	Enable debug message: external hardware
		No	Disable debug message: external hardware
	Debug: JMA early warning	***Yes***	Enable debug message: JMA early warning
		No	Disable debug message: JMA early warning
Instrument configuration options	***Enable autodetection of the instrument***	***Yes***	Instrument can automatically be found by GeoDAS in the LAN.
		No	Instrument can not automatically be found by GeoDAS.

	Time for sending daily logfile, hour	User selectable	If transfer is activated as described in chapter 8.7, the daily logfile will be sent to the server at this hour of the day. This can be adjusted to avoid that all instruments send the logfile at exactly the same time
	Time for sending daily logfile, minute	User selectable	
	Keep modem always powered	***Yes***	Keep the external cell modem always powered
		No	Turning it on only when required
	Startup time for cellular modem	User selectable	Time the system will wait for the Cellular modem to start up
	Connect time for cellular modem	User selectable	Time the system will wait for the Cellular modem to connect to the provider
Signal processing	***DSP mode set delay [s]***	User selectable	After startup, the instruments internal clock is roughly synchronized against a foreign network time source (NTP) and time is pushed to the DSP. During this initial time period the DSP will use this foreign time to do sampling while synchronizing to an external time-source such as GPS. After this initial time period the DSP will be switch to the external time-source.
	DSP sync behaviour	***Dilate***	The DSP is supposed to drift against to correct time, i.e., an offset of the reported and actual time is noted in each record of the mini-seed file. No interruptions of waveform processing occurs but it can take some hours until synchronization has been completed. This mode is ideal for building monitoring.
		Wrap	Upon switchinhg the time-source, the DSP stops waveform processing, re-synchronizes the ADC clocks and restarts waveform processing. This mode is only recommended when long drift times are undesirable.
	DSP snap window [ms]	User selectable	Specifies the maximum allowed time difference the DSP can drift to obtain synchronization with an external time-source, in case the instrument was running for a long period of time on its internal RTC, e.g., after GPS failure. If the time difference between the DSPs internal clock and the external time source is larger than the specified amount, the DSP will perform a time-warp and waveform processing will be restarted.
	Waveform processing style	***Slow***	Once per second waveform processing is executed which allows sampling rates as low as 1 SPS.
		Standard	This is the default mode on all GeoSIG instruments and supports sampling rates as low as 5 SPS.
		Real-time	The scheduler guarantees an execution rate of 50 times per second for waveform processing making this mode ideal for applications in the early warning field.

Table 16: Miscellaneous Parameters menu structure

9.9.3 Time synchronization

The system has a Real Time Clock (RTC) that maintains internal time when the unit is turned off. During normal operation the RTC is responsible for providing the most accurate time possible to the system and performing time synchronization with other available external time sources as:

- GPS time code receiver on the GPS interface
- NTP (Network Time Protocol) server from the wired or wireless Ethernet interface
- NET1PPS time signal over 433 MHz radio module

It also keeps under control the sampling clock of the ADCs and self-calibrates its oscillator against temperature and aging when it is connected with an accurate external time signal.

The DSP receives a continuous 1 PPS signal from the RTC with the best possible accuracy of the RTC, including temperature compensation, based on the saved coefficients. The DSP will sync the sampling clock with this 1 PPS signal to have accurate sample timing.

The following parameters can be adjusted in the Table 17.

Time source	***RTC***	RTC is not synchronizing itself to any source. It will keep it's own time which might differ from other devices or the actual time.
	GPS	RTC is synchronising to the, optionally, connected GPS, which allows very good time synchronisation between devices with other GPS enabled devices.
	NTP	RTC is synchronising to a NTP server.
	AUTO	RTC synchronises to NTP in case GPS is not available. This is a good option for GPS and Ethernet enabled devices, where the GPS reception might be lost from time to time.
	NET1PPS	RTC is synchronizing to the 1PPS signal. This signal can be received by the optional 433 MHz wireless module or the interconnection network. (This option needs a device which is broadcasting its time by 433 MHz.)
NTP server 1	User selectable	IP of the primary NTP Server.
NTP server 2	User selectable	IP of the secondary NTP Server.
NTP server query interval, sec	User selectable	Interval time in seconds the NTP server is contacted by the instrument.
NTP requests in a row	User selectable	Every time the instrument is contacting the NTP server the configured number of requests will be sent. For service and advanced user only, only change the default value if you know what you are doing.
NTP query intervals per RTC update	User selectable	Specifies the number of NTP synchronizations until the RTC is updated. The default is to update the RTC after each synchronization with a NTP server.
NTP synchronisation timeout warning, min	User selectable	Raise a warning if synchronization with the NTP server was not possible for the given amount of time. Default is 240minutes.
NTP synchronisation timeout error, hours	User selectable	Raise an error if synchronization with the NTP server was not possible for the given amount of time. Default is 12hours.

NTP maximum error, sec	User selectable	If the current RTC time differs more than this time limit in [seconds] from the NTP time, the RTC time will make a time jump to the NTP time. Otherwise the time will be tuned slowly. For service and advanced user only, only change the default value if you know what you are doing
GPS reception timeout, min	User selectable	If GPS signal is lost, after this time in [minutes] the RTC will change its synchronisation method to NTP
GPS check interval in NTP mode, min	User selectable	If the time synchronisation is in the 'Auto" mode, and the RTC is synchronized to the NTP (because the GPS signal has been lost) the instruments checks in the configured interval if the GPS is available again (minutes)
GPS check interval in NTP mode, sec	User selectable	If the time synchronisation is in the 'Auto" mode, and the RTC is synchronized to the NTP (because the GPS signal has been lost) the instruments checks for the configured time duration if the GPS is available again (seconds))
GPS power mode	***Always on***	The power to the GPS receiver is on continuously
	Duty cycle	To reduce the instrument power consumption, the GPS receiver is activated for a user selectable period of time and than switch it off
GPS power-on duration, min	User selectable	Minutes to energize the GPS receiver to obtain the time synchronization. Minimum 60 minutes are recommended
GPS power-off duration, hours	User selectable	Hours to power off the GPS receiver, after this period of time it will be activated again for the time set above. Minimum 1 hour is recommended
Turn GPS off on low battery voltage	***Ignore battery voltage***	Enable power to the GPS receiver regardless the batteries voltage
	Monitor internal battery	Reduce the instrument power consumption by turning off the GPS receiver when the internal battery voltage is below a certain threshold.
	Monitor External battery	Reduce the instrument power consumption by turning off the GPS receiver when the external battery voltage is below a certain threshold.
	GPS off on both batteries	Reduce the instrument power consumption by turning off the GPS receiver when the internal and the external battery voltages are both below a certain threshold.
	GPS off on either batteries	Reduce the instrument power consumption by turning off the GPS receiver when the internal or the external battery voltages is below a certain threshold.
Power-off voltage of internal battery, V	User selectable	Voltage threshold of the internal battery to turn off the GPS receiver
Power-off voltage of external battery, V	User selectable	Voltage threshold of the external battery to turn off the GPS receiver
Power-on voltage is higher by value, V	User selectable	ysteresis above the turn-off value, to turn on the GPS receiver.

RTC watchdog timeout, sec	User selectable	If armdas is not running for this amount of time, there will be a hard reset of the device. Only change this setting if you really know what you are doing! Wrong settings could render your device unusable without GeoSIG support. The value of 0 disables the Watchdog.
Send SOH upon RTC status change	***Yes***	In case RTC status changes, a SOH message will be uploaded to the server.
	No	In case RTC status changes, no SOH will be send
Offset to UTC, minutes	User selectable	Difference between the local time and Coordinated Universal Time (UTC). The default is to use UTC as time reference.
Use IANA timezone mapping	***Yes***	Use Time Zone to set instrument time
	No	Don't use Time Zone to set instrument time
Use ISO timestamp formatting	***Yes***	Use ISO 8601 in all files name including offset
	No	Don't use ISO 8601 in all files name including offset

Table 17: Time Synchronization Parameters Menu Structure

9.9.3.1 Temperature compensation

RTC uses the internal temperature sensor of the micro-controller to define the current operating temperature. When good time synchronization occurs, typically using a GPS, the RTC checks its own drift against the signal of the GPS and adds the correction coefficients in a trim table. With a NTP time source, the accuracy is worse but the same process occurs with more averaging and on longer period of time.

During factory test, all the coefficients are initialized to the room temperature coefficient using a GPS. After installation on site, the unit will learn the correction parameters according to the ambient conditions at site and also according to the aging of the oscillator.

9.10 Sensors and Virtual Channels

The virtual channels are basically that one can add more channels than the physical ones. Virtual channels can be used for:

- Have a filtered copy of another physical channel
- Have a lower sampling rate of another physical channel
- Have the vector sum of 2 or 3 channels
- Math function like integration and derivation

They can be used to save in the RBF only the decimated data and not the higher sampling rate data, trigger on a specific filtered data, etc

This chapter explains how to set up the virtual channels.

9.10.1 In the Web Interface or by GeoDAS

- Go to ***Configuration*** → ***Miscellaneous Parameters***

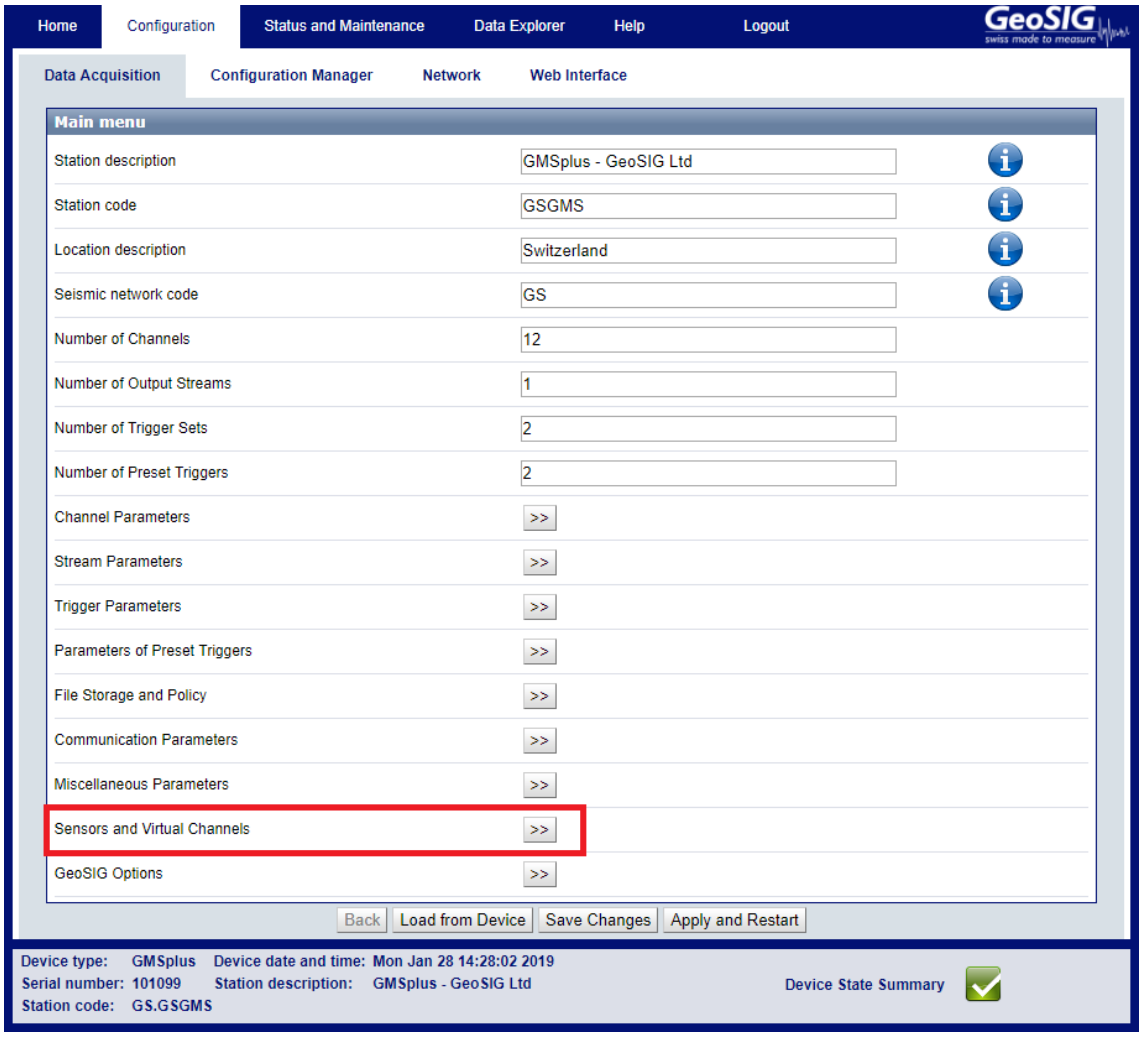


Figure 74: Sensors and Virtual Channels

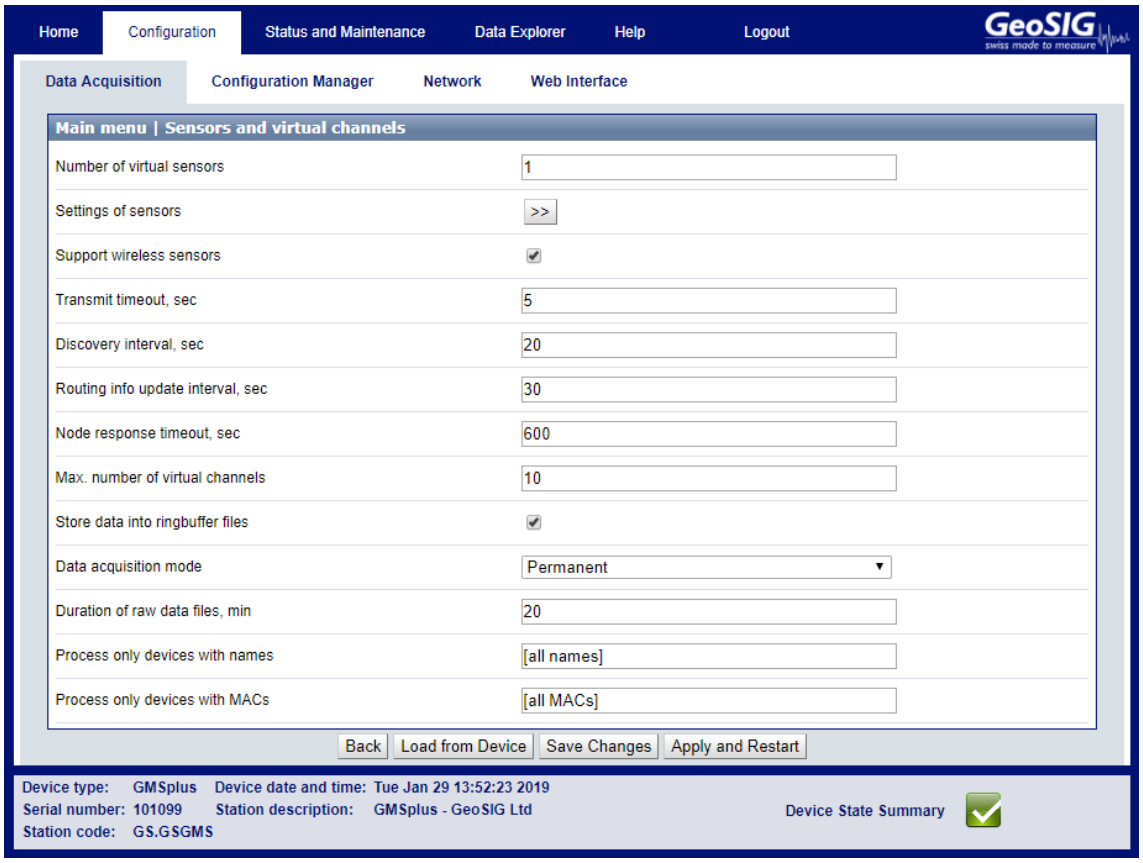


Figure 75: Edit GeoSIG Options

9.10.2 Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 1
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  L) Parameters of Preset Triggers ... ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  P) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- Press ***'P'*** to get to the *GeoSIG Options* menu to enter Product key for EEW applications, enable/disable and configure waveform injection and other GeoSIG specific features.

```
Main Menu | Sensors and virtual channels
  A) Number of virtual sensors ........... 1
  B) Settings of sensors ................. ->
  C) Support wireless sensors ............ Yes
  D) Max. number of wireless sensors ..... 10 (0x0A)
  E) Minimum request interval, ms ........ 2 (0x02)
  F) Transmit timeout, sec ............... 5 (0x05)
  G) Discovery interval, sec ............. 20 (0x14)
  H) Routing info update interval, sec ... 30 (0x1E)
  I) Node response timeout, sec .......... 600 (0x258)
  J) Delay after requests, ms ............ 200 (0xC8)
  K) Max. number of virtual channels ..... 10 (0x0A)
  L) Store data into ringbuffer files .... Yes
  M) Data acquisition mode ............... Permanent
  N) Duration of raw data files, min ..... 20 (0x14)
  O) Process only devices with names ..... [all names]
  P) Process only devices with MACs ...... [all MACs]
```

- The following parameters can be adjusted:

Number of virtual sensors			User selectable	Choose the number of virtual sensors [1-256]
Settings of sensors	***'+'*** and ***'-'*** can be used to change between the virtual sensors			
	Unique sensor ID		User selectable	Name of unique sensor ID
	Measurement type		User selectable	Name of the type of measurement
	Number of channels		User selectable	Choose the number of channels [1-256]
	List of channels	***'+'*** and ***'-'*** can be used to change between the virtual channels		
		Assigned channels name	User selectable	Assign channel name to a virtual sensor
		Quantity	User selectable	Name of the type of measurement
		Minimum value	User selectable	Type minimum value
		Maximum value	User selectable	Type minimum value
	Support wireless sensors		***Yes***	Enable wireless sensors
			No	Disable wireless sensors
	Transmit timeout, sec		User selectable	Put transmit timeout in second
	Discovery interval, sec		User selectable	Put discovery timeout in second
	Routing info update interval, sec		User selectable	Put Routing info update interval in second
	Node response timeout, sec		User selectable	Put Node response timeout in second
	Max. number of virtual channels		User selectable	Choose the maximum of number of channels
	Store data into ringbuffer files		***Yes***	Enable the store of data into ringbuffer files
			No	Disable the store of data into ringbuffer files
	Data acquisition mode		***Permanent***	Data acquisition is permanent
			Trigger-based	Data acquisition is trigger-based
	Duration of raw data files, min		User selectable	Put Duration of raw data file in minutes
Process only devices with names			User selectable	[all names] allows all names
Process only devices with MACs			User selectable	[all MACs] allows all MACs address

Table 18: Sensor and Virtuals Parameters menu structure

9.11 GeoSIG Options

This menu and the functions under it are subject to change. The user should not use or rely on any features under this menu without consulting GeoSIG.

9.11.1 In the Web Interface or by GeoDAS

- Go to ***Configuration → GeoSIG Options***

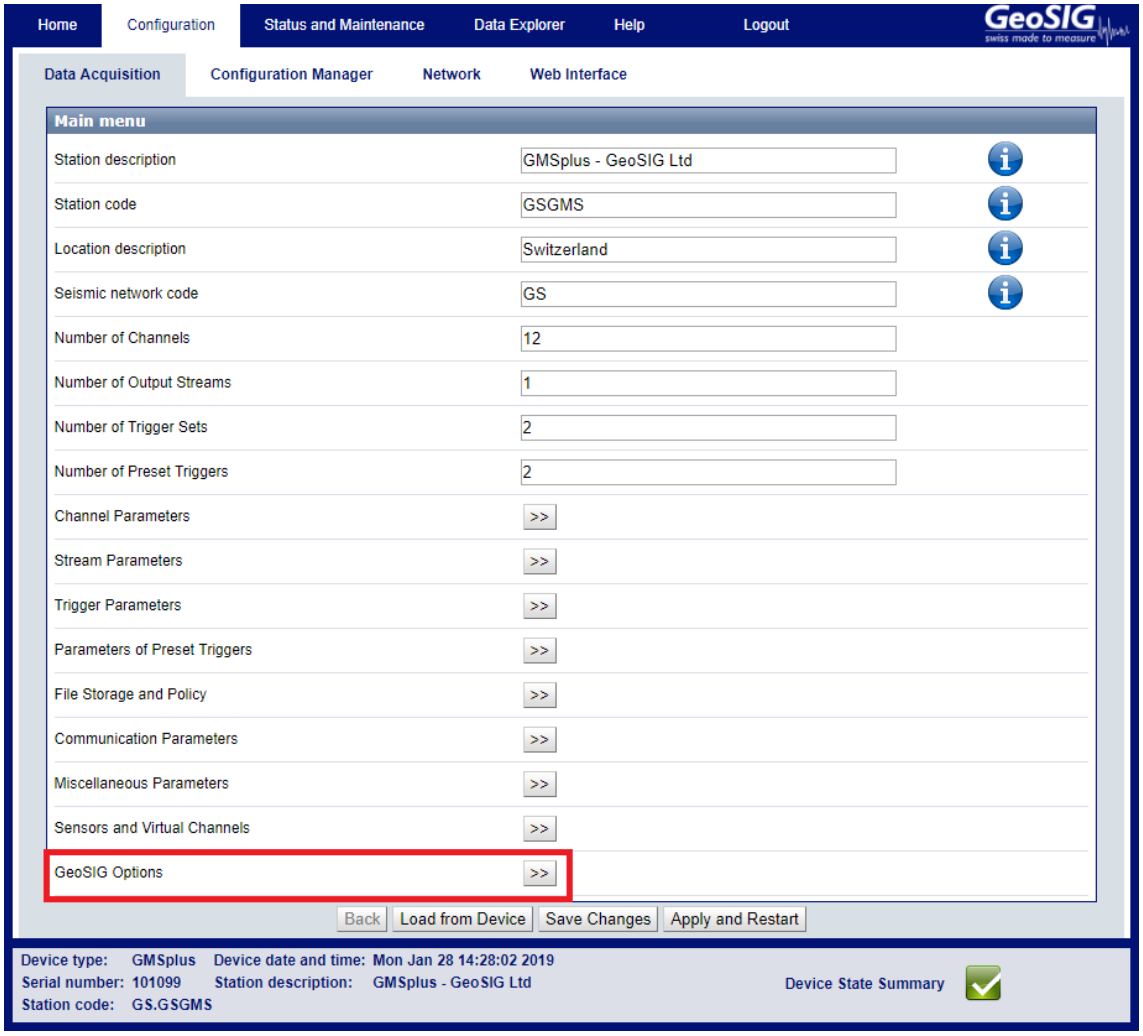


Figure 76: GeoSIG Options

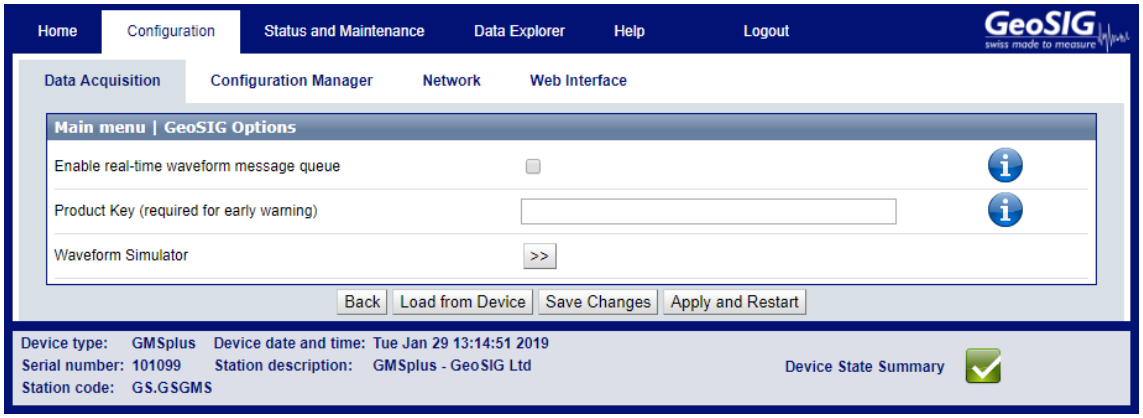


Figure 77: Edit GeoSIG Options

9.11.2 Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo GMSplus
  B) Station code .................... DEMO
  C) Location description ............ Switzerland
  D) Seismic network code ............ CH
  E) Number of Channels .............. 3
  F) Number of Output Streams ........ 1
  G) Number of Trigger Sets .......... 1
  H) Number of Preset Triggers  ...... 1
  I) Channel Parameters .............. ->
  J) Stream Parameters ............... ->
  K) Trigger Parameters .............. ->
  L) Parameters of Preset Triggers ... ->
  M) File Storage and Policy ......... ->
  N) Communication Parameters ........ ->
  O) Miscellaneous Parameters ........ ->
  Q) Sensors and Virtual Channels .... ->
  S) GeoSIG Options .................. ->
```

- Press ***'S'*** to get to the *GeoSIG Options* menu to enter Product key for EEW applications, enable/disable and configure waveform injection and other GeoSIG specific features.

```
Main Menu | GeoSIG Options
  A) Enable real-time waveform message queue .... No
  B) Product Key (required for early warning) ... XXXXX-XXXXX-XXXXX-XXXXX-XXXXX
  C) Waveform Simulator ......................... ->
```

- The following parameters can be adjusted:

Enable real-time waveform message queue		***Yes***	Enable the real-time waveform message queue.
		No	Disable the real-time waveform message queue.
Product Key (required for early warning)		User selectable	If purchased, enter the product key for early warning options. The product key is of the form XXXXX-XXXXX-XXXXX-XXXXX-XXXXX.
Waveform Simulator	***Enable waveform source***	User selectable	Enable waveform inject from files (0...disable, 1...first file, 2...second file, 3...third file.
	Source 1	User selectable	Path for first waveform source.
	Source 2	User selectable	Path for second waveform source.
	Source 3	User selectable	Path for third waveform source.

Table 19: GeoSIG options menu structure

9.12 Other Options in the Instrument Main Menu

Next to the edit of the instrument configuration, there are other actions possible from the main menu shown below:

```
GMSplus s/n 100582 version 21.11.00
Main menu:
C - Configuration
M - Messages ->
S - Shell command
L - List firmware images
X - Display errors (0) and warnings (0)
W - Clear errors and warnings
F - View/reset RTC trim values
T - File statistics
G - View RTC status
P - View GPS information
H - Set RTC time
U - User request
R - Restart
Q - Quit
```

	Action or command	Description
C	***Configuration***	Change of the configuration of the instrument. See chapter 9 for details.
M	***Messages →***	Possible to configure what kind of messages are shown in the console.
S	***Cell command***	Allows executing a Linux shell command from *armdas*. For advanced users only.
L	***List firmware images***	Displays the list of firmware images and configuration stored in the non-volatile memory of the instrument. There are two copies of each type of firmware, except for the Bootloader, which has only one image.
X	***Display errors (n) and warnings (m)***	Shows present errors and warnings.
W	***Clear errors and warnings***	Clears all errors and warnings.
F	***View/reset trim values***	Shows trim values of the RTC. Trim table can be erased as well. For advanced users only.
G	***View RTC status***	Shows the actual state of the real time clock and whether the RTC is synchronized to NTP or GPS.
P	***View GPS information***	Shows the actual GPS information if the unit is equipped by the GPS receiver.
H	***Set RTC time***	Allows setting the time of the instrument manually. Keep in mind, that if a GPS is connected or a NTP server is configured, the time will be synchronized to them after a while, not immediately.
U	***User request***	See chapter 9.12.1 for details.
R	***Restart***	Restarts the instrument, e.g. after a change of the configuration.
Q	***Quit***	Stops *armdas* data acquisition and exits to the Linux console. For advanced users only.

Table 20: Other options in the main menu

9.12.1 User Requests

Several actions can be initiated by the user:

- In the main menu press ***'U'*** to enter the User request menu; type ***HELP*** to see all the possible commands.

```
GMS-XX s/n 100710 version 20.00.97
Main menu:
C - Configuration
M - Messages ->
S - Shell command
L - List firmware images
X - Display errors (1) and warnings (0)
W - Clear errors and warnings
F - View/reset RTC trim values
T - File statistics
G - View RTC status
P - View GPS information
H - Set RTC time
U - User request
R - Restart
Q - Quit

Command or HELP for more information --> help
```

The list of all supported user requests (commands) along with their description is provided in the table below.

Action or command	Description
Data requests, triggering:	
GETEVT YYYY-MM-DD HH:MM:SS N	The instrument creates an event with the length of N seconds from the ringbuffer data, starting from the indicated date and time and uploads the data to the server if configured (see chapter 9.8).
TRIGGERNOW [trigger_name]	Activate a manual trigger to start recording, the manual trigger must be configured as described in the chapter 9.6
STOPTRIGGER [trigger_name]	Deactivates the manual trigger
Status and information:	
GETSOH	The instrument generates a SOH file with the current state-of-health information and uploads to the server if configured (see chapter 9.8).
GETLOG	The instrument uploads today's logfile to the server.
SETMSG flags	Enables/disables debug log messages. For service only, do not change
CLRMSG flags	
Service and recovery:	
LASTDT YYYY-MM-DD HH:MM:SS	Set date and time of the last transferred file The instrument saves the date and time of the latest uploaded file and will not upload any file which is created before this date and time. Under normal conditions this will be never the case. But if the time is changed backwards by the user - e.g. from 10:00 to 06:00 - the instrument will not upload any data till 10:00 again. So the time of the last transferred file can be adjusted here and should be set to 06:00 in this example.
FORMAT	Formats the data storage media. **All data will be lost, and instrument will be restarted.**
REBOOT	Performs full reboot of the instrument
RESETERR	Reset errors and warnings of the instrument

GETTRIM	The instrument will upload a SOH file containing the actual values from the RTC trim table. The latest SOH file can be found under *\\GeoDAS_DATA\StatusFiles\InfoSOH.xml*
CLEARTRIM	The instrument will clear the RTC trim table
TCAL <Tcur>	Calibration of the internal temperature sensor by applying the actual temperature in °C. The RTC uses temperature to learn.
SETDEFCFG	Makes the current instrument configuration as user default one. Whenever you change parameters of the instrument, they are saved in the non-volatile instrument memory as Current Configuration, and used to set all parameters of the data acquisition at startup. But if due to some reason the current configuration gets corrupted, and the instrument cannot load or cannot process it, the Default Configuration file, which is created by this command, will be used instead. Note that Default Configuration is compiled from the actual parameters of the running system, and therefore it is already approved by the instrument and is supposed to be correct. Thus, we recommend sending this command to the instrument after you are sure that your instrument is started with the latest configuration correctly and everything works as expected. The default configuration can also be set and restored in the Web Interface, see chapter 8.3.2
RSTUSRDEF	Reset the instrument to its user default configuration.
DELETE <file_prefix or ALL> [YYYY-MM-DD [HH:MM]]	Delete one group of files or all groups of files from the compact flash card. One can request to delete only files that are older than the specified date (and optionally time).
Sensor test and calibration:	
TSTSENSOR 1 [REC=TRG|YES|NO] [ALARM=TRG|YES|NO]	The instrument generates a sensor test pulse. Optional parameters REC and ALARM specify whether a file will be recorded during test and whether an alarm will be generated in case an alarm board is present. Parameters TRG, YES and NO correspond to the modes Normal, Always and Never described in the section 9.9.2
REMOVEDC	Remove offsets from signals
Others:	
CANCEL	Leave the menu

Table 21: User requests

In case the instrument has a Seismometer Control Board installed, then additionally the following user requests are possible under *Sensor test and calibration*:

SLOCK	Performs a mass locking of the connected seismometer
SUNLOCK	Performs a mass unlocking of the connected seismometer
SCENTRE	Perform a mass centring of the seismometer

The same request can also be done from GeoDAS by choosing 'Send a Request' from the 'GMS Communication Interface'. See chapter C.3.4 for details.

10 Test and Configuration Menu

The test and configuration menu can only be accessed locally at the instrument over the serial cable.

- Switch on the instrument by pressing and holding the POWER button for 2 seconds.
- Press ***<Ctr> + 'Z'*** as soon as the following message appears on the console to enter the test and configuration mode:

```
Press Ctrl+Z to enter the test mode...............
```

- The test and configuration menu has three access levels.

```
-------------------------------------------------------------------------------------------
Level         Shortcut Password Description
-------------------------------------------------------------------------------------------
User          Ctrl+U   None     Basic operations only
Powerful User Ctrl+W   None     Also hardware options and pre-selected tests
Administrator Ctrl+A   None     Also manual tests and altering the FLASH memory content
-------------------------------------------------------------------------------------------
Your level [U/W/A] or press B to boot now:
```

The test and configuration menu has three access levels as outlined above: User, Powerful User and Administrator, and each level can be protected by a password. Instead of pressing ***<Ctrl>+'Z'***, one can press ***<Ctrl>+'U'***, ***<Ctrl>+'W'*** or ***<Ctrl>+'A'*** to bypass the above messages and to proceed directly to a menu of the desired level. The Administrator has access to the most complete menu but the majority of functions are not used for the standard instrument operation, and therefore they are not described here in detail. The useful options are highlighted and described below.

```
Access level: User

 --- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
5 - Boot now
X - Reboot the instrument
Y - Power off

 --- Hardware Setup and Monitor ---
N - Network settings

 --- Security ---
O - Set password

-->
```

```
Access level: Powerful User

 --- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
5 - Boot now
X - Reboot the instrument
Y - Power off

 --- Hardware Setup and Monitor ---
K - Instrument hardware parameters
N - Network settings
T - Battery installation dates

 --- Security ---
O - Set password
J - Reset all passwords

-->
```

```
Access level: Administrator

 --- Flash Images and Boot Options ---
L - List flash images
Q - Reset instrument configuration to the user default
V - Reset instrument configuration to the factory default
5 - Boot now
X - Reboot the instrument
Y - Power off

 --- Hardware Setup and Monitor ---
K - Instrument hardware parameters
N - Network settings
T - Battery installation dates

 --- Test Functions ---
P - Test RTC
M - Test GPS

 --- Security ---
O - Set password
J - Reset all passwords

-->
```

10.1 Flash Images and Boot Options

L	***List flash images***	Lists all the current firmware in the image
Q	***Reset instrument configuration to the user default***	Forces the instrument to load the user default configuration. See description of the command SETDEFCFG in the chapter 9.12.1
V	***Reset instrument configuration to the factory default***	Forces the instrument to load the factory default settings
5	***Boot from the default image***	Exits the test and configuration menu and starts the instrument normally
X	***Reboot the instrument***	Forces the watchdog to completely restart the instrument
Y	***Power off***	Forces the watchdog to switch off the instrument

10.2 Hardware Setup and Monitor

K	***Instrument hardware parameters***	Checks what HW is installed in the instrument and adjust the number of sensors
N	***Network settings***	Enters the menu to adjust the network settings (dynamic or fixed IP, subnet and gateway, DNS servers), the PPP settings, enable/disable the SSH and Web Interface and configure the backup server. For details see chapter 5.2
T	***Battery installation dates***	Whenever you install a new battery, you must set the installation dates using this menu.

10.3 Test Functions

P	***Test RTC***	Runs an automatic check of the RTC
M	***Test GPS***	Allows user to the see the NMEA messages of the GPS and to initialise the GPS receiver.

10.4 Security

O	***Set password***	Sets the password to prevent unauthorised access to the current level of the test and configuration menu.
J	***Reset all passwords***	Resets all passwords below the levels of access

- Leave the test and configuration menu by pressing ***'5'*** or ***'Y'***

10.5 Comparison of User Permissions

	User	Powerful User	Administrator
Flash Images and Boot Options			
List Flash images	X	X	X
Reset instrument configuration to the user default	X	X	X
Reset instrument configuration to the factory default	X	X	X
Boot now	X	X	X
Reboot the instrument	X	X	X
Power off	X	X	X
Hardware Setup and Monitor			
Instrument hardware parameters		X	X
Network settings	X	X	X
Battery installation dates		X	X
Test Functions			
Test RTC			X
Test GPS			X
Security			
Set password	X	X	X
Reset passwords		X	X

Table 22: Comparison of test and configuration menu users

11 Firmware Upgrade

All the firmware for

- Linux operating system
- armdas firmware
- DSP
- RTC

can be upgraded by the user by using GeoDAS as described in the following chapters. The firmware will be released only as a complete package, containing all the firmware listed above. Please see ***www.geosig.com → Support → Downloads*** to download the latest firmware release package.

Even if there is no known case of data loss during the upgrade, we recommend backing up all recorded data and the configuration before starting the upgrade.

After any firmware upgrade, the configuration and the correct function of the instrument should be fully verified.

If the instruments are configured to contact a server, it is possible to upgrade all or specific instruments remotely using GeoDAS. Before trying to upgrade remotely, be sure the instruments have a working network connection to the server. To proceed with the firmware upgrade, please take the following steps:

- Make a right click on the Station in the GeoDAS main window and select ***Instrument Control...***

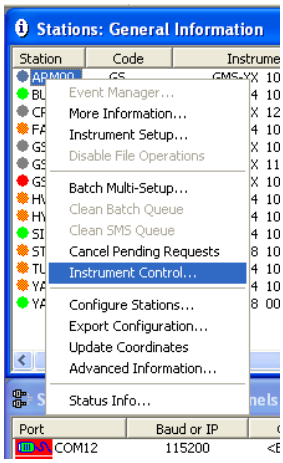


Figure 78: Select Instrument Control

- A list box will appear.

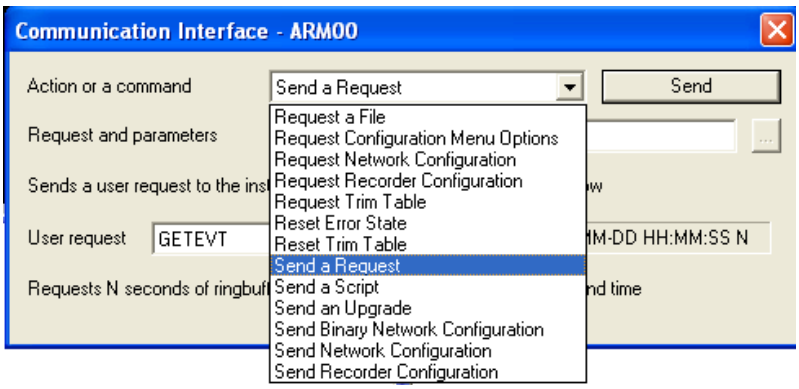
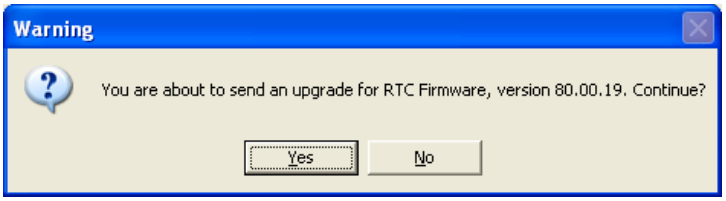


Figure 79: instrument Communication Interface

- Select the item Send an Upgrade
- Press on the button Browse **...** to select the required firmware. Select a firmware container with the extension ****.gsfw*** or a ****.zip*** archive containing several update packages.
- If the file is selected, press the ***Send*** button. GeoDAS identifies the firmware and asks for confirmation. Please double check that the correct firmware has been selected.



- Upon pressing the ***Yes*** button, the firmware will be placed in the Outgoing directory, so that it can be collected by the instrument(s) upon next connection.

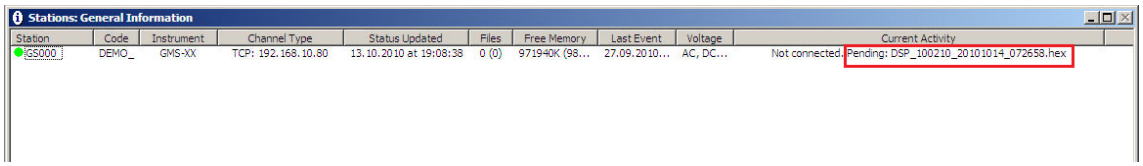


Figure 80: Pending upgrade on the server

- As soon as the instrument has downloaded the new firmware, the text *Pending: xxx.gsfw* disappears. The instrument will verify the firmware and once the upgrade process is finished, the instrument will restart.

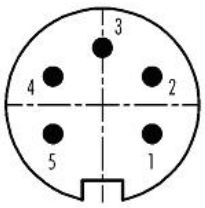
When the instrument software receives such a file it checks the actual version and, only if the file contains more recent firmware than the existing one, it will start the upgrade. After the upgrade, the new firmware will be in “trial” mode and a reboot is done. If the reboot and instrument operation is correct, the new firmware will be accepted. If the instrument reboots through its watchdog because the firmware was faulty, the previous firmware version will be used and the system will be restored to its state before the upgrade.

Downgrades to the older firmware versions might be required in some specific cases. This is possible, too. Please contact GeoSIG support for the exact procedure of such downgrade.

Appendices

Appendix A Connector Pinouts

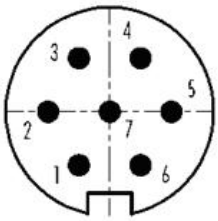
A.1 POWER Connector



Pin	Description
1	External power supply, 15 VDC
2	GND
3	External battery [1], 12 VDC
4	GND
5	Shield

Mating Type: Binder Series 423, cable connector female, 5 pole

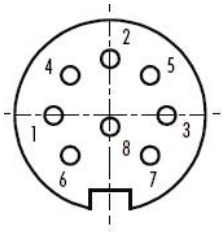
A.2 ETHERNET Connector



Pin	Description
1	Detection if cable is connected, to be connected to GND inside the cable
2	RXD+
3	RXD-
4	TXD+
5	TXD-
6	Shield / GND
7	Shield / GND

Mating Type: Binder Series 423, cable connector female, 7 pole

A.3 SERIAL Connector

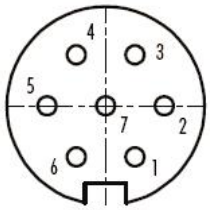


Pin	Description - COM Pinout	
1	TXDa	*COMa: ttyS2 or ttyS3*
2	RXDa	*Serial data streaming and cellular modem*
3	RTSa	
4	CTSa	
5	TXDb	*COMb: ttyS0*
6	RXDb	*Configuration Console*
7	Power, 12 VDC	*For external cellular modem only*
8	GND	
Pin	**Description - USB Pinout**	
1	USB Device Vbus	*USB Device Connector*
2	USB Device D+	
3	USB Device D-	
4	GND	
5	USB Host D+	*USB Device Connector*
6	USB Host D-	
7	USB Host Vbus	
8	GND	

Mating Type: Binder Series 423, cable connector male, 8 pole

[1] Cannot be used together with an internal battery

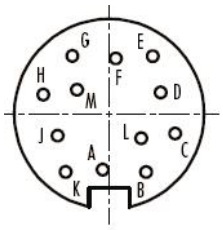
A.4 GPS Connector



Pin	Description
1	TXD
2	RXD
3	N/C
4	GND
5	1PPS
6	Power, 12 VDC
7	GND

Mating Type: Binder Series 423, cable connector male, 7 pole

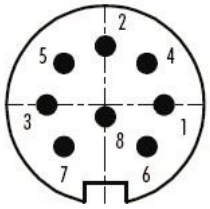
A.5 SENSOR Connectors



Pin	Description
A	X+
B	X-
C	Y+
D	Y-
E	Z+
F	Z-
G	S_Test, Calibration Test Pulse
H	GND
J	Power, 12 VDC
K	GND
L	S_Mode, Calibration Enable
M	Analog AGND

Mating Type: Binder Series 423, cable connector male, 12 pole

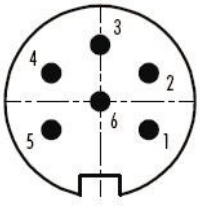
A.6 INTERCONNECTION Connector



Pin	Description	Seismometer Control Option
1	Trigger +	/Lock
2	Trigger -	/Center
3	Time Synchronisation +	Mass Position E/W
4	Time Synchronisation -	/Unlock
5	RS-485 + (not used)	Busy Signal
6	RS-485 - (not used)	GND
7	N/C	Mass Position N/S
8	GND	Mass Position V

Mating Type: Binder Series 423, cable connector female, 8 pole

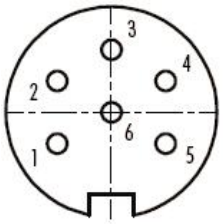
A.7 MODEM Connector



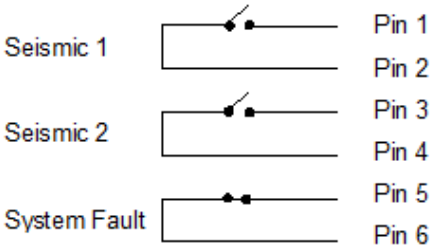
Pin	Description
1	Line a
2	Line b
3	N/C
4	N/C
5	N/C
6	HGND

Mating Type: Binder Series 423, cable connector female, 6 pole

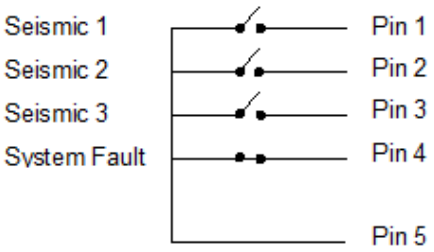
A.8 ALARM Connector



Standard Configuration
3 isolated relay contacts



Optional Configuration
4 relay contacts with common pin



Mating Type: Binder Series 423, cable connector male, 6 pole

The contacts are suitable for a low voltage control. In case large load must be switched then external relays must be implemented. Max rating of the internal relay is 125 V */ 250* mA.

Appendix B Remote Access to the Instrument over SSH

The following chapter is for advanced users only.
Warranty will be void if something is damaged by user during changes in the root file system.

Secure Shell (SSH) is a network protocol for secure data communication, remote shell services or command execution and other secure network services between two networked computers that it connects via a secure channel over an insecure network: a server and a client (running SSH server and SSH client programs, respectively).

The armdas console cannot be shown through the SSH. This is a limitation of the armdas firmware.

The instrument supports all types of remote access through SSH. User can connect from his PC by SSH client program to the SSH server of the instrument. Simple SSH client program can be used for this purpose. Use root as login and swiss as the password, as shown:

Login: ***root***
Password: ***swiss***

Sign '#' is a command prompt where you can type console commands.

The password can be changed by **passwd** command.

Warranty will be void in case password is changed and forgotten.

B.1 SSH Clients for Linux OS

For the Ubuntu or other Debian-like GNU/Linux OS, SSH client program, with command line interface, can be installed by command

```
$ sudo apt-get install openssh-client
```

To login into the instrument console, "ssh root@192.168.1.10" command can be issued from any terminal emulator as following figure shows:

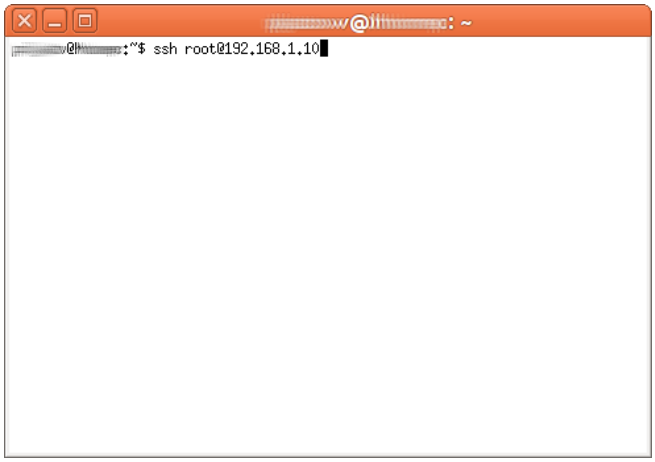


Figure 81: Command line SSH client at terminal emulator

Alternatively, the PuTTY SSH client with GUI interface can be installed by command

```
$ sudo apt-get install putty
```

This software can be found in a menu ***Applications*** → ***Internet*** → ***PuTTY SSH Client*** and its configuration dialog looks like:

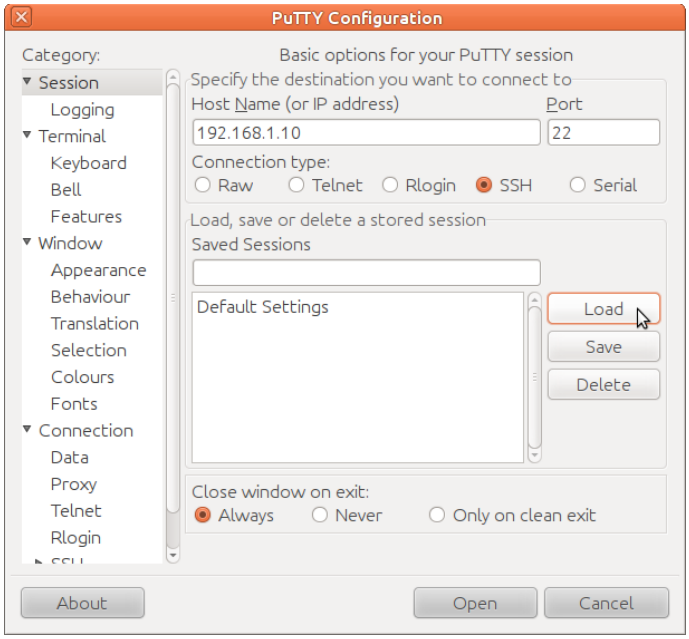


Figure 82: Configuration window of PuTTY

IP address 192.168.1.10 from examples above should be changed to the real IP address of the instrument.

B.2 SSH Clients for Windows OS

The same PuTTY as for GNU/Linux OS or alternatively TeraTerm software can be used for Windows OS to have remote access to the instrument by means of SSH.

Its connection window is shown below

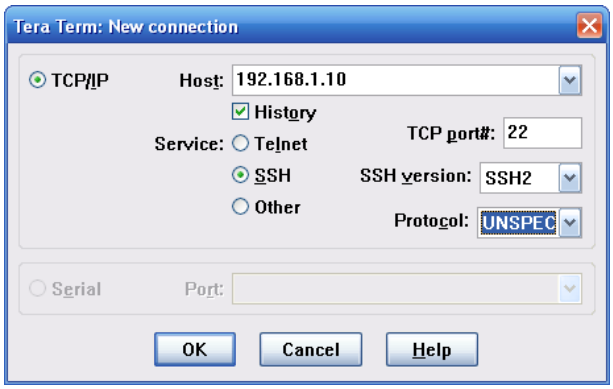


Figure 83: TeraTerm Connection Window

The PuTTY software for Windows OS operates the same as PuTTY for Linux OS.

The PuTTY software can be downloaded from https://www.chiark.greenend.org.uk/~sgtatham/putty/

The TeraTerm software can be downloaded from http://ttssh2.osdn.jp/

B.3 SFTP access for Windows OS

WinSCP is an open source free SFTP client for Windows. Its main function is the easy file transfer between a local computer and the instrument.

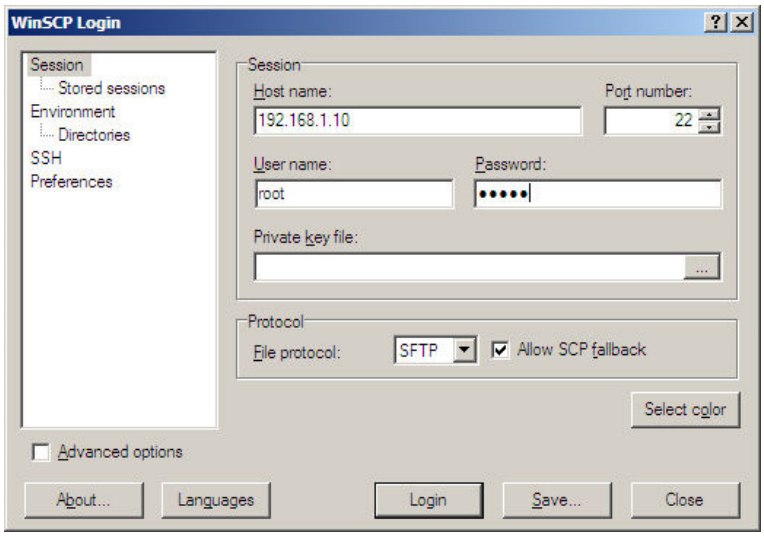


Figure 84: WinSCP login window

To connect to the instrument put the IP address of the GMS[plus] and enter the following user name and password:

Login: ***root***
Password: ***swiss***

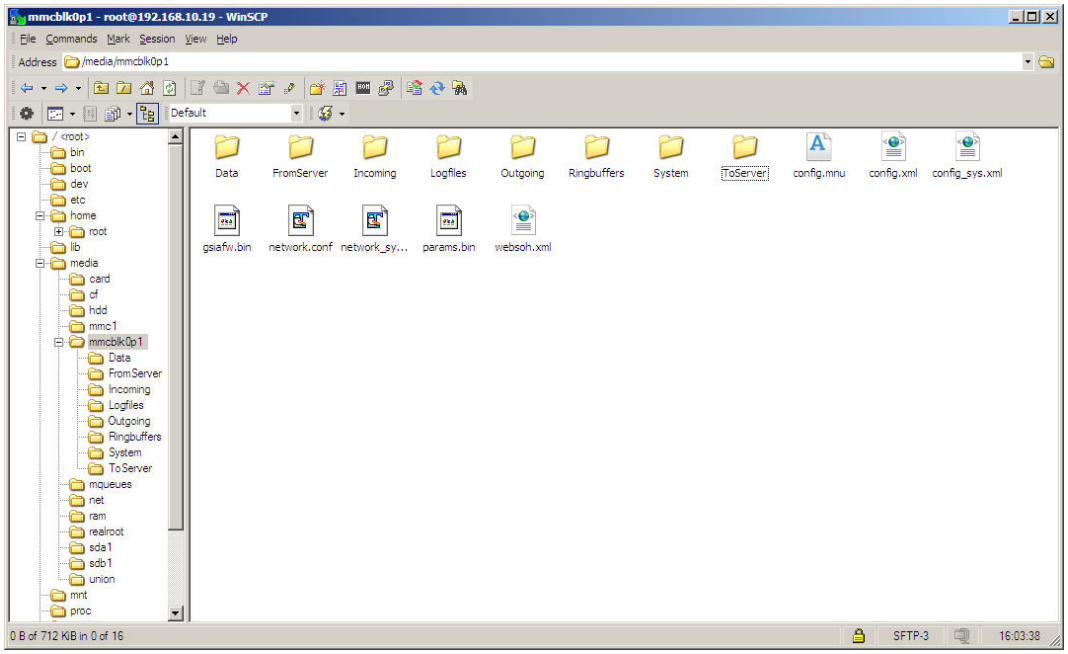


Figure 85: Explorer mode of WinSCP when connected to the instrument

It is then possible to browse through the available data on the instrument and copy files from or to the computer. The file structure is described in the following chapter.

The WinSCP can be downloaded from here: https://winscp.net/eng/download.php

B.4 File Structure of the Instrument

On the instrument the files are organized as following

\media\mmcblk01\...	in case an SD card is installed
\media\sda1\...	in case a CF card is installed
...Data\	Event files
...Ringbuffers	Permanent recording files
...Logfiles	Log files of armdas

The filenames contain the following information

XXX_SNSNSN_YYYYMMDD_HHMMSS.ext

Extension	**.ext**	Depending on file type
	.msd	MiniSEED containing waveform data
	.xml	SOH and PGM information
	.txt	LOG and ERR files
	.bin	MMA packets (special for Korean market)
Time	**HH**	Hour
	MM	Minutes
	SS	Seconds
Date	**YYYY**	Year
	MM	Month
	DD	Day
S/N	**SNSNSN**	Six digit serial number of instrument
Type	**XXX**	Depending on file type
	TRG	Event trigger
	USR	User request
	TTT	Time table trigger
	CAL	File with test pulse
	MAN	Manual trigger
	RBF	Permanent recording
	LOG	Log files
	SOH	State of Health information
	PGM	PGM information of event
	ERR	Error messages

Appendix C GeoDAS Settings

C.1 Configuration of Stations

To be able to communicate with the instrument, GeoDAS must act as a server. This chapter should help to find the correct settings.

- Open GeoDAS and Go to the menu ***Settings*** → ***Configure Stations...*** , the following window will appear:

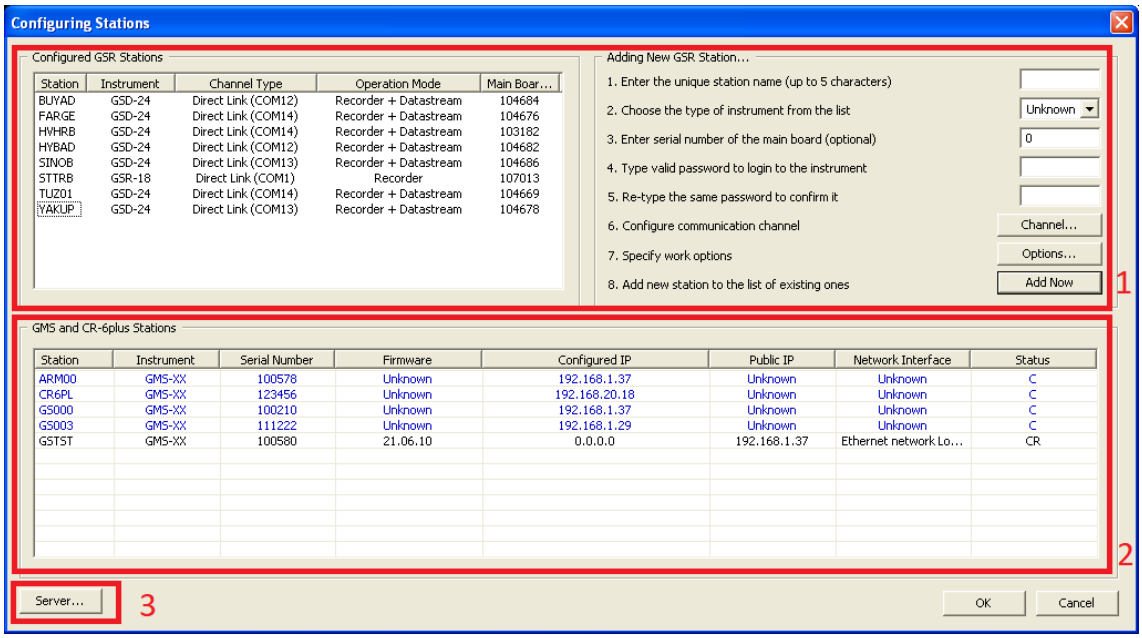


Figure 86: Configuration Stations

Area	Topic	Description
1	Configured GSR Stations	Details about the configured GSR-xx and GCR-xx stations. Check separate *GeoDAS Manual* for details.
2	Instrument Stations	Details about the configured instruments. All instruments connected to the same network will be listed in grey. ***Station*** name can be changed by a double click on the field you want to change. The column ***Instrument*** and ***Serial Number*** shows the instrument type and its serial number. The ***Firmware*** column shows the firmware version of the main data acquisition firmware. The ***Public IP*** shows from where the instrument is connected to the server. In case the instrument is behind a router or firewall, then this IP address will be shown. Network settings can be done according to chapter 7. If one wants to connect manually to the instrument, then GeoDAS will try the address and port listed under ***Address***. The last column in the table is ***Status***, which is indicated by one or more letters, which are the following: • N - New instrument • C - already Configured earlier • A - Altered parameters • R - actual settings were Received from the instrument
3	Server Settings	For configuration of the Server, see chapter C.2

C.1.1 Add a new Instrument

All instruments connected to the same network will be listed in grey. To add one of these stations into the current configuration do the following:

- Select the instrument and make a ***right click***
- Click on ***Add Station to Current Configuration***
- Press ***OK***

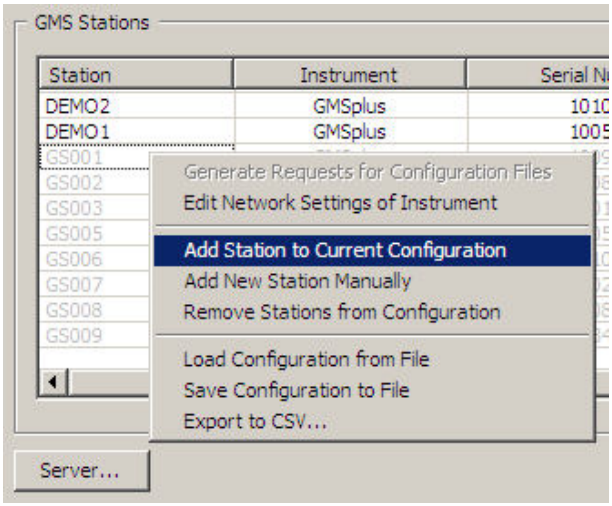


Figure 87: Add Station to Current Configuration

If the instrument is not in the local network and cannot directly be accessed, then press ***Add New Station Manually*** and enter the serial number of the instrument.

C.1.2 Remove an Instrument

To remove one of the stations of the current configuration do the following:

- Select the instrument and make a ***right click***
- Click on ***Remove Station from Configuration***
- Press ***OK***

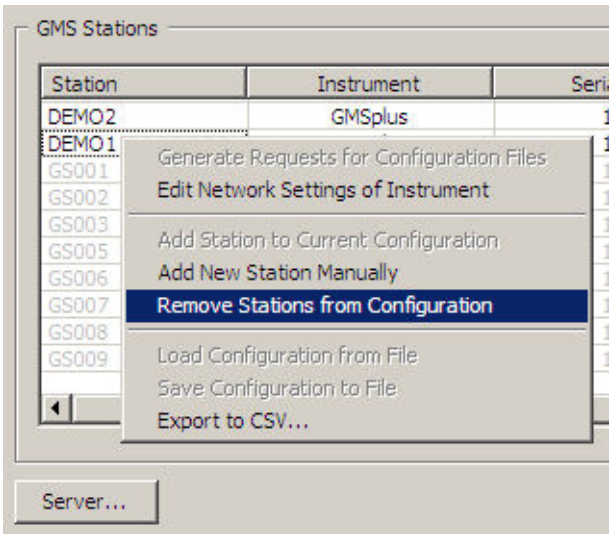


Figure 88: Remove Station from Current Configuration

For more details please see *GeoDAS Manual*.

C.2 Configuration of Server Parameters

- Press the button ***Server...***, the window below appears:

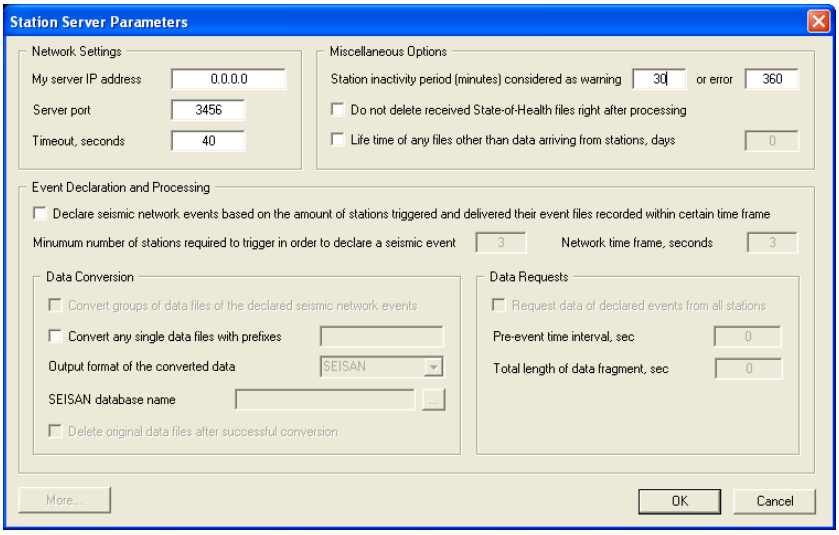


Figure 89: Station server parameters

Group of Controls	Description
Network Settings	***IP address and port*** of the server, i.e. computer which GeoDAS is running on as well as the network ***Timeout*** in seconds. If server has several network interfaces but connections from instruments are expected from only one of them, then its IP address must be specified. Otherwise, leave it zero, which means that GeoDAS accepts incoming connection at any interface. The timeout is used to decide when to terminate current network connection if the remote party does not respond within the indicated time interval.
Miscellaneous Options	***Network error*** is declared if an instrument did not communicate with GeoDAS within the indicated period of time. Make sure that this parameter is higher that the communication interval set in the instrument as described in chapter 9.8 If ***State-of-health forwarding interval*** is set to nonzero value, then SOH reports are collected within this period of time and only then are forwarded. You can also choose not to delete SOH reports after processing. If this option is selected, all received state of health reports remain in the directory *\\GeoDAS_DATA\StatusFiles \InfoSOH*
Event Detection	GeoDAS can be instructed to analyse event data files received from configured instruments to see if they belong to the same earthquake and to declare an event if it is so. You need to enable the option ***Declare and process triggers of seismic network*** in order to do so. A network event is declared if at least ***Minimum number of stations triggered*** within the ***Network time frame***. Received event files can be converted to Seisan format and stored in Seisan database on the same computer.
Customised Data Processing	This is not a standard feature of GeoDAS. Therefore please check the GeoDAS Manual and contact GeoSIG for further details if you need to use this functionality.

C.3 Instrument Control in GeoDAS

By making a right click on the station name in the window *Stations: General Information*, several options become available to control and check the instrument. See the figure below:

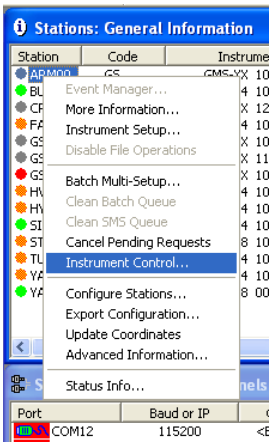


Figure 90: Instrument control of the station in GeoDAS

C.3.1 More Information... (State of Health of the Instrument)

The status of the instruments can be easily checked if the instrument is set up to transfer periodically the SOH file to the server. (See details about SOH configuration in chapter 8.4 and 9.8).

- Make right click on the Station in the GeoDAS main window and select ***More Information...*** , the following window will appear:

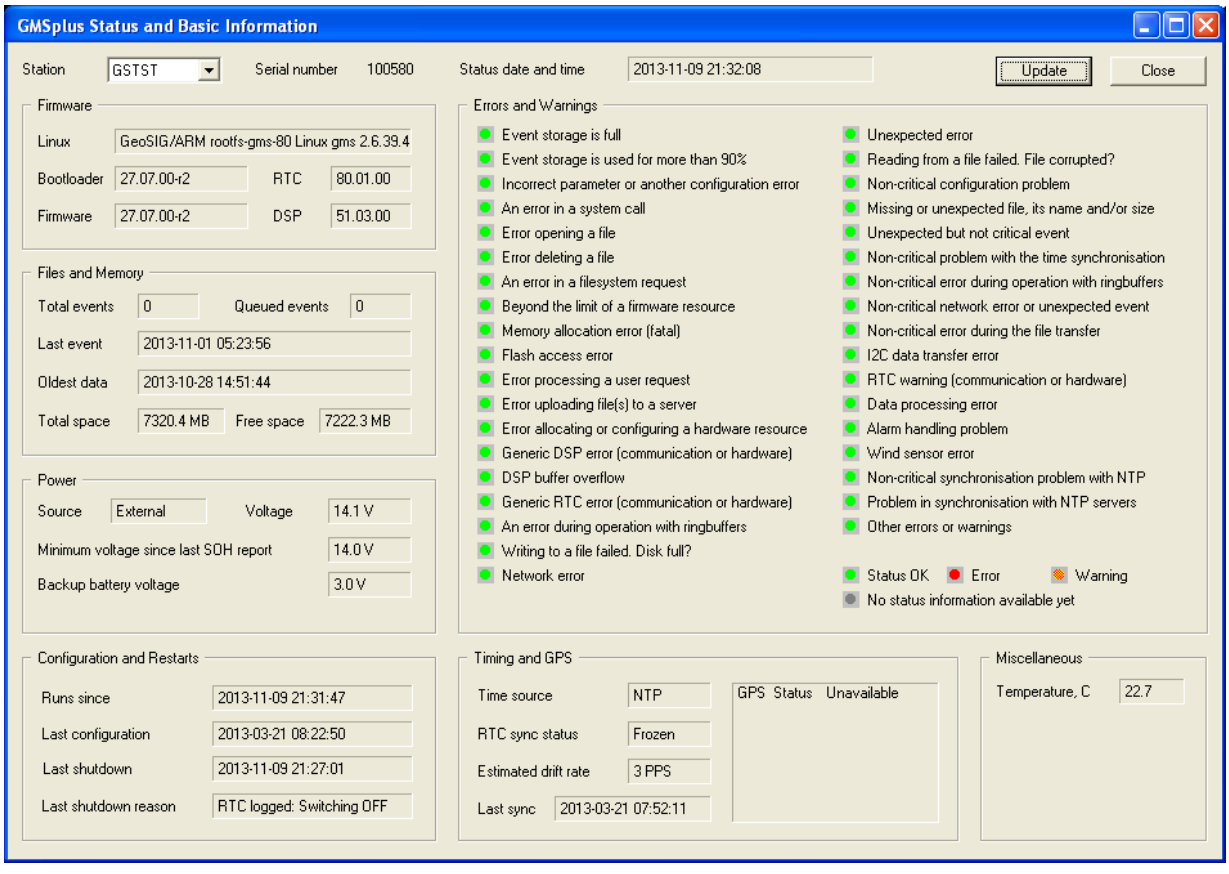


Figure 91: SOH information in GeoDAS

Information Area	Description
Status date and time	Before analysing the SOH data always make sure that the SOH files are current ones by checking the time and date here.
Firmware	Here the firmware versions of all components can be viewed.
File and Memory	Information about events and available memory
Configuration and Restarts	Date and time of the last restart, the last configuration change and the last shutdown are shown. Additionally the reason of the last shutdown is indicated.
Miscellaneous	Ambient temperature, measured inside the instrument. Other information may appear here, depending on the firmware version of the instrument.
Errors and Warnings	List of all errors and warnings of the instrument
Timing and GPS	Status of the RTC and the related GPS information if a GPS receiver is connected and configured
Power	Status of the power supply and the battery voltages

C.3.2 Instrument Setup...

See chapter 9.2.2 for details.

C.3.3 Cancel Pending Request

The pending requests on the server, as shown in the Figure 80, can be canceled by the user.

C.3.4 Instrument Communication Interface

- Make a right click on the Station in the GeoDAS main window and select ***Instrument Control...***; the following window will appear:

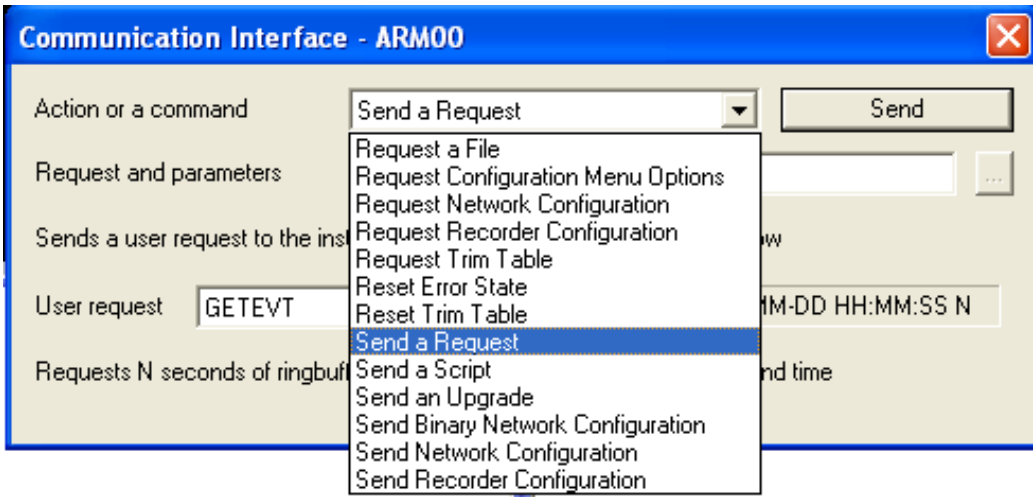


Figure 92: Instrument Communication Interface

Action or command	Description
Request a File	Request a file from the instrument (the full path to the file must be specified)
Request Configuration Menu Options	The instrument uploads the structure of the configuration menu and saves the file in *\\GeoDAS_DATA\Config\Stationname.mnu*. This file is needed for offline configuration of the instrument as described in chapter 9.2.1
Request Network Configuration	The instrument uploads the network settings of the instrument and saves the file in *\\GeoDAS_DATA\Config\Stationname.net*
Request Recorder Configuration	The instrument uploads the configuration of the instrument and saves the file in *\\GeoDAS_DATA\Config\Stationname.xml*. This file is needed for offline configuration of the instrument as described in chapter 9.2.1
Request Trim Table	The instrument will upload a SOH file containing the actual values from the RTC trim table. The latest SOH file can be found under *\\GeoDAS_DATA\StatusFiles\InfoSOH.xml*
Reset Error State	The instrument will clear all errors and warnings.
Reset Trim Table	The instrument will clear the RTC trim table.
Send a Request	Sends a user request to the instrument. For details see chapter 9.12.1
Send a Script	The instrument will download and execute the attached script. This function is for advanced users only, as it can seriously damage the instrument if the script is not written correctly.
Send an Upgrade	The instrument will download the attached file, which can be any type of the firmware, namely: Bootloader, RTC, DSP, main firmware and or the entire Linux image. For more details about the upgrade of the firmware, see chapter 11.
Send Binary Network Configuration	The instrument will download binary network configuration file from the server.
Send Network Configuration	The instrument will download the attached manually adjusted network configuration file from the server.
Send Recorder Configuration	The instrument will download the attached manually adjusted recorder configuration from the server.

C.4 Open recorded miniSEED files in GeoDAS

The system is recording miniSEED files (.MSD). For viewing such files, GeoDAS can be used. As the signal is stored inside the miniSEED file in counts, a scaling factor has to be applied when opening the data. If an ***Extended format of MiniSEED*** files is used (see the chapter 9.9), scaling factors are applied by GeoDAS automatically, and you may skip the information below.

- Open GeoDAS
- Open recorded mini-seed file from the menu ***File*** → ***Open...***

Event files are stored under: *\\GeoDAS_ DATA\Data\STATION_NAME*
Ringbuffer files are stored under: *\\GeoDAS_DATA\DataStreams\STATION_NAME*
Testpulses are stored under: *\\GeoDAS_ DATA \Incoming\NNNNNN*

- When you open a '.MSD' file with *GeoDAS*, the following dialog box for scaling factor appears:

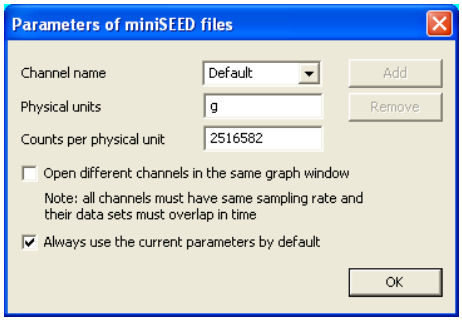


Figure 93: GeoDAS miniSEED parameters

- The values *Physical unit* and *Counts per physical unit* must be set for correct display data in GeoSIG software GeoDAS. The values can be calculated as described in chapter C.4.2.

The user has the possibility to tick "Always use the current parameters " because the unit gets send with the miniseed file

- Press ***OK***
- If instead of the scale prompt you get directly the graph, to get back the prompt each time you open a miniSEED file, use menu: *Analyse* → *Parameters. . .* → *Parameters of miniSEED files* and press ***Edit***:

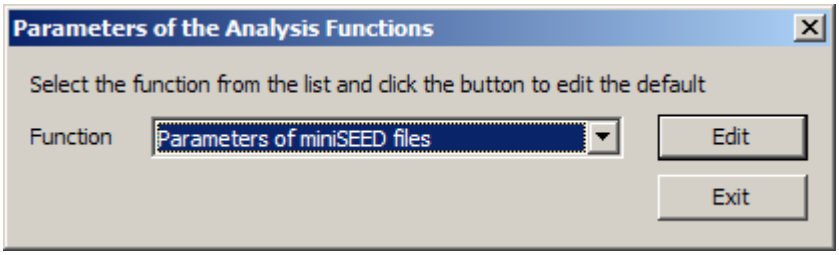


Figure 94: GeoDAS analysis parameters

- Now the dialog box for scaling factor should be seen. Enter the correct values, close and reopen the file you want to see. You will be prompted again for scale; just press OK as the scale is now correct.

C.4.1 Save predefined Scaling Factors

The scaling factor set under Counts per physical unit is always valid for all channels in the same miniSEED file. If the channels have different physical units (e.g. if a six-channel instrument with two different types of sensors is used) a scaling factor for each channel separately can be defined.

To define a scaling factor for a specific channel, enter the full channel name (e.g. LCAX1) in the *filed Channel* name and press ***Add***

All channels which are not specifically defined are converted with the scaling factor saved under *Default*.

C.4.2 Calculation of the Scaling Factors

The scaling factor is the inverse of the LSB value.

$$Scalingfactor = \frac{1}{LSB}$$

See section 9.3.3 for details about how to calculate the LSB factor.