GeoSIG
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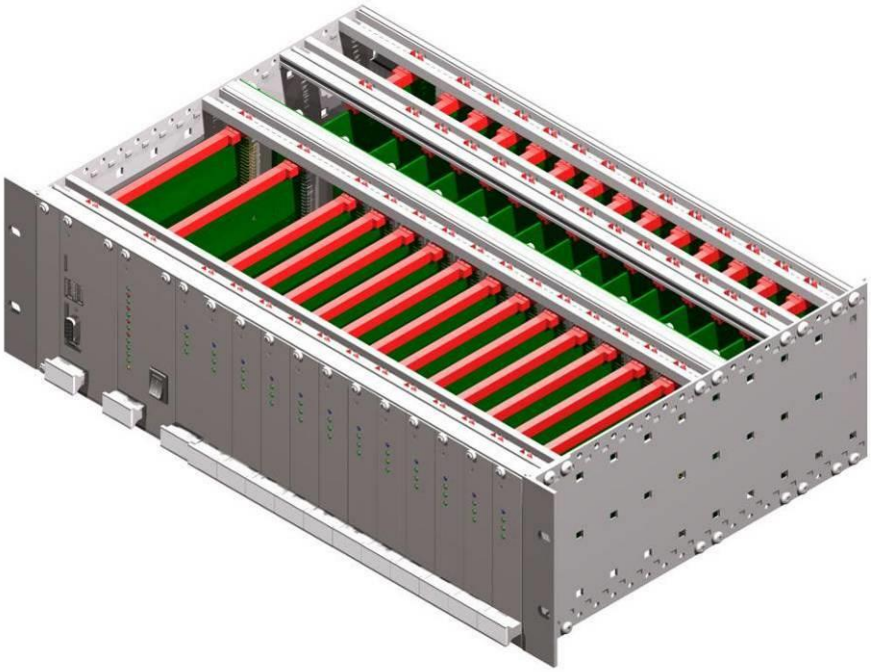
CR-6plus

User Manual



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Document Revision

Version	Date	Modification	Prepared	Checked	Released
1	22.11.2013	First release	FAR	MAE	MAE
2	02.12.2013	Minor changes	MAE	TAB	MAE
3	13.11.2015	Addition of alarm card	JON		
4	06.01.2015	Addition of GPS standard cable colors	WES		
5	12.09.2016	Addition of “GeoSIG Cybersecurity Recommendations” section.	KES	VAG	VAG
6	12.09.2017	Addition to section 5.2.3.1	PAT	VAG	VAG

GeoSIG Ltd

Switzerland

Table of Contents

Table of Tables

Applicability of This Manual

CR-6plus 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 the GeoSIG web page 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	2.25
armdas	Data acquisition software of the instrument	26.05.00
RTC	Real time clock	80.02.02
Bootloader	Barebox	2011.06.0
Web Interface	Web Interface	1.6
Linux OS	Root file system Kernel Version	rootfs-gms-77 3.8.2-rt2

Warnings and Safety

STATIC ELECTRICITY
The Instrument contains 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.

BATTERY LIFE
Although supplied through an AC/DC adapter from the mains, the instrument is optionally shipped with the batteries to provide the backup power supply. If the system is not in use, the batteries should be disconnected. If connected, the batteries are attached using the clamps; the red cable on "+", the black cable on "–" poles of the battery.
Note: The battery lifetime can drastically change depending on operating conditions. Strong discharge of the main battery must be avoided.

REPLACEMENT OF SLOT-IN-MODULES
The slot-in-modules are not hot swappable. When changing any slot-in-modules, the instrument must be switched off first to avoid any damage on the instrument.

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
Bootloader	First program executed when unit starts
CR-6-SBC	Single Board Computer Slot-In Module
CR-6-COMB	Base Communication Slot-In Module
CR-6-OVPB	Base Over Voltage Protection Slot-In Module
CR-6-OVPS	Sensor Over Voltage Protection Slot-In Module
CR-6-WDB	Base Watchdog Slot-In Module
RTC	Real Time Clock
SSH	Secure Shell
SSID	Service Set IDentifier, This is the identifier name of a wireless network.
STP	Shielded Twisted Pair
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.

Foreword

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 be 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, which requires care, attention and know-how in configuring, installing, operating and maintenance.

GeoSIG continuously 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.

1. Introduction

The Central Recording System CR-6plus (in further text CR-6plus or instrument) is a 24 bit seismic system suitable for centralised data acquisition and recording. The CR-6plus is designed for both, temporary and permanent setups such as bridges, tunnels, and tall buildings. It is easy to use and provides user with a possibility to easily reinstall the system and acquire the seismic data from numerous measurement points.

Several types of externally mounted sensors can be used with the instrument, like seismometers, geophones, accelerometers, anemometers or other sensors with single-ended or differential outputs.

The CR-6plus collects and records the data on the microSD card in the slot in front of the housing. This data can be uploaded and analysed to a remote PC running the dedicated software package GeoDAS. Optionally the data can be downloaded by accessing the web interface of the instrument from remote or on site. Given the system is configured to store the data permanently; the data can alternatively be accessed by turning the instrument off and copying the data stored on the microSD card.

Frequency response (bandwidth) depends on the chosen low-pass filter and the sampling rate. Typical attenuation at 99% of the Nyquist frequency is >120 dB.

During normal operation the instrument continuously amplifies, filters and converts sensor inputs to 24 bit digital form and passes these to the embedded computer. The recording parameters can be set by the computer. The recorded data can then be downloaded over the network and analysed with the GeoDAS software package.

Trigger algorithms include STA/LTA ratio triggering and level triggering. The STA/LTA ratio trigger computes the short term and long term signal averages.

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. 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	**Disconnected**
	OFF	NO	**Disconnected**	**Disconnected**
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 1, 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 1 month, always have it connected to power and let it running.

3.1. Main battery

The instrument is normally connected to a 100 Ah battery, which is charged through a separate power supply module.

3.2. Backup battery

The jumper JMP_BBATT on the SBC Slot-in module has to be put in position 2-3 to disconnect the backup battery if the instrument is turned off for more than one month. In this mode the RTC (Real Time Clock) will continue to operate from the battery in order to keep the time information. The RTC is able to store the time for approximately 1.5 years at ambient temperature when the system is turned off, before the battery runs low.

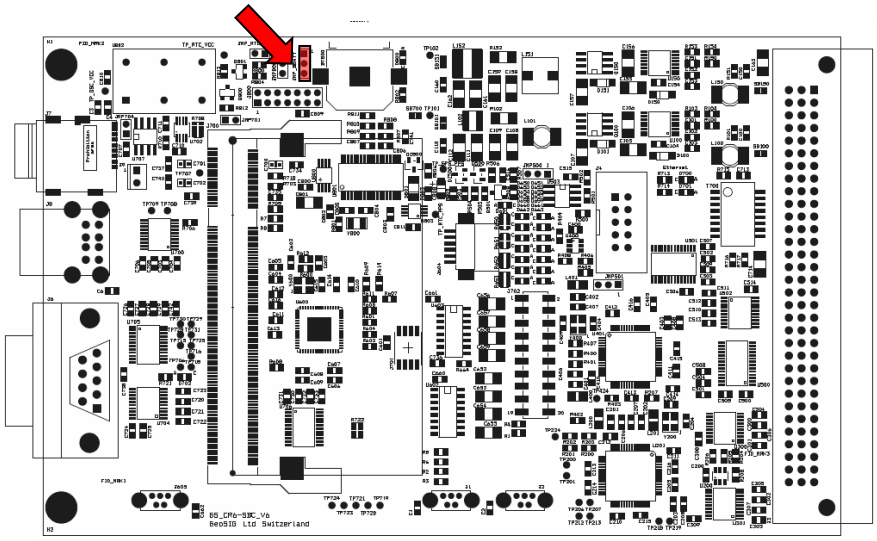


Figure 1. Jumper location to disconnect Backup Battery of the RTC

4. System Description

The CR-6plus is a multi-channel central recording system mounted in a 19” rack and containing an industrial single-board-computer (SBC) with up to 12 digitisers. As each of the digitisers provides 3 data channels, the CR-6plus can provide a maximum number of 36 channels.

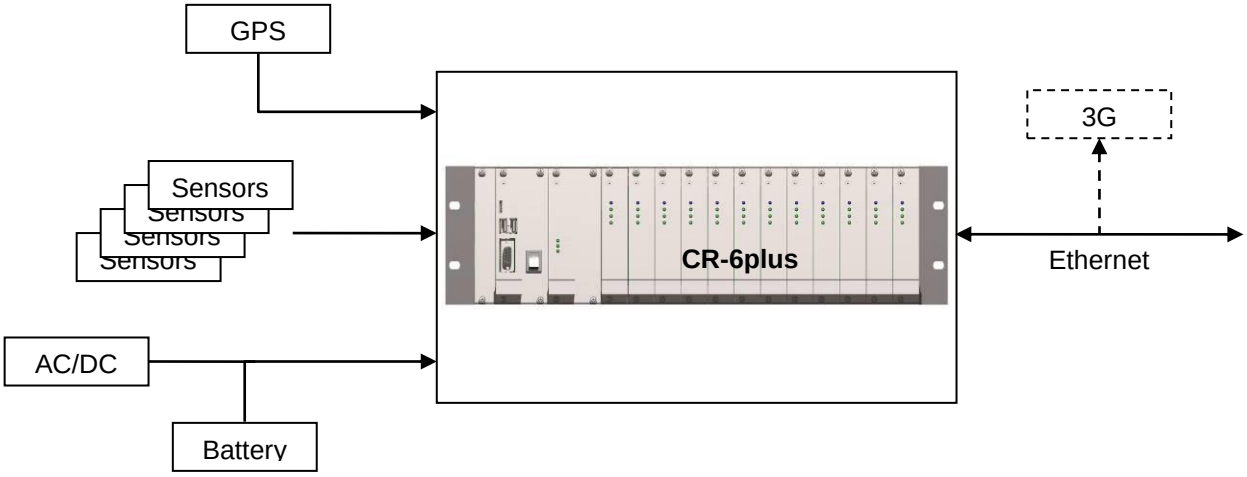


Figure 2. System Overview

The GPS module provides an accurate time source to the CR-6plus Recording System. The CR-6plus system locks the internal RTC with the GPS time source. If GPS is lost, the internal RTC signal will reproduce the 1PPS signal and run for itself keeping all the channels synchronised. Alternatively, time synchronisation can be achieved over NTP, in which case a reliable NTP server must be accessible over Ethernet from the CR-6plus.

The CR-6plus system can manage up to 36 channels and contains an OVP protection on all in- and outputs. A wide variety of sensors can be used: acceleration, velocity, displacement, temperature, current, wind speed, wind direction, stress and pressure.

The CR-6plus system is powered from an external 12 VDC source (24 VDC on request). The internal watchdog permanently checks the supplied voltage and shuts the system down in case of a voltage drop to protect the battery from deep discharge.

An over voltage protected RJ45 Ethernet input allows the CR-6plus to be connected to the local network.

The block diagram below shows the design of the CR-6 system, including all internal and external connections.

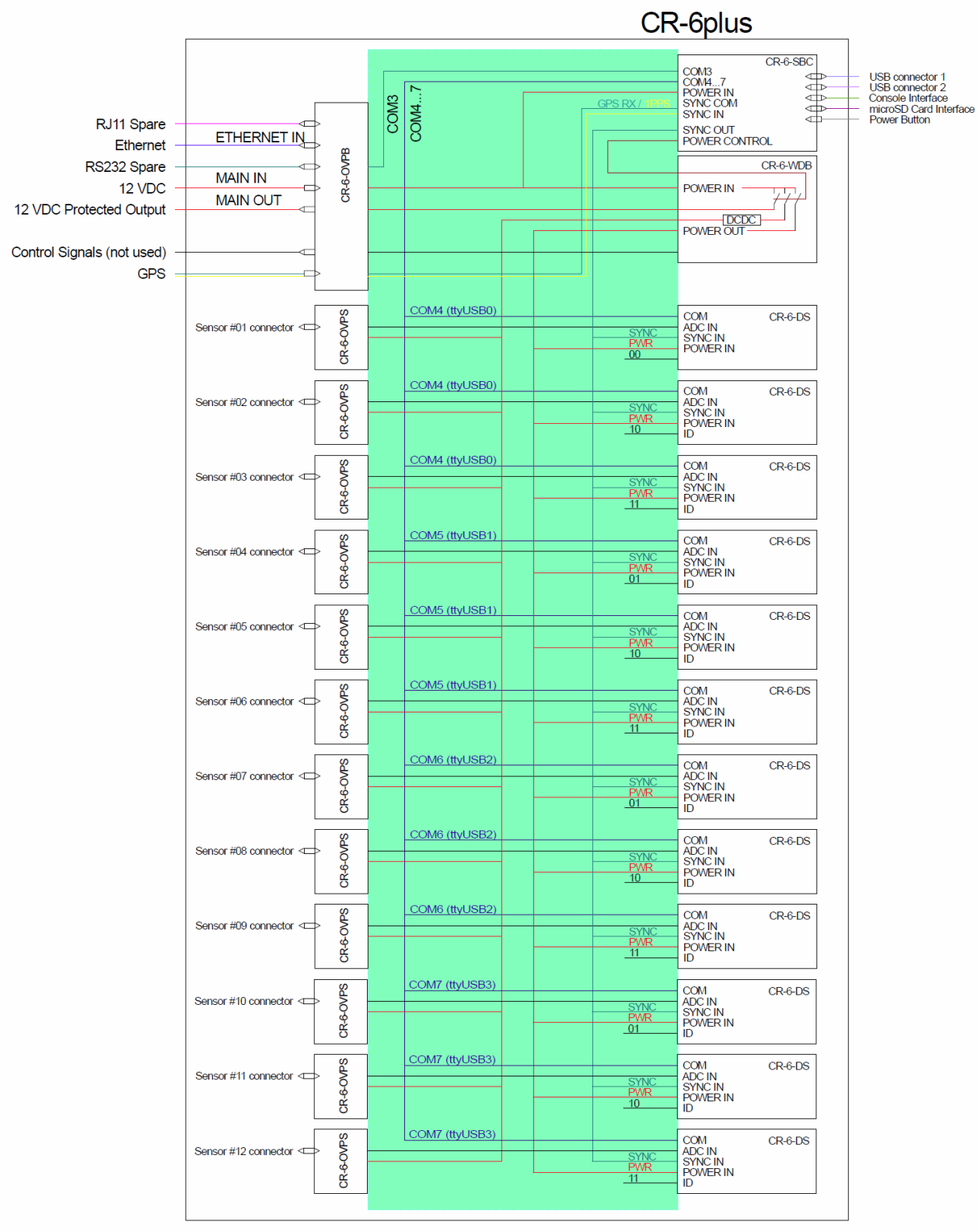


Figure 3. Internal Block Diagram

4.1. CR-6plus

The CR-6plus consists of slot-in modules, independent if accessible from the front or from the back, which are plugged into a backplane that is fixed to the middle of the housing and is responsible for exchanging all signals within the system between the slot-in modules. The racks are designed, that there are no active components on the backplane, which allows the user to easily replace every part of the system by simply exchanging the related plug-in module.

4.1.1. Front Side

The SBC (Single-Board-Computer) is the slot-in module on the most left side accessible from the front is responsible for the data processing, storage and communication. The next module right of the SBC is the CR-6-WDB. It controls the voltages that are applied to all the other modules and sensors. The button on it allows to turn the system on and off. The remaining 12 slots on the right of the CR-6-WDB module slot can contain a digitiser of the type CR-6-DS.

The front of the rack is therefore containing:

CRplus Rack		Task
1x	CR-6-SBC	Data storage, processing and communication
1x	CR-6-WDB Base Watchdog	Voltage control
12x	CR-6-DS Slave Digitiser	Data acquisition

Each of the 12 CR-6-DS Digitiser Slot-In Module contains three channels. Always three CR-6-DS Digitiser Modules are connected to the same serial port, sending their data time multiplexed over the same line to the SBC. The CR-6-DS Slave Slot-In Modules can be plugged at any slot.

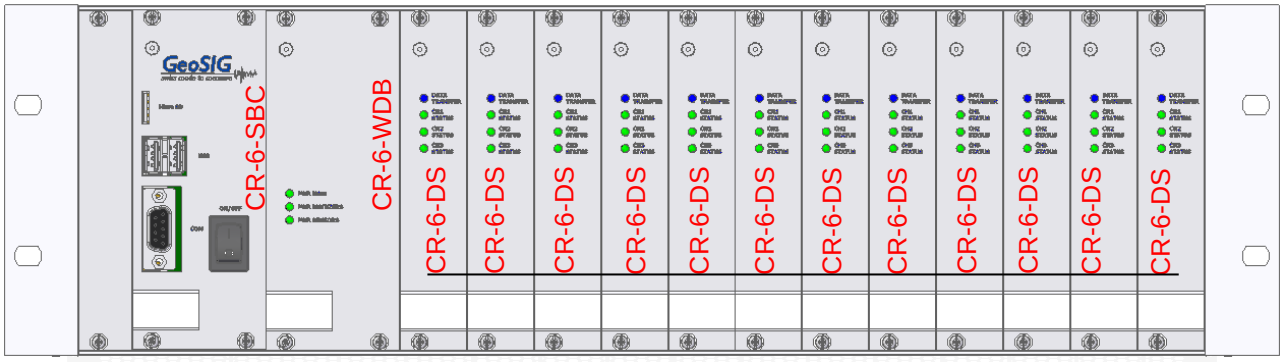


Figure 4. Front view of the CR-6plus

4.1.2. Back Side

On the backside the rack contains:

CR-6plus Component		Task
12x	CR-6-OVPS -Sensor OVP	Interface to the sensor. Protects the CR-6plus from over-voltages from the sensor.
1x	CR-6-OVPB Base OVP	Interface of the SBC to peripherals. Protects the SBC from over-voltages from the GPS, batteries and power supplies.

All sensors are connected to the over voltage protection Slot-In Modules CR-6-OVPS. All other external signals (power, GPS, Ethernet, …) are connected to the CR-6-OVPB or CR-6-OVPS Slot-In Module. All the Slot-In Modules are described in more details in the following chapters

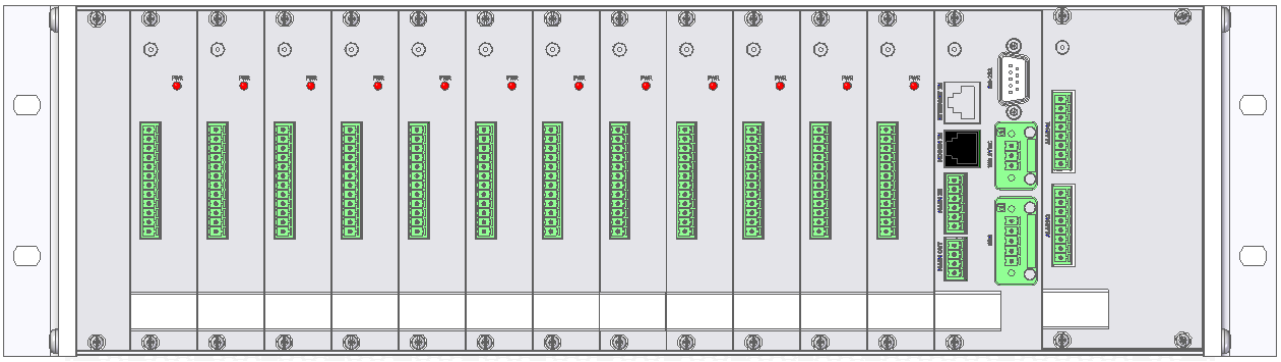


Figure 5. Back view of the CR-6plus

4.2. Backup battery

The backup battery on the SBC 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	48 mAh
Cell diameter	12.5 mm
Cell height	2.5 mm
Weight	<1 g

Table 2. Main battery specification

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

Supplier	Model
VARTA	CR1225

Table 3. Backup battery models

4.3. Supplied and Optional Accessories

4.3.1. 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
- **AC Power cable**, depending on the shipping address with European, US or Swiss power plug
- **Console cable** for use on the internal RS-232 connector
- **GPS** time code receiver with 20 meters cable, other cable length on request. GPS is an option as the time can also be synchronised through the network using NTP.
- **microSD card reader for USB** for reading the memory card on a computer or laptop.
- Any **spare connectors**
- External **battery**

5. Slot-In Modules

The slot-in-modules are not hot swappable. When changing any slot-in-modules, the instrument must be switched off first to avoid any damage on the instrument.

5.1. Front Side

5.1.1. CR-6-SBC Single Board Computer Slot-In-Module

The CR-6-SBC (Single Board Computer Slot-In Module) is mounted into the CR-6plus in the first position on the left side of the device. The CR-6-SBC is the data processing and storing unit of the CR-6plus Recording System and will acquire the data from the digitisers.

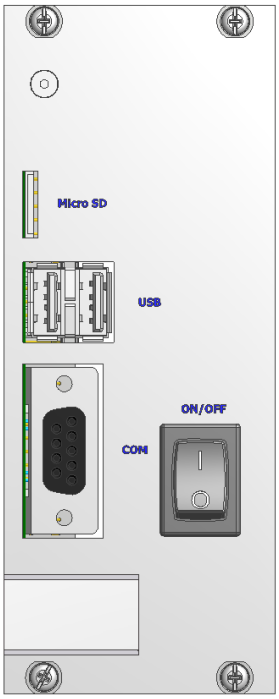


Figure 6 CR-6-SBC Slot-In module

5.1.1.1. ON/OFF Switch

In default position of the ON/OFF button is ‘O’. To turn the system on, one has to press the button into postion “I” for about 2 seconds. Likewise to turn the system off if it is already running, the button has to be pressed into the “I” position for about 2 seconds. The status of the system can observed on the LED’s of the watchdog bord as described in Section 5.1.2.1

5.1.1.2. COM Interface

The COM interface allows to access the control and configuration menu of the CR-6plus. By connecting a PC to it with a serial cable (terminal settings: 8N1, 115200 baud) it is possible to access this menu with a terminal emulator. More information on how to do this can be found in Chapter 11.

5.1.1.3. USB Interfaces

The USB interfaces in the front of the SBC are reserved for later use and are not supported at the moment.

5.1.1.4. microSD Interface

The microSD slot of the SBC is the default data storage of the CR-6plus. The microSD in this slot will contain, depending on the configuration, the recorded Ringbuffer, Trigger and calibration files as well as SOH- and Log files.

5.1.1.5. Real Time Clock

The CR-6-SBC has a complete, self-contained time-keeping system (RTC). This clock keeps track of days, hours, minutes, seconds down to milliseconds. The instrument synchronise the clock automatically with an encoded external time signal coming from a GPS or any NTP server. The clock operates from the internal battery and runs regardless whether the main switch is at ON or OFF position. If the CR-6plus Recording System is stored in shelf, please see chapter 3 to avoid that the backup battery for the RTC is discharged.

5.1.2. CR-6-WDB Watchdog Slot-In-Modules

The CR-6-WDB (Base Watchdog Slot-In Module) is mounted into the CR-6plus next to the SBC and the watchdog of the whole CR-6 Recording System. This Slot-In Module supervises the status of the data acquisition software and power supplies.

Figure 7. CR-6-WDB Watchdog Slot-In Module

5.1.2.1. LED's

Function	LED		Description
PWR OUT	ON	OFF	Supply voltage of the SBC and external devices is on (Green LED on) or off (Green LED off)
PWR DIGITIZERS	ON	OFF	Supply voltage of the digitizers and the GPS is on (Green LED on) or off (Green LED off)
PWR SENSORS	ON	OFF	Supply voltage of the sensors is on (Green LED on) or off (Green LED off)

5.1.3. CR-6-DS Digitiser Slot-In Module

The CR-6-DS Digitiser Slot-In Module measures the value of the sensor with an ADC. The filtered value will be transferred to the SBC to be recorded and analyzed.

Figure 8 CR-6-DS Digitiser Slot-In Module

5.1.3.1. LED's

Function	LED		Description
DATA TRANSFER	ON	OFF	In case the blue LED is blinking, the Digitiser Module transfers data to the SBC
CH1 STATUS	ON	OFF	Channel 1 is enabled (Green LED on) or disabled (Green LED off)
CH2 STATUS	ON	OFF	Channel 2 is enabled (Green LED on) or disabled (Green LED off)
CH3 STATUS	ON	OFF	Channel 3 is enabled (Green LED on) or disabled (Green LED off)

5.1.3.2. Full Scale Settings

On the CR-6-DS the electrical signals from seismic sensors are range-adjusted in preparation for conversion to digital form and are filtered to prevent aliasing effects. The signals are next sampled and digitised, and then digitally filtered under software control to further reduce noise.

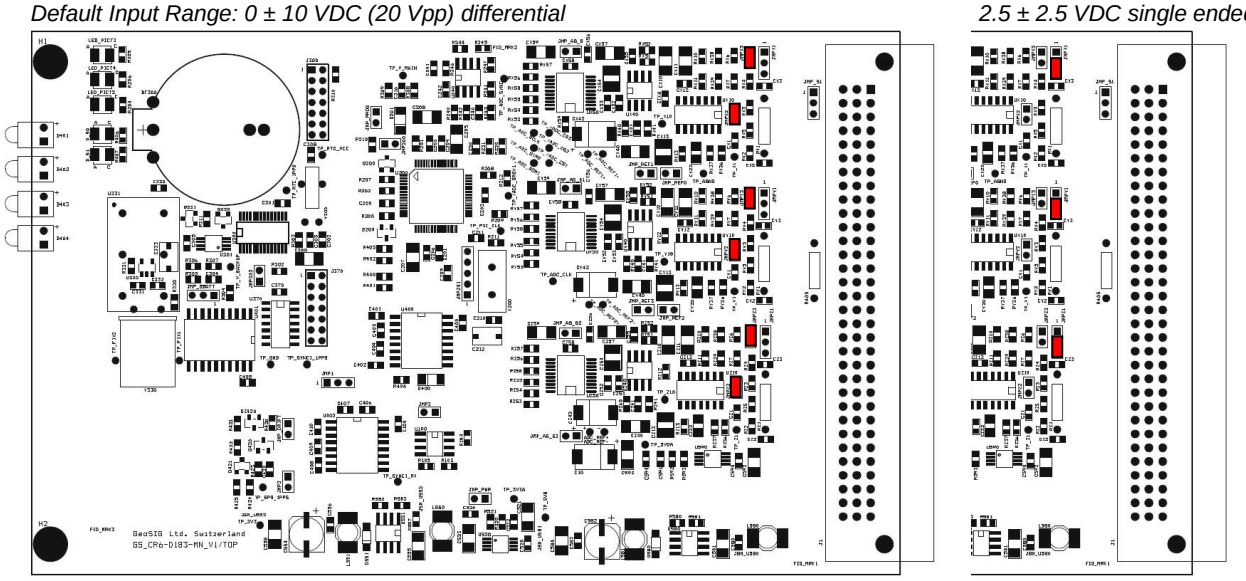
Depending on the jumper configuration, the instrument accepts signals from sensors within the sensor voltage output ranges as follows:

Range		Jumpers on CR-6-Dx Digitiser Slot-In Modules		
		JMPX1 JMPY1 JMPZ1	JMPX2 JMPY2 JMPZ2	JMPX3 JMPY3 JMPZ3
0 ± 10 VDC (20 Vpp)	Differential	open	**1-2**	**1-2**
0 ± 2.5 VDC (5 Vpp)	Differential	open	open	open
0 ± 10 VDC (20 Vpp)	Single Ended	**1-2**	**1-2**	**1-2**
0 ± 2.5 VDC (5 Vpp)	Single Ended	**1-2**	open	open
2.5 VDC ± 2.5 VDC	Single Ended	**2-3**	open	open

Examples:

Default Input Range: 0 ± 10 VDC (20 Vpp) differential

2.5 ± 2.5 VDC single ended



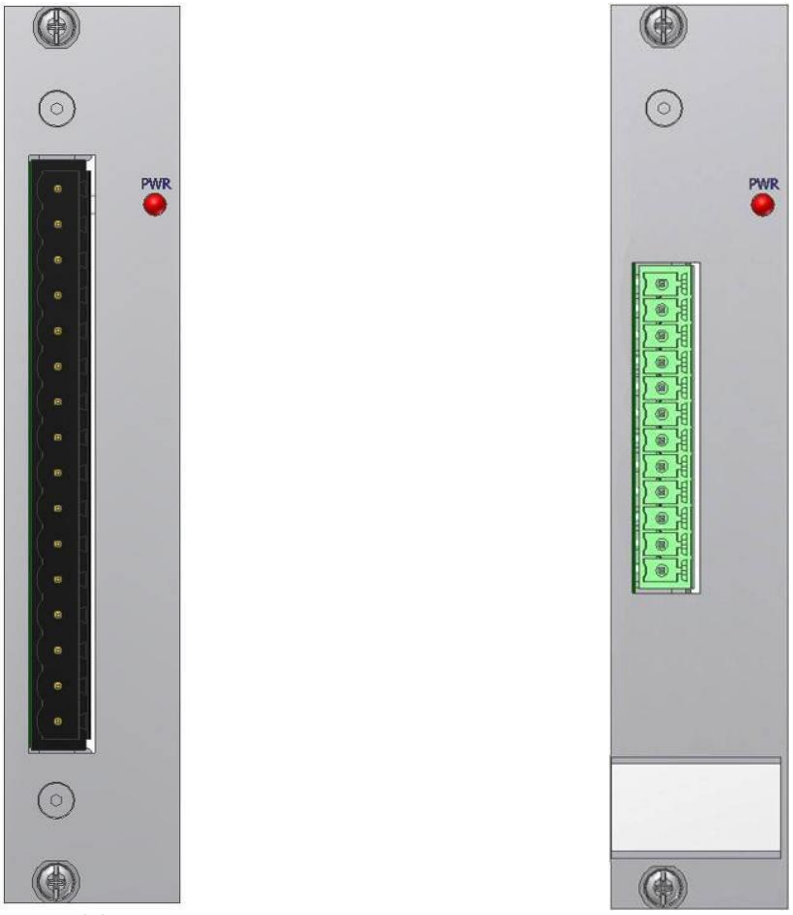
Each channel of the CR-6plus has a low-pass 500 Hz 4th-order Butterworth analogue filter prior to being sampled and converted to digital form. This filter removes signal energy at frequencies above one-half the input sampling rate (1000 Hz), so that higher frequencies are not aliased by the sampling process. For different sampling rates, further anti-aliasing is achieved by digital filters in the DSP (equi-ripple FIR filter structures with the linear phase) with a -3dB point above 80% of the Nyquist rate. Any delay from the digital filter is directly compensated inside the DSP.

The sampling rate is common to all three channels digitised by one CR-6-DS Digitiser Slot-In Module, i.e. the sampling rate cannot be individually set for a specific channel.

5.2. Back Side

5.2.1. CR-6-OVPSx Sensor OVP Slot-In Module

Each triaxial sensor is connected to a separate CR-6-OVP-S Sensor OVP Slot-In Module. This Module protects the CR-6 Recording System from over voltage, injected on the sensor cable. Two versions are available. The CR-6-OVPS1 is backwards compatible option to the CR-4 and can be ordered on request. The new standard version is however the CR-6-OVPS2. Both of them can be seen in Figure 9.



(a) (b)

Figure 9. CR-6-OVPS1 (a) and CR-6-OVPS2 (b) Sensor OVP Slot-In Module

5.2.1.1. LED

Function	LED		Description
PWR	ON	OFF	In case the LED is on, the sensor is powered.

5.2.1.2. Connector Pinout

The sensor connector is a CR-4 compatible 16 pin connector, which is used to connect an external sensor to the CR-6 Recording System. The sensor connector provides a stabilised +12 VDC power to the sensor. Optionally also -12 VDC can be provided.

Pin	CR-6-OVPS1 (CR-4 Compatible)	CR-6-OVPS2 (Standard)
1	X+	X+
2	X-	X-
3	GND	Y+
4	Y+	Y-
5	Y-	Z+
6	GND	Z-
7	Z+	S_TEST
8	Z-	GND
9	GND	Power +12 VDC
10	S_TEST	GND
11	GND	S_MODE
12	Positive Power +12 VDC	AGND
13	Power GND	
14	Earth	
15	S_MODE or negative Power -12 VDC	
16	AGND	

5.2.2. CR-6-OVPB OVP Slot-In Module

The CR-6-OVPB protects the rack from over voltage on any incoming cables (e.g. power, Ethernet, GPS, …)

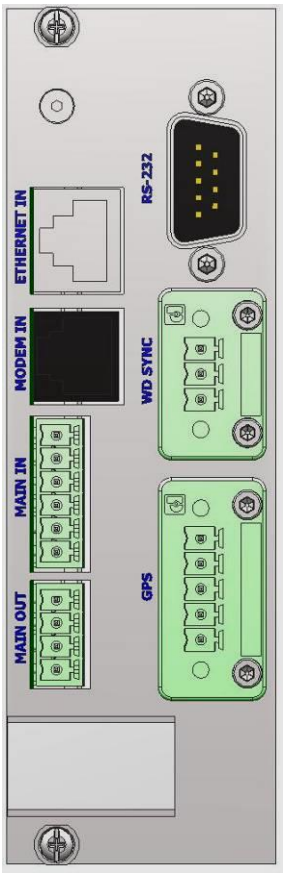
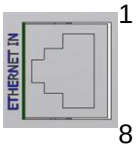


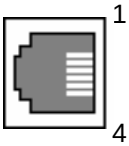
Figure 10. CR-6-OVPB (a) and CR-6-OVPE (b) OVP Slot-In Module

5.2.2.1. Connectors

ETHERNET IN	Connection of the CR-6plus to the local LAN with a standard RJ45 Ethernet plug.¨
MODEM IN	This connector is not used



1	TX+
2	TX-
3	RX+
4	NC
5	NC
6	RX-
7	NC
8	NC



1	NC
2	Phone line A
3	Phone line B
4	NC

MAIN IN

This connector is used to supply the CR-6plus. 12 VDC from a battery or a power supply shall be provided.

1	12 VDC (optionally 24 VDC)
2	12 VDC (optionally 24 VDC)
3	GND
4	GND
5	AC Control Input (**No AC**, max. 30 VDC from relay contact)
6	GND

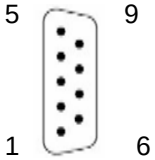
MAIN OUT

This connector is used to supply any external devices like modems.

1	Same voltage as for "MAIN_IN", but output controlled by watchdog. **500 mA max.**
2	
3	GND
4	GND

RS-232

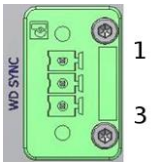
This connector is used for any external devices (DTE) with RS-232 interface.



1	CD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

WD SYNC

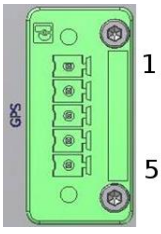
This connector is not used.



1	SW3
2	SW4
3	GND

GPS

This connector is used to connect the GPS receiver.



	RS-485 *JMP1: 1-2* *JMP500: 2-3* *JMP501: 2-3*	RS232 (default) *JMP1: 2-3* *JMP500: 1-2* *JMP501: 1-2*
1	RX+ (White)	RX (Brown)
2	RX- (Brown)	TX (White)
3	1PPS from GPS receiver (Green)	
4	Power (12VDC) for GPS receiver (Yellow)	
5	GND (Grey)	

5.2.3. CR-6-Relay Alarm card slot-in module

The CR-6-Relay is the “alarm card” or “relay card” of the CR-6plus. This card gives access to four relays.

Relay ratings: 250 VAC [220 VDC] max continuous current 3 A.

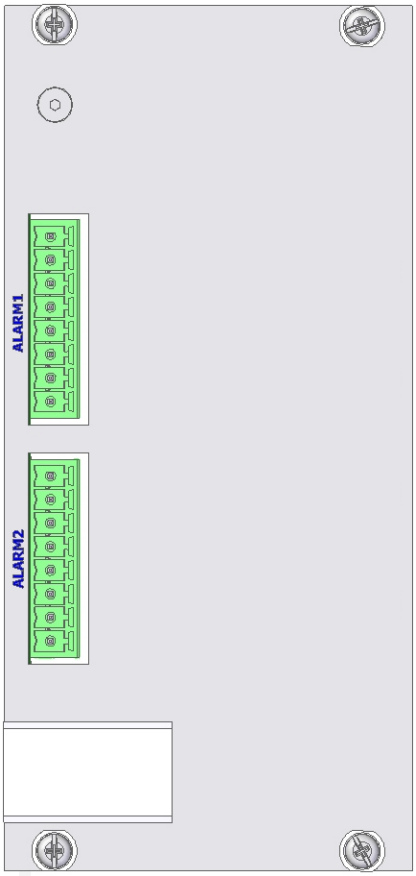
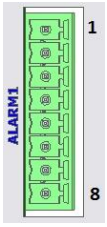


Figure 11. CR-6-Relay Slot-In Module

5.2.3.1. Connectors

ALARM1

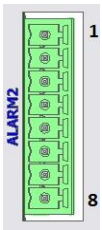
This connector is used to connect external devices to the relays of the CR-6-Relay.



1	K1 Normally Closed (NC) *
2	K1 Normally Open (NO) *
3	K1 Common
4	GND
5	VRELAY
6	K2 Common
7	K2 Normally Open (NO) *
8	K2 Normally Closed (NC) *

ALARM2

This connector is used to connect external devices to the relays of the CR-6-Relay.



1	K3 Normally Closed (NC) *
2	K3 Normally Open (NO) *
3	K3 Common
4	GND
5	VRELAY
6	K4 Common
7	K4 Normally Open (NO) *
8	K4 Normally Closed (NC) *

** Each relay can be normally energized or de-energized. Please look the remarks of CR-6-Relay option at the test record of the instrument.*

6. Installation

This section lists the procedures involved in installation, configuration and operation 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.

6.1. Site Selection

6.1.1. Environmental Considerations

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

Although the Instrument is in a solid case, a location shall be arranged that is free from direct sunlight, dangers of falling materials in the event of an earthquake and the risk of tampering or vandalism. Furthermore, the installation site must not be affected by weather conditions such as ice, snow or rain.

The user must ensure that the location is provided with either 115 / 230 VAC or 12 VDC (e.g. from a solar panel or battery).

In case of the setup of the event triggered recordings, any local environmental source of noise, disturbance or vibration such as vibration from machinery, highway traffic, aircraft, waves, etc. around the site must be taken into account. This will cause false triggering of the recording system in case the threshold is set too low. These influencing factors must be taken in account when configuring the trigger settings in armdas. It is recommended 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 storage.

6.1.2. Power Supply Considerations

The CR-6plus is powered by battery and/or an external power supply, connected to 230/115 VAC. The power supply works as a battery charger at the same time and therefore guarantees maximum of autonomy in case of a power loss. A solar panel can be used as well instead of a power supply, ask GeoSIG for more detailed specifications.

- With 115/230 VAC power, a cable has to be connected to the external power supply. The cable must consist of Phase, Neutral and Earth Protection.
- If the system is powered only by battery, the battery must be fully charged at least 24 hours uninterrupted before connecting to the system. The configuration of the instrument may be performed while the charger is connected to the instrument.

Please ensure that the right voltage (115 VAC / 60 Hz or 230 VAC / 50 Hz) is selected on the external power supply.

The best solution for the system is to use the battery with the external power supply at the remote installation site. The instrument can be checked and configured locally in the work shop before going on site (e.g. correct time, trigger and all relevant settings). It can be transported then to the installation site (Ensure that the system is “OFF”). When in place and powered again, the system will run with the preconfigured parameters. After turning the Instrument *ON* (see chapter 11.1), 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.

Many times the locations of seismic equipment are highly exposed to electrical disturbances caused by lightning or by the industrial environment. It may sometimes be necessary to use additional surge protectors for the equipment. Contact GeoSIG or your local representative for more information.

6.2. Cabling of a CR-6plus

In the figure below the external cabling of the CR-6plus is shown.

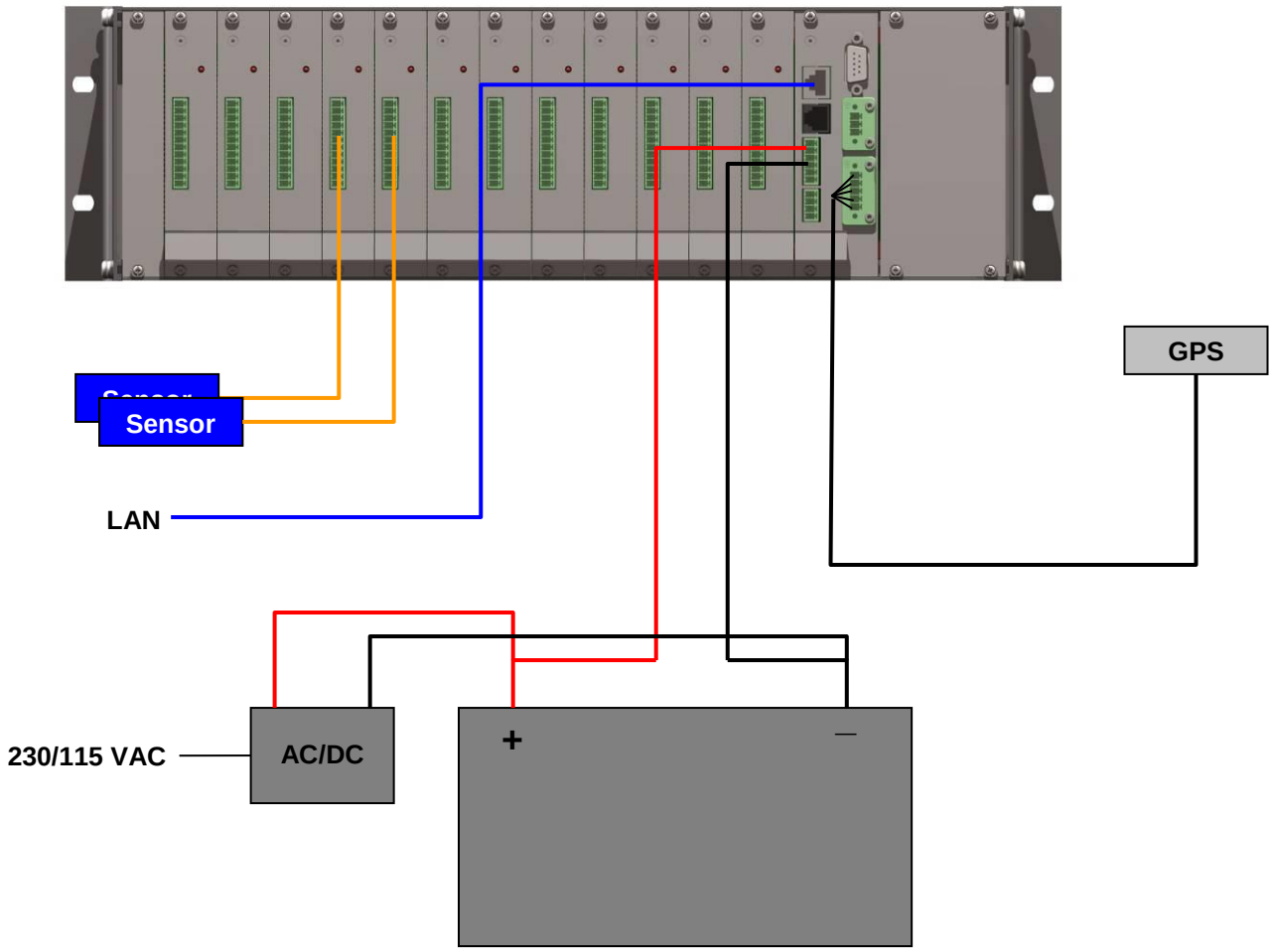


Figure 12. External cabling of a CRplus

6.2.1. Communication Considerations

An Ethernet connection must be present to have a 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 standalone recording station, a notebook with an Ethernet connector can be used for downloading the data on a regularly basis. In a network the stations will upload the data to the configured server.

6.3. Sensors

For information on how to mount the sensors and connect them to the CR-6plus, please refer to the manual of the sensor and section 5.2.1.2 of this document.

7. Principle of Operation of the Instrument

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

7.1. Normal Operation

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

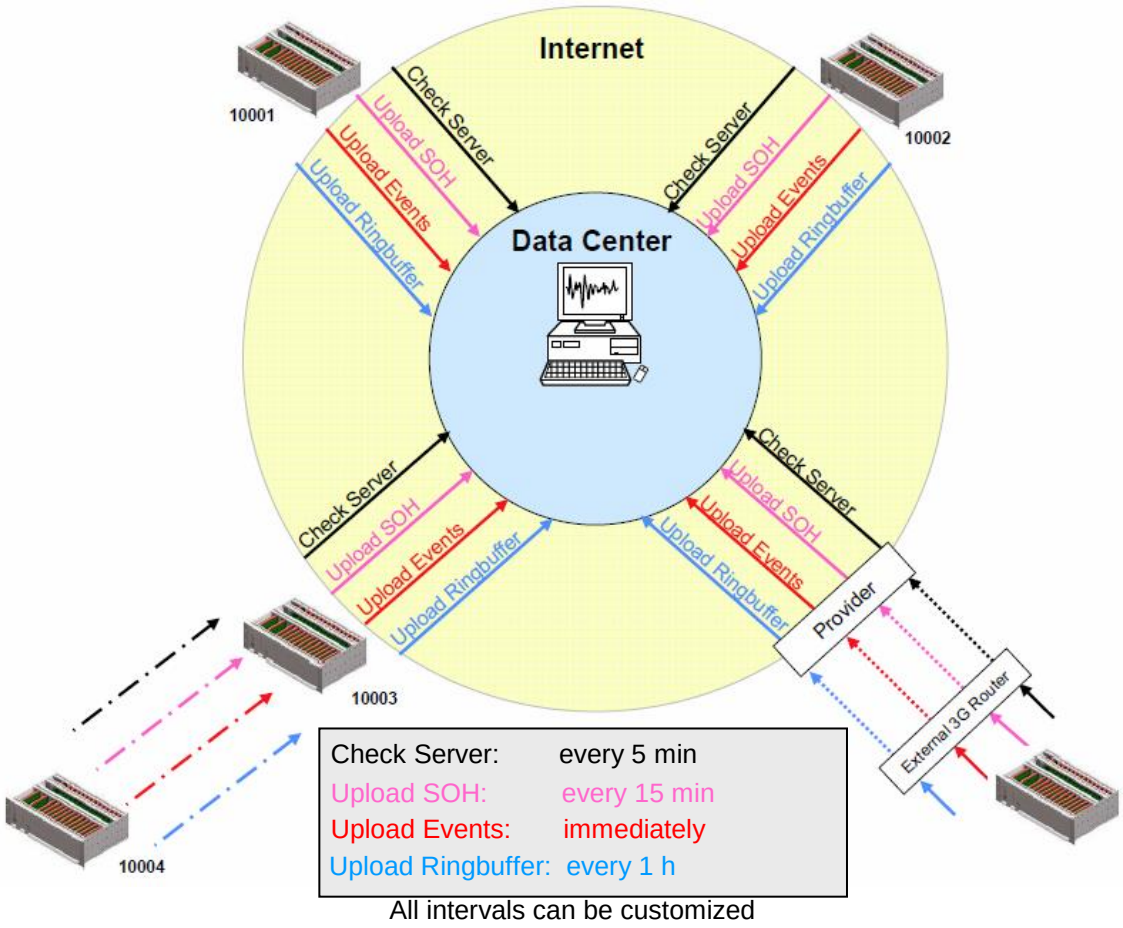


Figure 13. Normal operation in a network

7.2. Behaviour on a Seismic Event

In case there is an earthquake and the vibrations are above the trigger threshold, the instrument is recording the event and immediately uploading it to the data server (see Figure 14)

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 15).

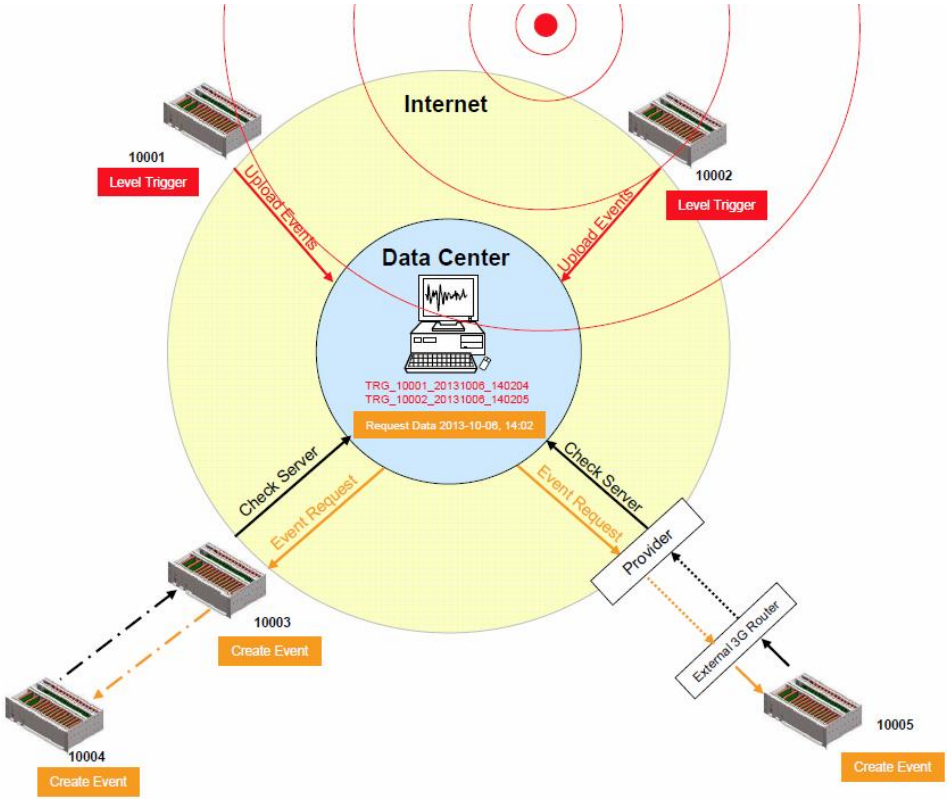


Figure 14. Upload of seismic events and download of requests from the server

- 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 15)

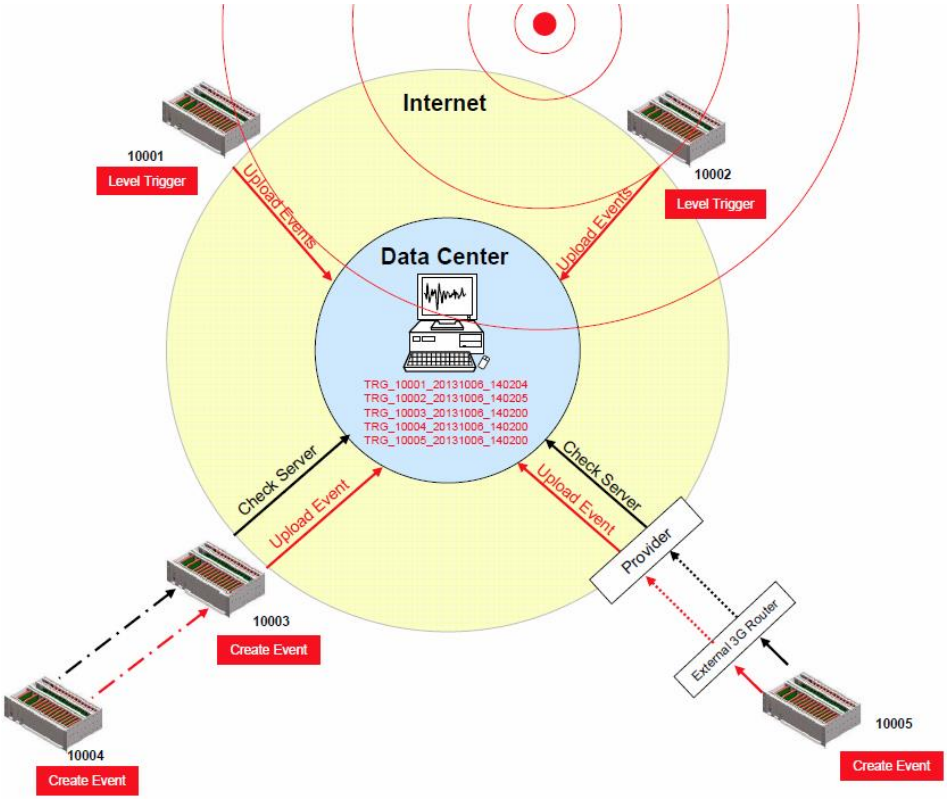


Figure 15. Behaviour on Events: Upload of extracted events

7.3. 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 13 for details about the firmware upgrade.

The same happens also with new configurations. In case under *Server Parameters* the option *Keep connection to the server i*s enabled (see chapter 11.8 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 of the instrument. See chapter 10 for details.

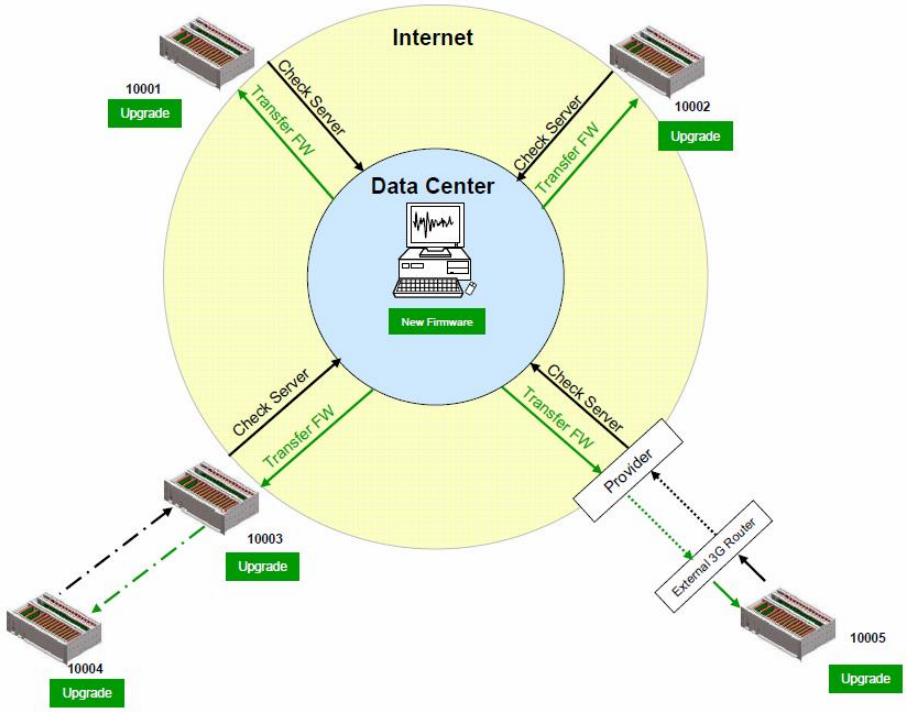


Figure 16. Firmware upgrade

7.4. 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, this can happen for example in case accidentally a configuration file with wrong server settings will be uploaded to an instrument. In this case the instrument will contact the backup server, 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 the set the backup server see chapter 8.2.

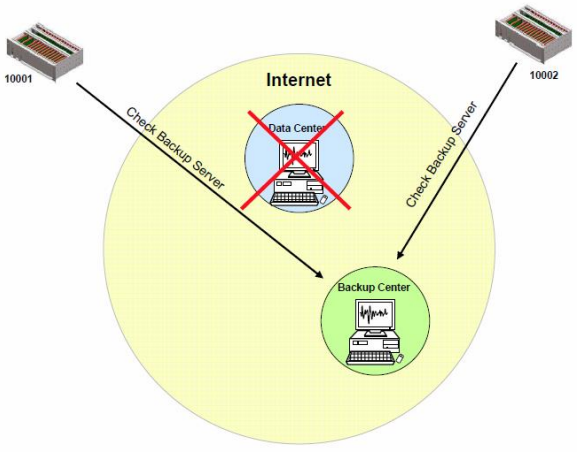


Figure 17. Connection to backup server in case connection to main server fails

8. 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.*

8.1. Preparation

- Make sure the instrument is powered by the provided power supply
- Make sure the instrument is connected to a LAN with an Ethernet Cable
- If it is planned to use a battery with the device 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. In any way 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 chose the appropriate COM port. Baud rate is 115200. Alternatively open *GeoDAS*, go to ***Tools → Terminal…*** and chose the COM Port. As Baud rate select ***115200.*** Then Press ***Connect***

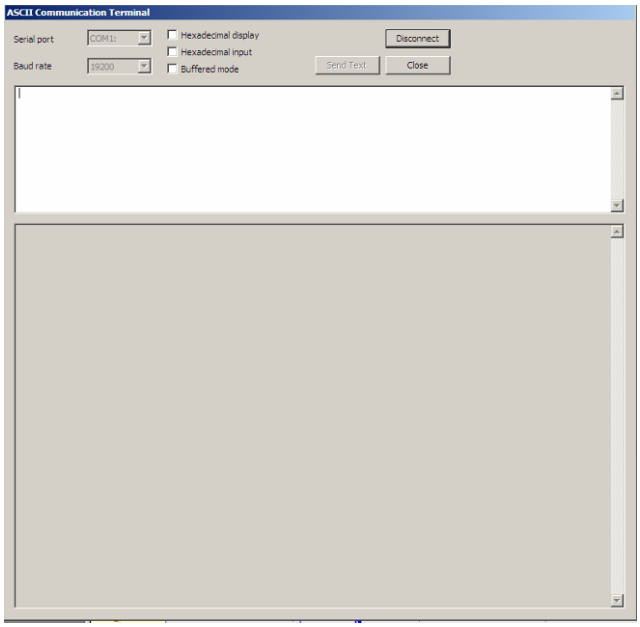


Figure 18. GeoDAS terminal

- Keep the terminal open for the next step.

8.2. 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.

- 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.

```
CR-6plus s/n 100582. Firmware in the Linux image: 26.05.00
################################################
###### Test and Initial Configuration Mode ######
################################################
Press Ctrl+Z to enter the test mode.....
```

The following menu will appear (see chapter 12 for details):

```
Press Ctrl+Z to enter the test mode.................
Instrument serial number: 100582
Instrument MAC address: 00:50:C2:77:42:93

-------------------------------------------------------------------------------------------
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 any passwords are set, so press '**U**' to enter the User Mode, and then '**N**' to enter the menu *Network setting*s.

```
==== 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*. In case you don't know these parameters please ask your network administrator.
- The instrument allows access to the operating system from remote over SSH. This feature is not needed for the normal operation of the instrument and can be disabled in case of security concerns. By default it should be kept enabled, to disable press '**1**'

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

- It's highly recommended to configure a *recovery server IP* address and *recovery server port*. The instrument will contact this server with the interval defined in *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 can, for example, happen in case a configuration file with wrong server settings is 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.

```
Bootloader Menu of the CR-6plus s/n 100582
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

-->
```

- As soon the instrument is up and running start ***GeoDAS*** (if not already done)

8.3. No Stations Configured at first Start Up

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

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

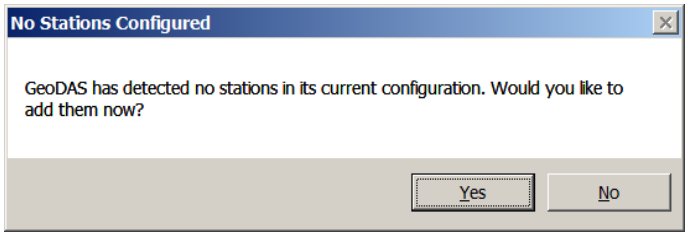


Figure 19. "No stations configured" message at startup of GeoDAS

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

8.4. 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 GMS or CR-6plus instrument is connected to the local network*** and press ***Next >***

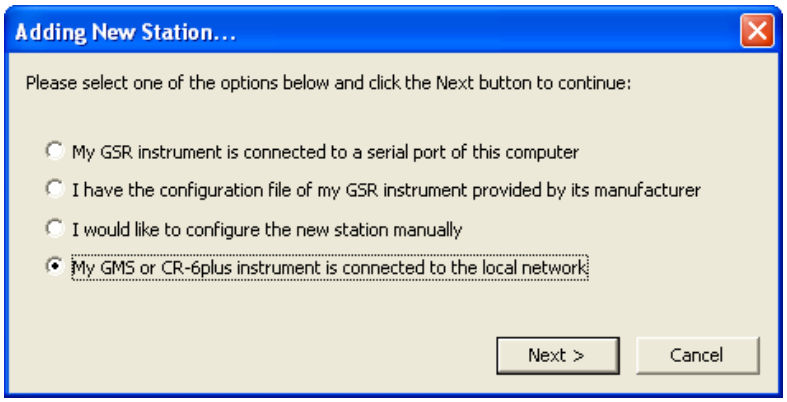


Figure 20. Instrument Wizard

- 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.

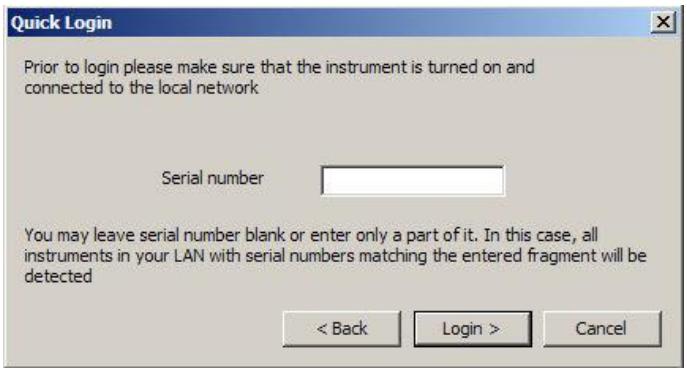


Figure 21. Quick Login Window

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

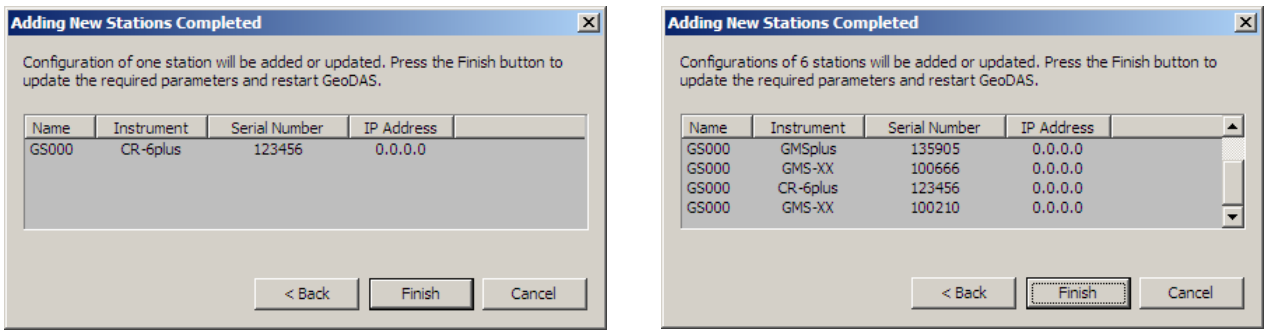


Figure 22. List of all stations found – single station left, multi-selection right side

8.5. 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 15.1 for details.

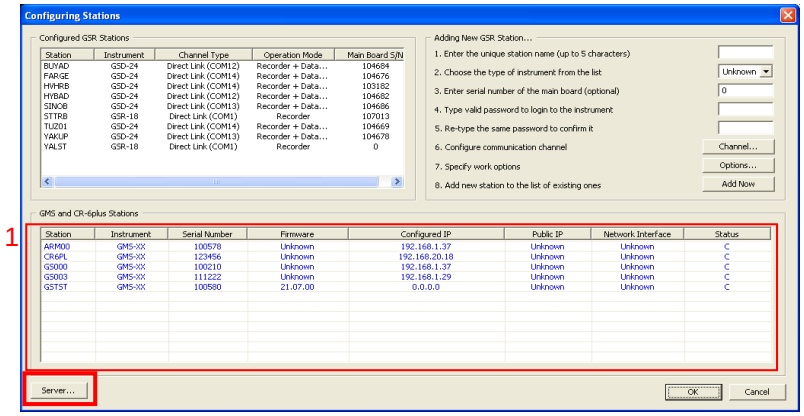


Figure 23. Configuration and overview of the stations

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

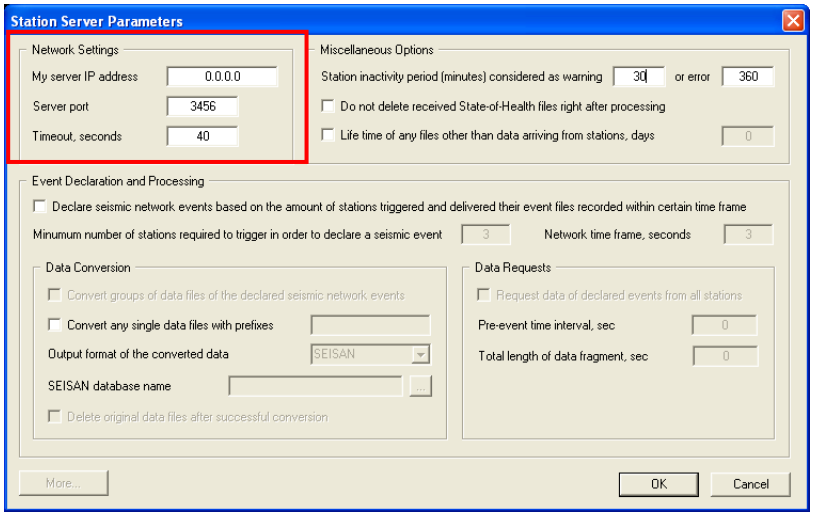
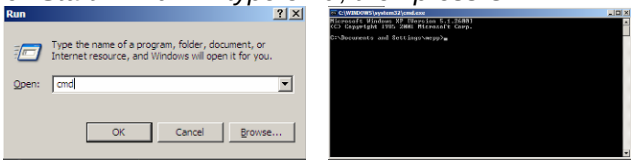


Figure 24. Data server parameter

If you don't know how to find out your IP Address, follow these steps:
*- Click Start → Run → type **cmd**, then press **OK***



*- Type **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*

8.6. Basic Configuration of the Instrument

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

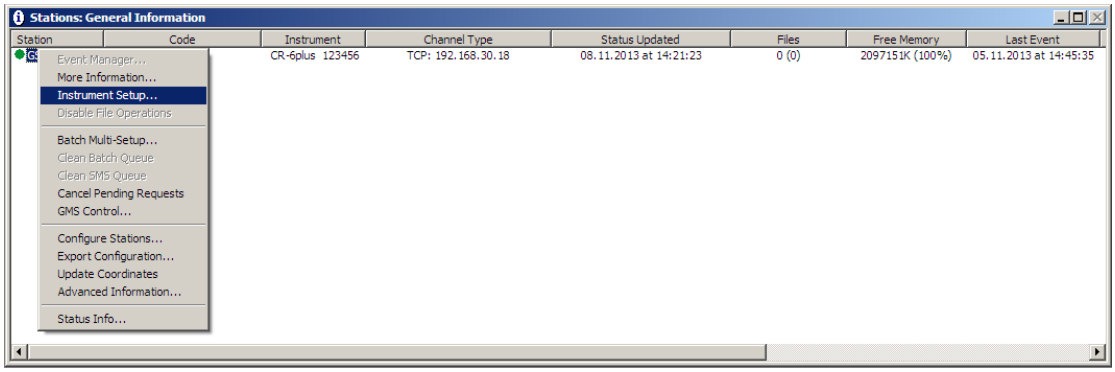


Figure 25. Instrument setup

- A window showing the Web Interface will appear.

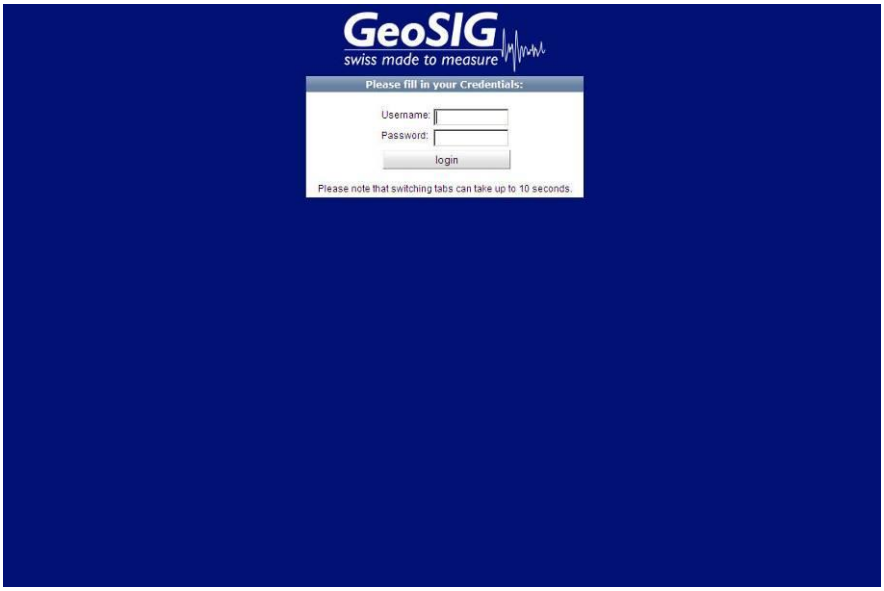


Figure 26. Web interface of the selected instrument

- 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*** → ***armdas Configuration*** → ***File Transfer Settings***, the following screen appears.

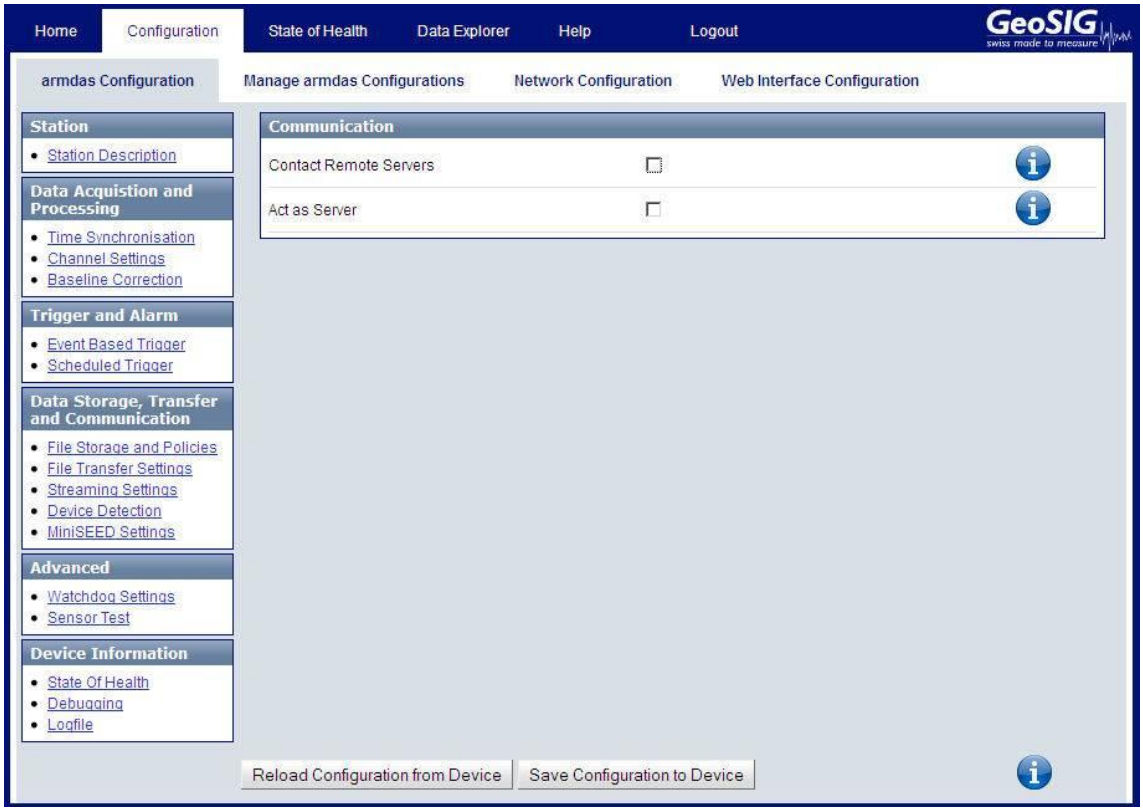


Figure 27. Server parameters

- Tick the flag ***Contact Remote Servers*** to configure a connection to a remote server
- Add the ***IP of your server*** and press ***Add Server with IP***. Under ***Settings…*** more options can be configured. The default *Server port* is ***3456*** and should be kept.

Figure 28. Added Server (left) and its parameters (right)

- Then press Save Configuration to Device
- After the instrument has restarted it is ready for operation and can be configured according to chapter 10 and 11.

9. Network Settings

9.1. Network Settings through the Web Interface or Instrument Setup…

- 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 9.4 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
- Adjust the wired Ethernet settings under *eth0*
- click ***Save Network Configuration to Device***.

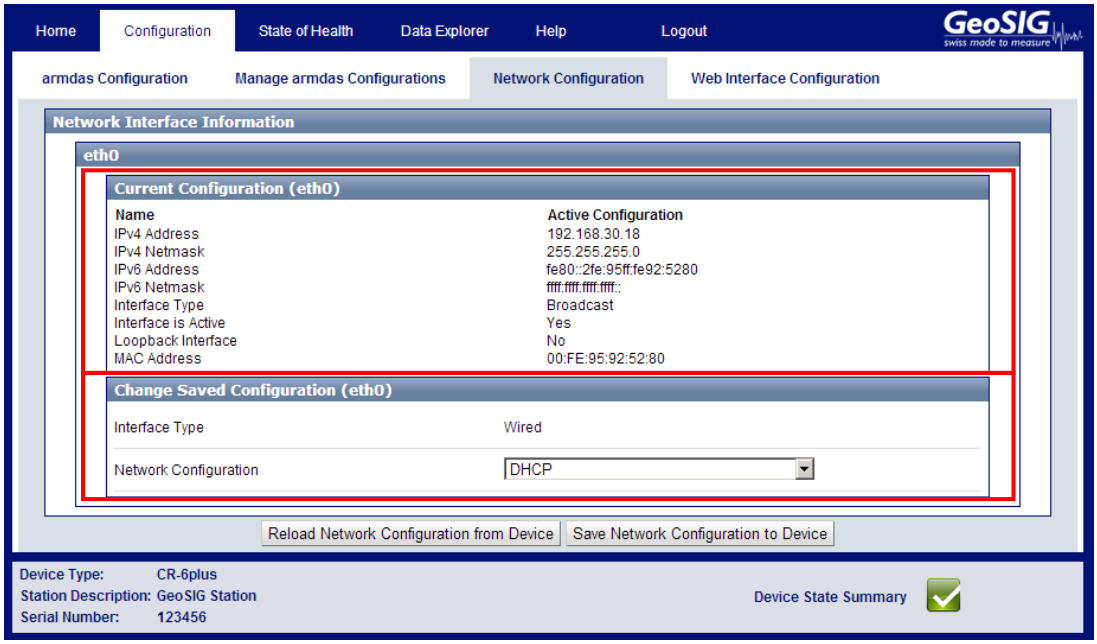


Figure 29. Configuration of network interface

9.2. Network Settings through GeoDAS

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

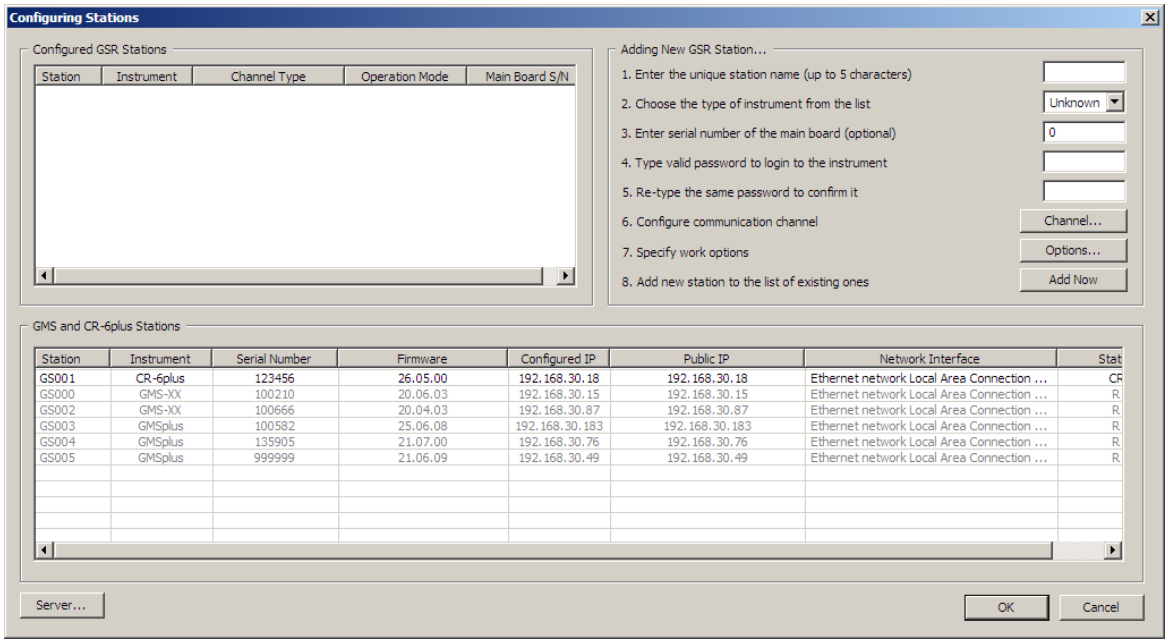


Figure 30. *Configuring Stations* screen

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

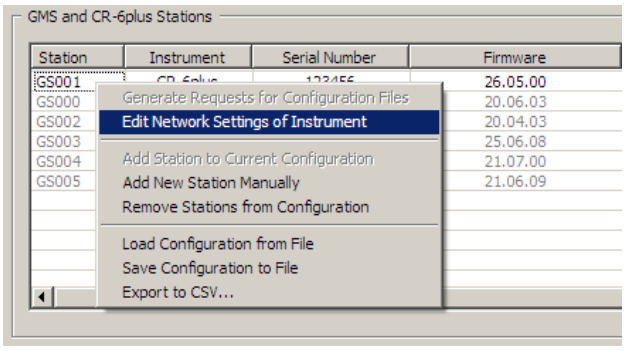


Figure 31. Edit Network settings

- Adjust the network parameters in the following screen whereas the ***Primary Network interface*** is the wired Ethernet

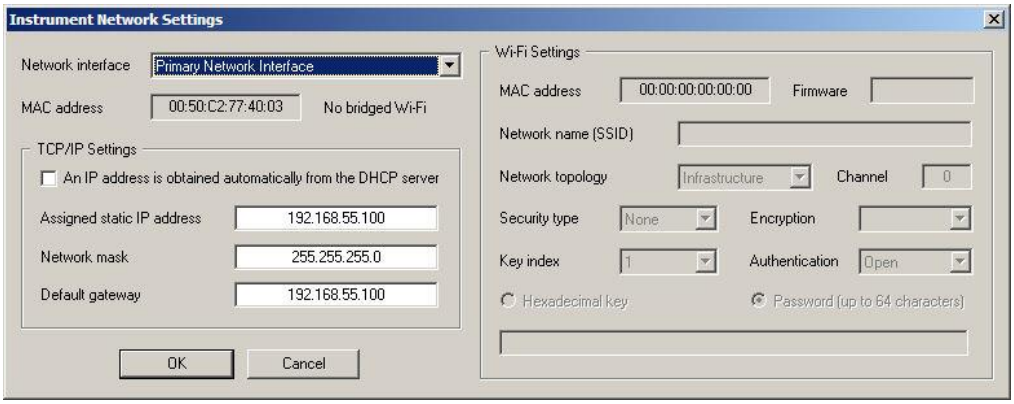


Figure 32. Configuration of wired Ethernet

9.3. Wired Ethernet settings through the local Console

Please see chapter 8.2 for details.

9.4. Get IP from Instrument

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

```
CR-6plus s/n 100582 version 26.05.00
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
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 IPs of the wired Ethernet (*eth0*) 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)
```

10. 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* is enabled under *Server Parameters* (see chapter 11.8 for details) must be enabled (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.

10.1. 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 …***, or
  Open your browser and enter the IP-Address (e.g. 192.168.10.13) of the device in the address bar of your browser, as can be seen in Figure 35.

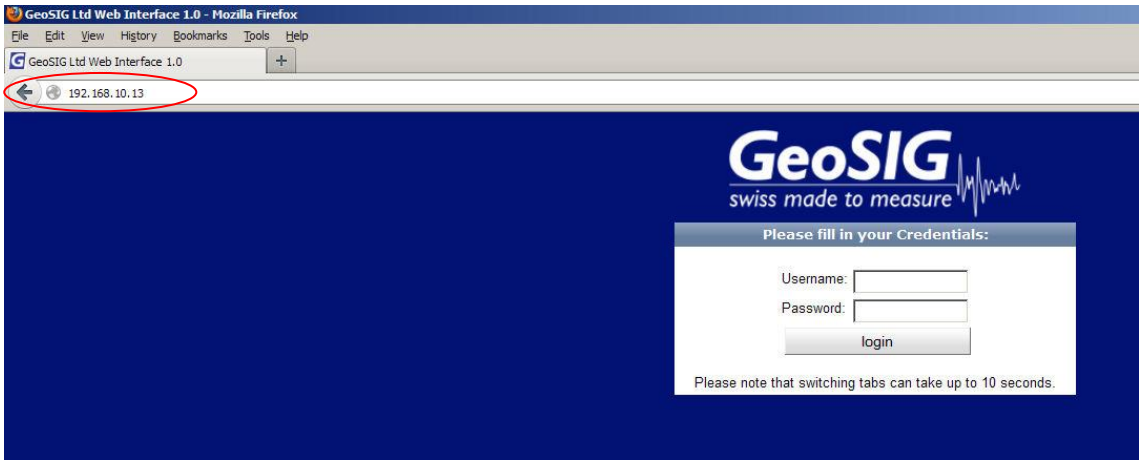


Figure 33. The login screen of the instrument at 192.168.10.13

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 10.3.4 of this manual. If the admin password is forgotten, please delete the webuser.txt file on the SD/microSD 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 12 for details.

10.2. The Home Panel and the General Navigation

After the login process has ended, the screen shown in Figure 34 becomes visible. The width of the Web Interface is optimised for a screen with of 1024 pixels. If the width of the browser window is smaller than that, it might be necessary to scroll horizontally.

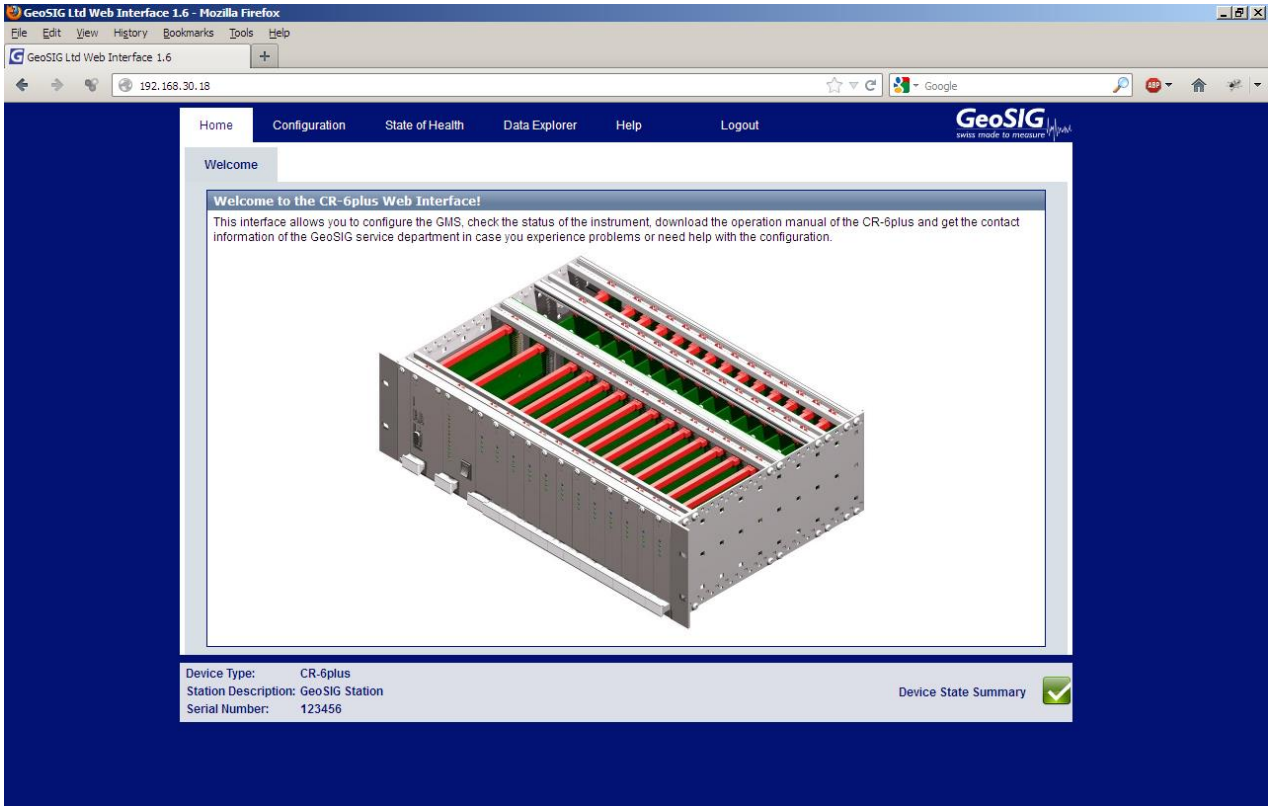


Figure 34. The Home Panel of the Web Interface

As can be seen in
Figure 35, 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 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 which are possible are listed in Table 4. 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 10.4.

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.
	A warning 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 avoid limited functionality.

Table 4. The over all error states shown in the Web Interface

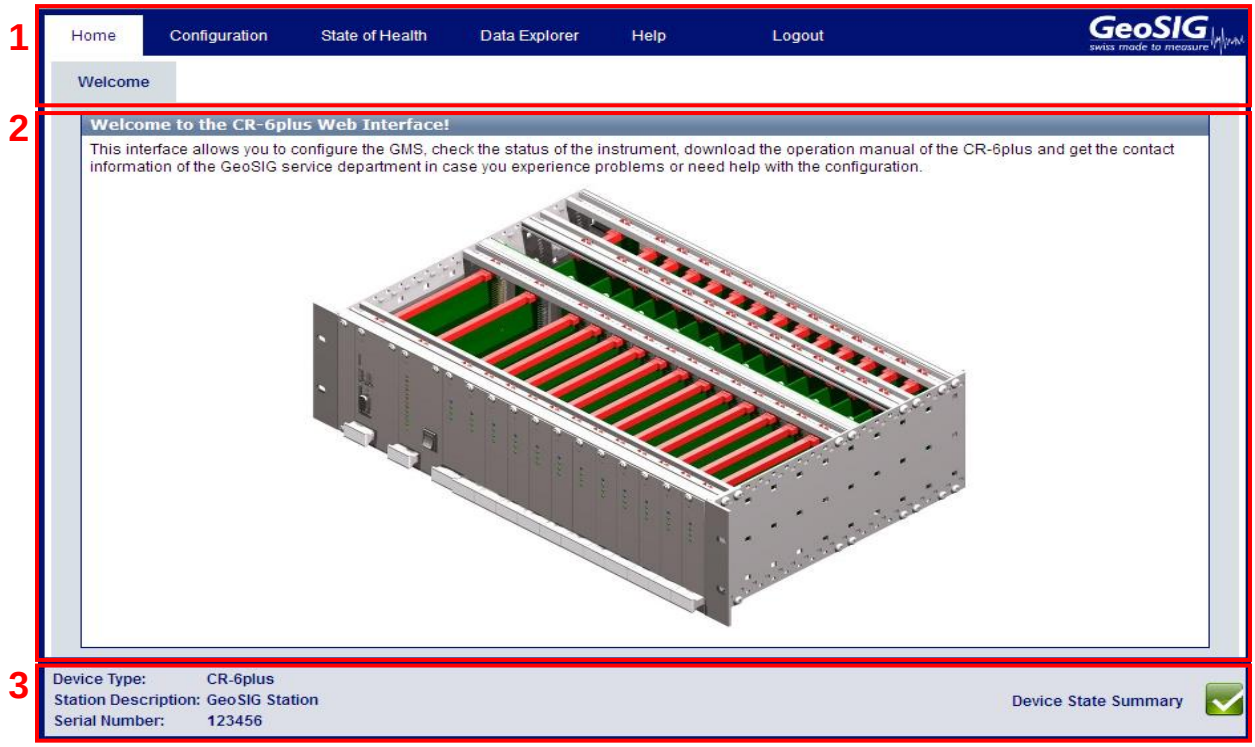


Figure 35. Division of the Screen in the Web Interface

10.3. 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.

To load the configuration can take several seconds. During this time at the right corner of the browser ***Loading…*** is displayed. Please be patient till the screen as shown in Figure 36 appears.

Figure 36. Configuration main menu

10.3.1. armdas Configuration

The ***armdas Configuration*** sub menu provides access to the current armdas configuration options. armdas is the data acquisition program running on the instrument. As depicted in Figure 37, the content of this tab is divided into three sections:

1. **The Configuration Menu**: The Configuration Menu is the additional navigation menu through the currently active configuration in this particular screen. By switching between the listed items in this menu, the Configuration Value Panel can be changed.
2. **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 over the option will be displayed. Please note that the only way to restore the original values of the fields after making changes to them is by using the "*Reload Configuration from Device*" Button in the Action Panel.
3. **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. By saving the changes to the device, the data acquisition software armdas will be restarted to load the new configuration. This will interrupt the current recording for about 20 seconds. During this time, triggers will not be executed as well. 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.

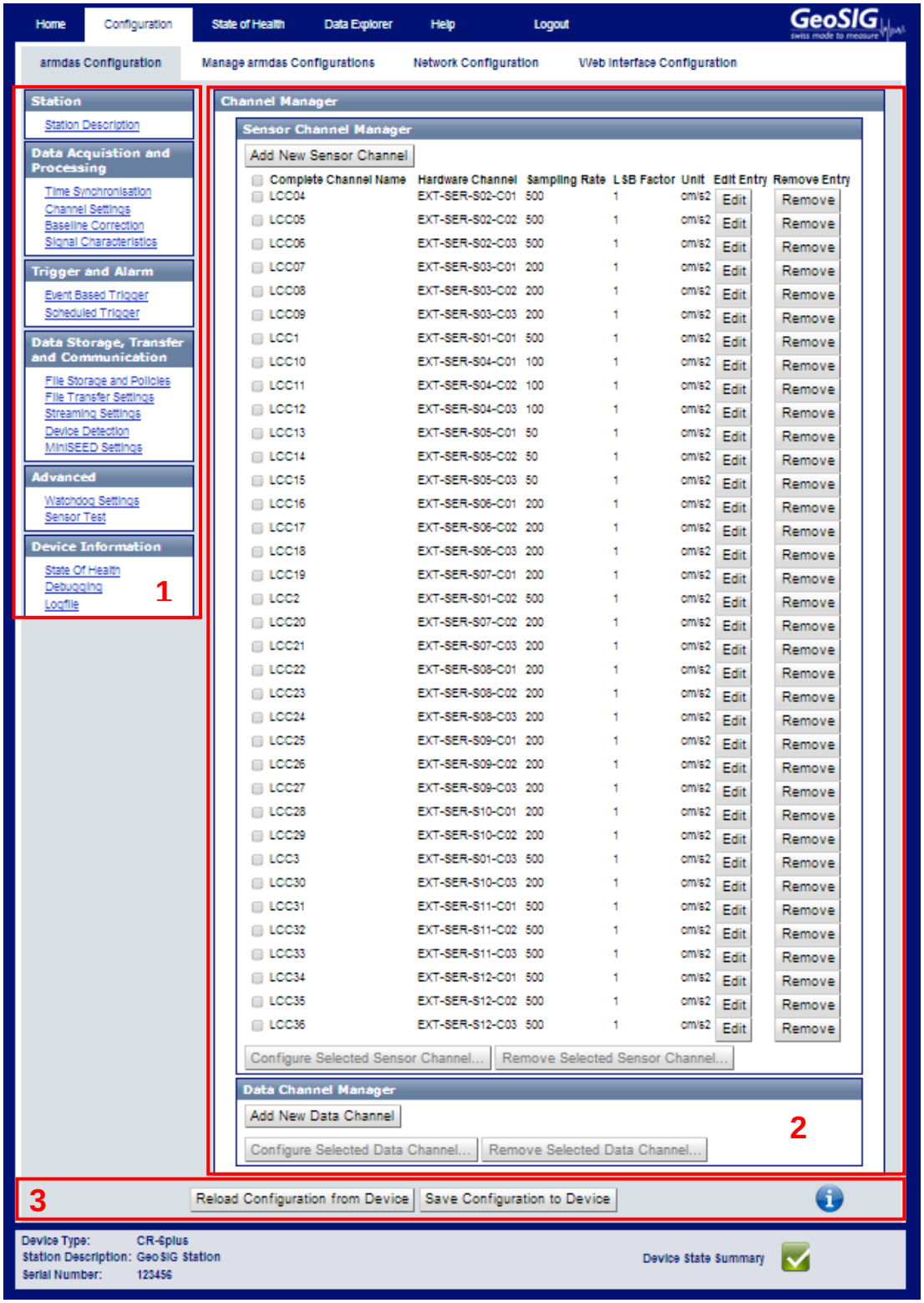


Figure 37. The *armdas Configuration* screen

10.3.2. Manage armdas Configurations

As described in the previous chapter, the *armdas Configuration* screen only allows configuring the currently used configuration. The ***Manage armdas Configurations*** screen described in this chapter allows managing several configurations, changing the current configuration upload a new configuration and so on. As depicted in Figure 38, the screen is divided into three sections:

1. **The Configuration List**: This list contains all configurations currently available on the microSD 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 already the current). As depicted in Figure 39, these options become available to other configurations stored on the microSD 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 *armdas Configuration* 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 39, after a successful upload a new file is shown in the Configuration List and the name of the newly available configuration is written on 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 differently, depending on the Browser in use.
3. **User Default Panel**: With the ***Reset To Default Config***, the *Current Configuration* will be overwritten by the user default (see command SETDEFCFG in the chapter 11.10.1) 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***

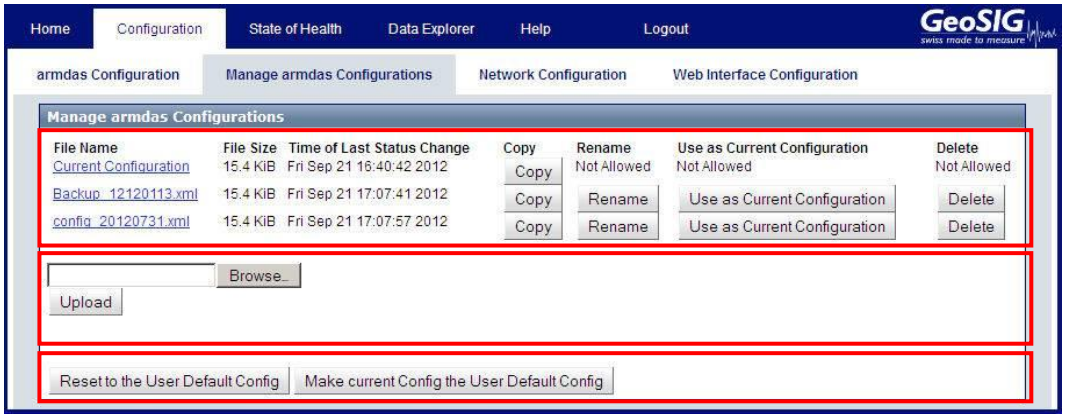


Figure 38. *The Manage armdas Configurations* screen

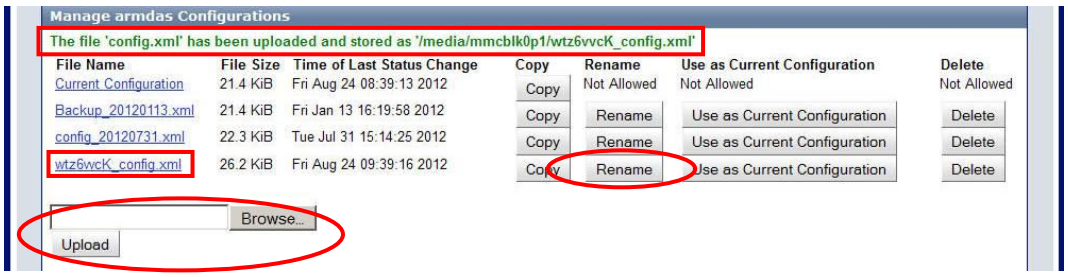


Figure 39. New file upload

10.3.3. Network Configuration

10.3.3.1. Wired Ethernet

The *Network Configuration* screen provides the possibility to change the network configuration of all network interfaces of the instrument. For standard instrument only one network interface is available, which is the Ethernet interface and which is present in all devices. This interface can be configured in the section of the screen shown in Figure 40. 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***.

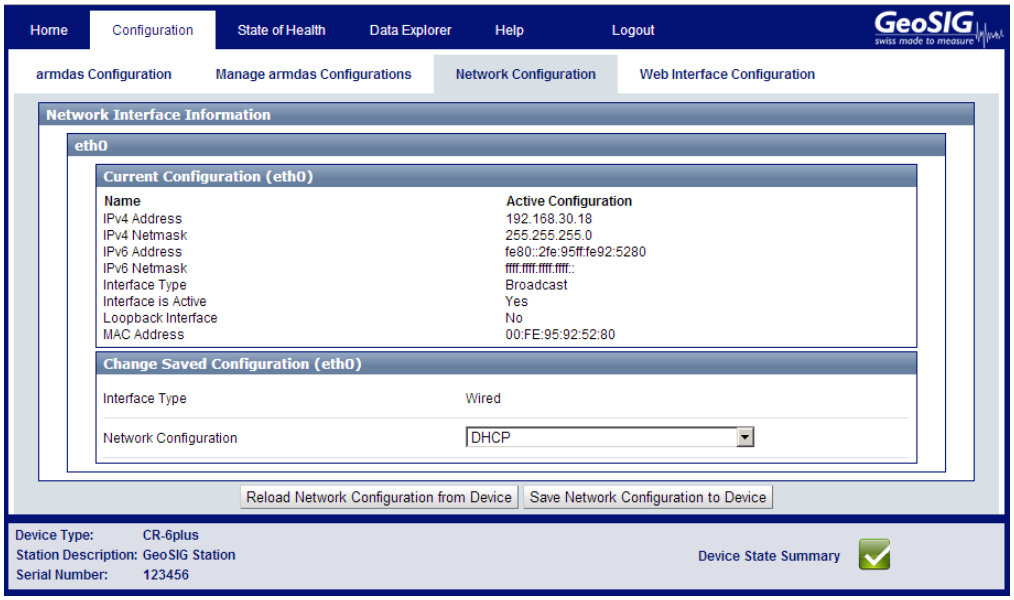


Figure 40. *Network Configuration* Screen

10.3.4. 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 to change 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 microSD card and restart the instrument to restore the default password.

Figure 41. Web Interface Configuration Screen

10.4. State of Health

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

10.4.1. Error Status

As depicted Figure 42, this screen provides basic information on the device at hand (area no 2) as well as the error status for each module (area no 3). The summery of this SOH information are visible on each page on the bottom as the Device State Summary, described in chapter 10.2. 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 no 1).

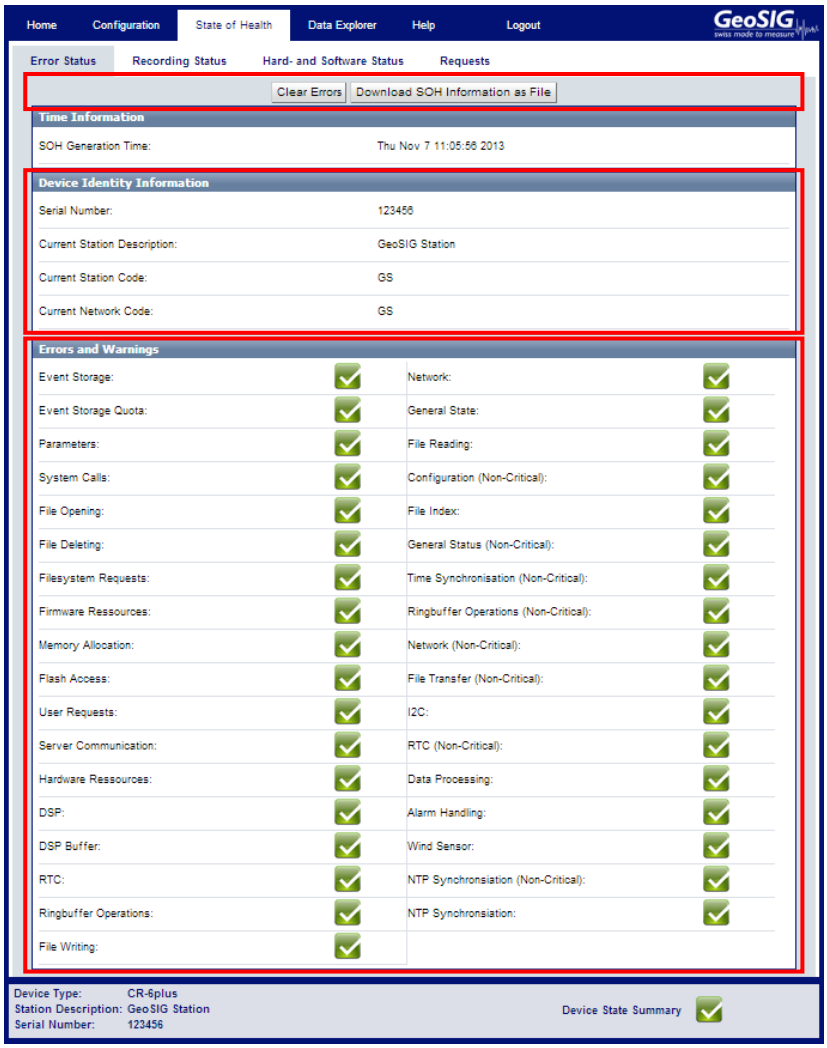


Figure 42. *Error Status* Screen

The modules in the area 3 can have one of the states defined in Table 5 at all time.

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.
	A warning 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 avoid limited functionality.

Table 5. The over all error states shown in the Web Interface

10.4.2. Recording Status

This screen provides all information on the recording and time synchronisation status of the device. As depicted in Figure 43, this contains besides information on the number of events also information on the timing and synchronisation status of the device. Also information about the GPS quality and the GPS position of the instrument can be found here

Figure 43. *Recording Status* Screen

10.4.3. Hard- and Software Status

In the Hard- and Software Status contains information on the ***Software Versions***. The ***Hardware Status*** provides information as uptime, available disk space and the device temperature and so on. Information about the available hardware options in the instrument can be found in the section ***Hardware Configuration Status***.

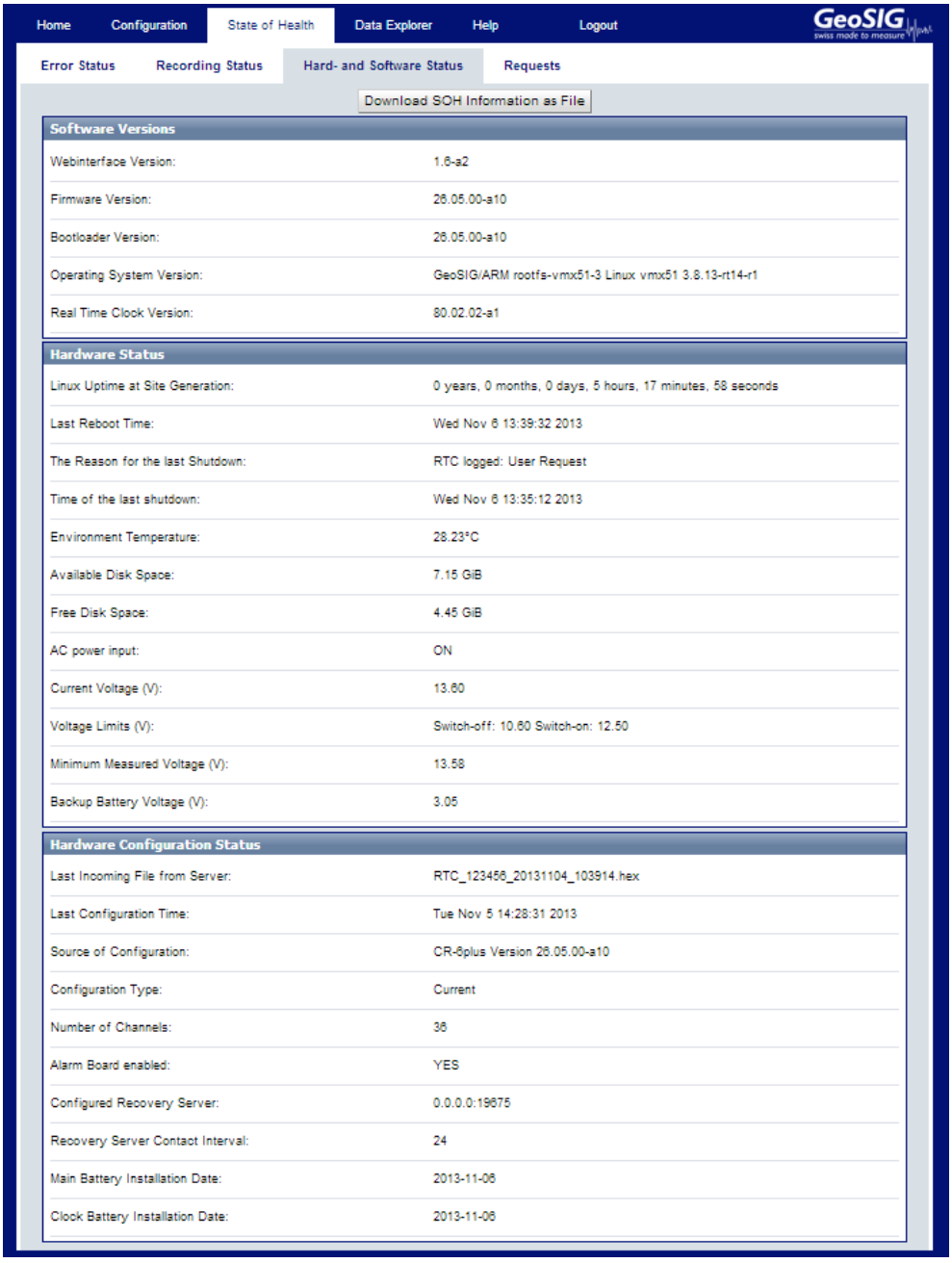


Figure 44. Recording Status Screen

10.4.4. Requests

As shown in Figure 45, the Requests screen allows sending signal-related requests to the data acquisition software. Currently two such signal requests are supported:

- ***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.

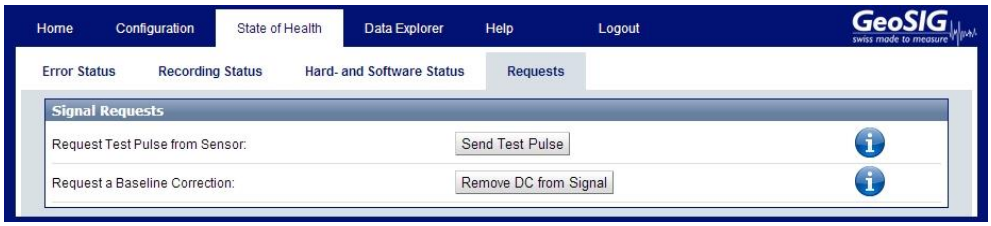


Figure 45. The Requests Screen

10.5. Data Explorer

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

- Event- and Calibration files
- Log- and SOH-files
- Ringbuffer files

With the menu on the top of the Data Explorer it is possible 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.

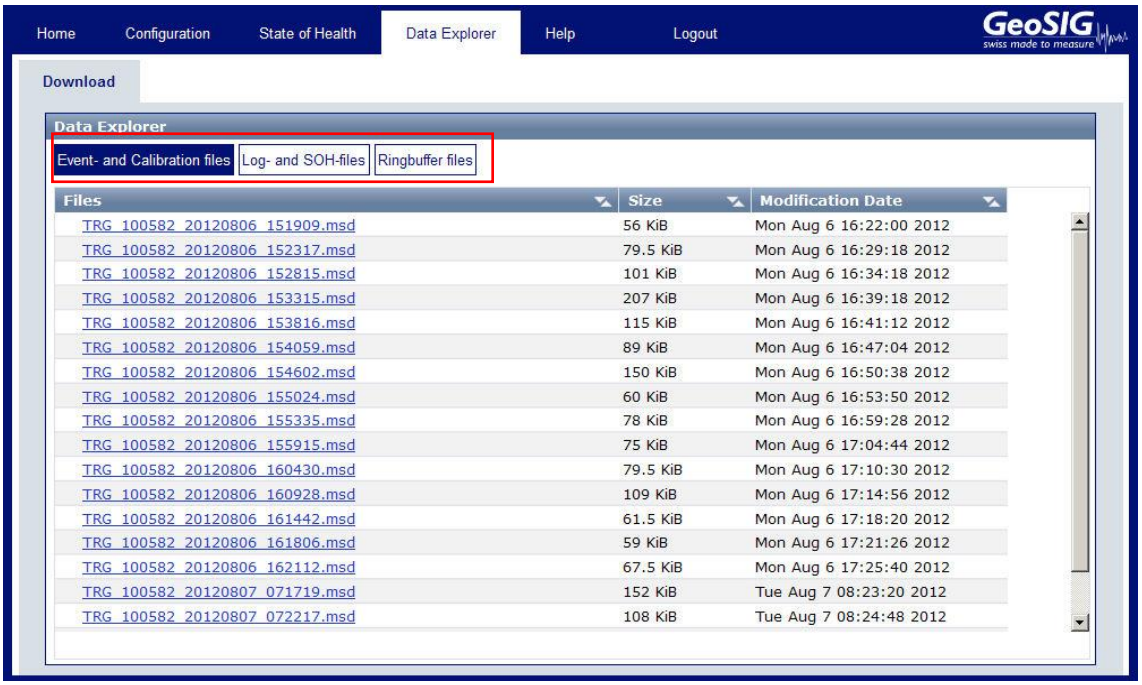


Figure 46. The Data Explorer Screen

10.6. Help

The Help Menu provides help, if there are any problems the device or the web interface.

10.6.1. Online Help

On this screen, the current version of the CR-6plus User Manual can be downloaded from the device. This manual contains additional information on the instrument, which is not provided in the interface itself.

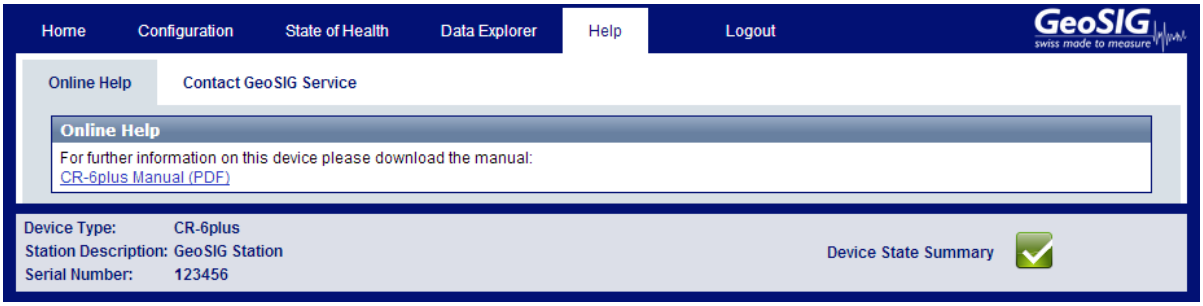


Figure 47. Download the CR-6plus Manual

10.6.2. 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.

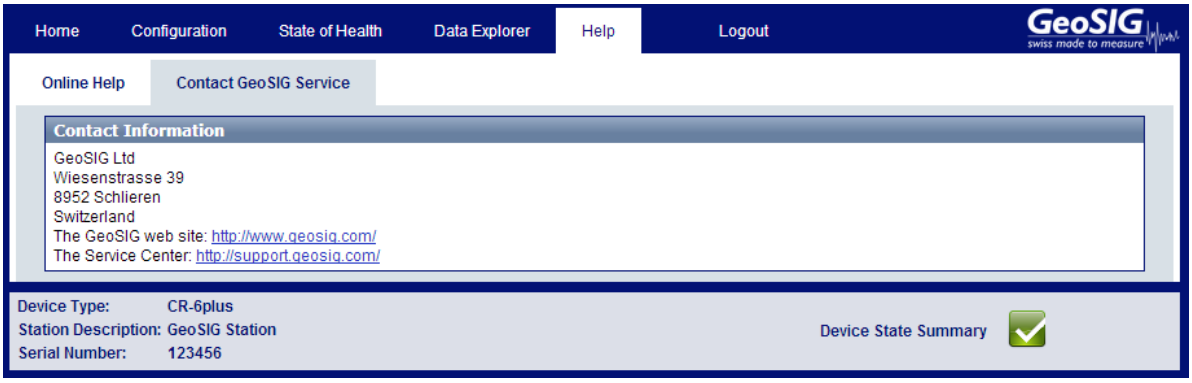


Figure 48. Contact information

11. Detailed Configuration of the Instrument

11.1. Switch ON and OFF the instrument

The main power switch operates as follow:

- Open the cover of the instrument by removing the four screws in the corners.
- Press the *POWER* button for 2 seconds to switch the instrument **ON**.
- To turn the instrument **OFF**, press the power button for a minimum of 2 seconds.

11.2. General Comments to the Configuration

All the configuration changes can be either done over the network by the Web Interface and GeoDAS or on the instrument itself using a RS-232 cable on the serial connector and a terminal program.

11.2.1. 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 9.4 for the full explanation of the Web Interface.

11.2.2. Change Configuration by GeoDAS

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

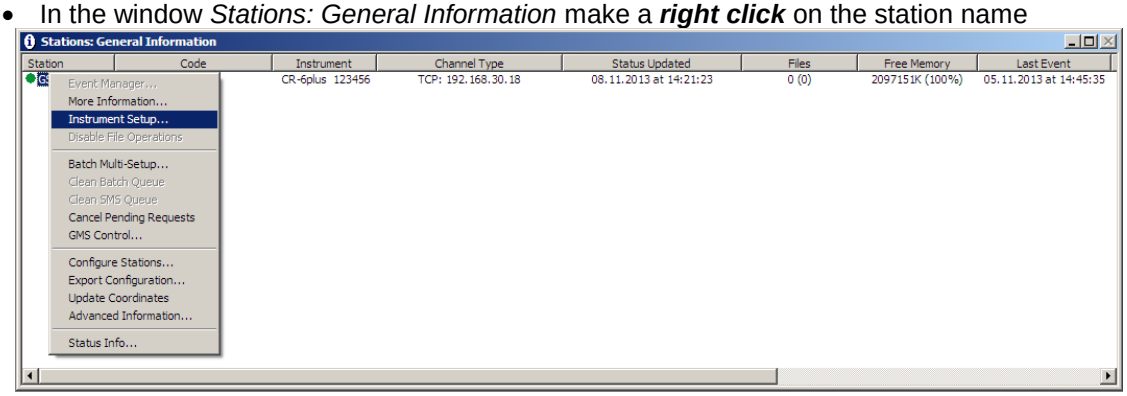


Figure 49. Instrument setup

- GeoDAS is opening the default internet browser and the Web Interface of the instrument will appear. See chapter 8.7 for the full explanation of the Web Interface.

11.2.3. Changing Configuration by the Console

- Connect the CR-6plus to a serial port of your computer and switch on the CR-6plus if not already done.
- In GeoDAS go to ***Tools → Terminal…*** and chose your COM Port. As Baud rate select ***115200.*** Then Press ***Connect***
- Press ***<Enter>***, the following menu appears:

```
CR-6plus s/n 100582 version 26.05.00
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
H - Set RTC time
U - User request
R - Restart
Q - Quit
```

- To configure armdas, from CR-6plus 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
- Press **<Esc>** to leaf the configuration menu. If asked, select ***save as current configuration***, by pressing '**C**'

11.2.4. Explanation of the Structure in the Manual

As sometimes in the configuration the parameters depend on each other, not all parameters are shown all the time. The configuration is also sorted in several sub-menus. Therefore the explanation of 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 6. Explanation table structure

11.3. Configuration of the Channels

11.3.1. In the Web Interface or by GeoDAS

- Go to ***Configuration → armdas Configuration → Channel Settings***

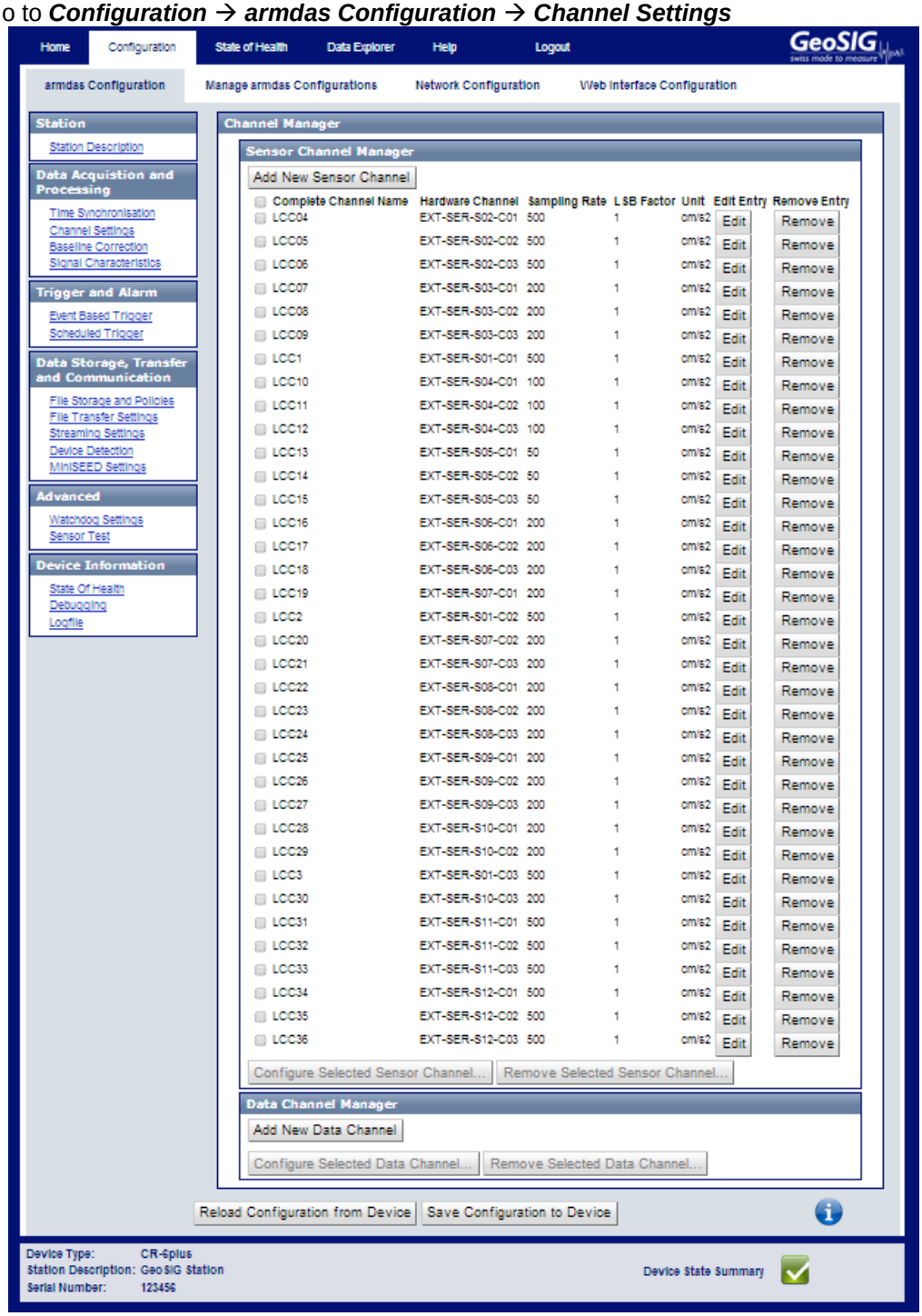


Figure 50. Channel Settings

- Add new sensor or virtual channels by the buttons ***Add New Sensor Channel*** or ***Add New Data Channel***. Channels can be removed again by ***Remove***.
- The edit a channel press the button ***Edit*** and adjust the parameters in the pop-up window. See Table 7 for additional information.
- After having selected several of the channels with the checkbox on the left side, the selected channels can be configured at the same time with ***Configure Selected Sensor Channel…*** or removed with ***Remove Selected Sensor Channel…***

11.3.2. 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.

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

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

```
Main Menu | Channel 1 of 3
  A) Data source ..................... EXT-SER-S01-C01
  E) Channel name .................... C01
  F) Location code ................... CH
  G) Data unit ....................... g
  H) LSB factor ...................... 3.97364e-007
  I) Sampling rate, sps .............. 200 (0xC8)
  K) Negative axis ................... No
  L) Offset compensation ............. No
  M) Fixed offset value .............. 0
  N) Maintain the ringbuffer ......... Yes
  R) 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:

Data source	The source of the channel can be defined	
	EXT-SER-Sxx-Cxx	See chapter 11.3.4
	DATACHAN	
	DATAVSUM	Virtual channels
	DATAVSU3	Vector sum of two channels
		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*	
Data unit	*User selectable*	Data unit of the selected channel
LSB factor	*User selectable*	LSB factor, depending on the connected sensor. See chapter 11.3.3 for details and Table 8 for the specific values of the sensors.
Sampling rate	***50, 100, 200, 500***	Sampling rate of the selected channel
Negative axis	***Yes***	Inversion of the axis is enabled
	No	Inversion of the axis is disabled
Offset compensation	***Yes***	Compensation is enabled
	No	Compensation is disabled
		Detail behavior of the offset compensation can be configured as described in chapter 11.9
Maintain Ringbuffer	***Yes***	Permanent recording is enabled
Continuously Record Data	***No***	Permanent recording is disabled
Decimation and peaks	The data can be decimated or just peaks can be stored	
Online 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 averaging, 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 interval	*User selectable*	

Table 7. Channel configuration menu structure

11.3.3. Calculation of the LSB factor

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.

11.3.3.1. Overview

The LSB's of all GeoSIG sensors 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 Vs/m)		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 8. LSB of all GeoSIG sensors

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

11.3.3.2. Calculate LSB from Sensors with given Full Scale

Output Voltage of the sensor must be +/- 10 V

$$\text{LSB} = \frac{FullScale}{0.9 \cdot 2^{23}} = \frac{FullScale}{754'9747.2}$$

Example, 3 g sensor

$$LSB = \frac{3g}{0.9 \cdot 2^{23} counts} = \frac{3g}{754'9747.2\,\text{counts}} = \underline{\underline{3.973643e-7\ {}^{g}\!/_{count}}}$$

11.3.3.3. Sensors with given Sensitivity

$$\text{LSB} = \frac{\frac{10V}{Sensitivity}}{0.9 \cdot 2^{23} counts} = \frac{1.324547e-6 \frac{V}{counts}}{Sensitivity}$$

Example, 1000 V/m/s sensor

$$LSB = \frac{\frac{10V}{1000 \frac{V}{m/s}}}{0.9 \cdot 2^{23}} = \frac{1.324547e-6 \frac{V}{counts}}{1000 \frac{V}{m/s}} = \underline{\underline{1.324547e-9\ {}^{\frac{m}{s}}\!/_{count}}}$$

11.3.4. Channel Naming

The naming of the channels is organised as following. All cr6plus sensors start with **EXT-SER**.

EXT-SER-Sxx-Cxx

Channel	C01 … C03	
Sensor	S01 ... S12 e.g. 3ch: S01 6ch: S01, S02 ... 36ch: S01, S02, ... , S12	Sensor number (3 channels each)

For example if there are two digitisers configured in the system, the following channels are available

EXT-SER-S01-C01	EXT-SER-S02-C01
EXT-SER-S01-C02	EXT-SER-S02-C02
EXT-SER-S01-C03	EXT-SER-S02-C03

11.4. Configuration of Data Streams

11.4.1. In the Web Interface or by GeoDAS

- Go to ***Configuration → armdas Configuration → Streaming Settings***

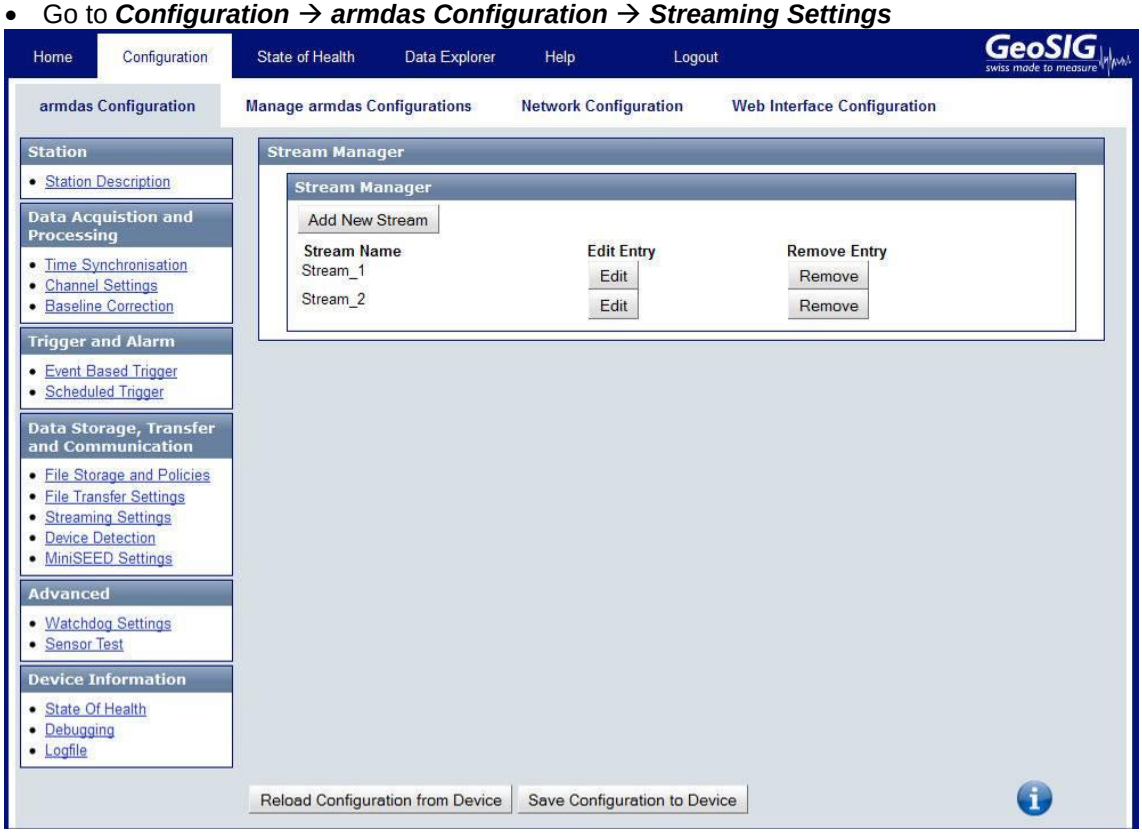


Figure 51. Streaming Settings

- Add new data stream channels by the button ***Add New Stream.*** Streaming channels can be removed again by ***Remove***.
- The edit a streaming channel press the button ***Edit*** and adjust the parameters in the pop-up window. See Table 9 for additional information.

11.4.2. 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 CR-6plus
  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 ........ ->
```

- 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:

Stream name	*User selectable*	Name of the output stream
Stream type	***GSBU***	Streaming possibly in GSBU format only
Channels in the stream	*User selectable*	Number of channels which should be streamed
List of streamed channels	*User selectable*	Depending on the number of channels for every channel a different source can be selected, '**+**' and '**-**' can be used to change the channel, 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 in case '***5***' is selected, then every second a packet with the last second of data will be sent
CRC32 protected packets	*Yes or No*	Whether data packets are sent CRC32 protected or 16-bit checksum protected See GSBU Protocol description for details.
Number of padding bytes	*User selectable*	The number of zero bytes added to the packet right after CRC32 or checksum

Port configuration	***Communication Port***	***TCP/IP***	Streaming over the network
		ttyUSB6	Do NOT use this port
		ttyUSB7	Do NOT use this port
	Protocol	**TCP (Server)**	GeoDAS software or any other client supporting the selected protocol connects to the IP configured under 'IP Address' for data streaming
	Network Port	*User selectable*	Server port listening for incoming connections
	Baud Rate	***1200***	Baud rate of the serial data stream. Make sure that the serial port of the computer is configured to the same baud rate
		2400	
		4800	
		9600	
		19200	
		38400	
		57600	
		115200	

Table 9. Data streaming configuration menu structure

11.4.3. Set up of Data Streams

In this chapter there will be described how to set up an Instrument for data streaming.

11.4.3.1. In the Web Interface or by GeoDAS

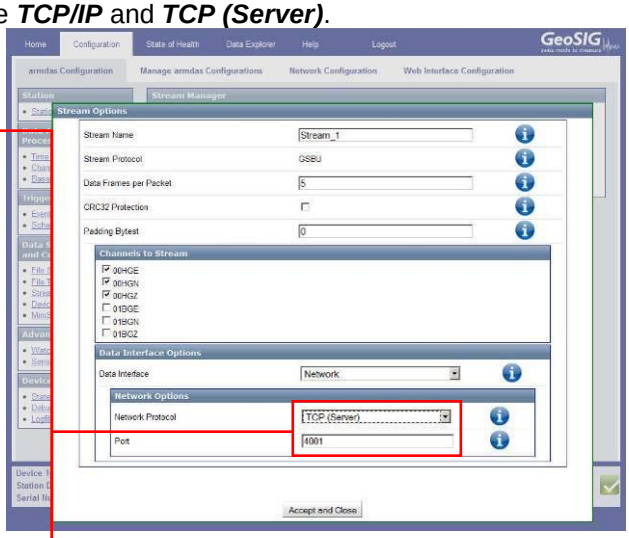
- Connect to the Web Interface and go to ***Configuration → armdas Configuration → Streaming Settings***
- Add a new stream by pressing ***Add New Stream***, one output stream can have several channels.
- Click ***Edit*** to adjust the settings of the output streams.

11.4.3.2. 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 11.4. Carefully select the settings in the *Port Configuration*. In case you want to stream over Ethernet, choose ***TCP/IP*** and ***TCP (Server)***.

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



- Open ***GeoDAS*** and go to the menu *Settings* → ***Channels of Digitizers…*** The following window appears:

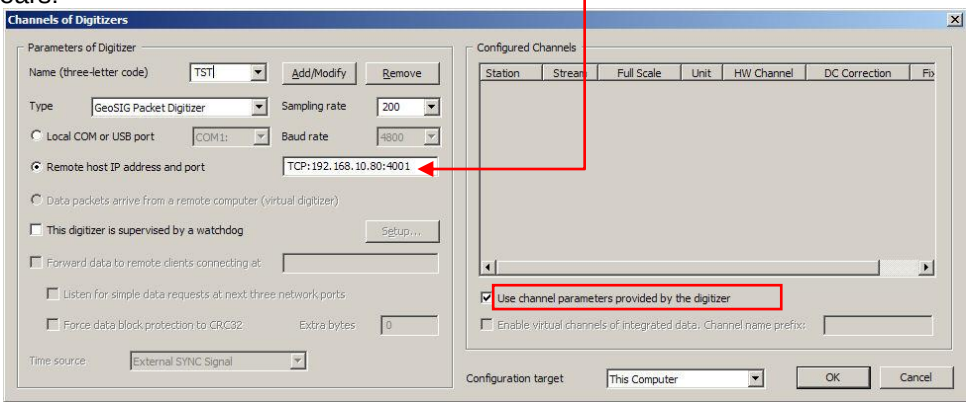


Figure 52. Channels of Digitisers...

- Adjust the ***Name,*** chose any three-letter code for the data stream
- Select as ***Type*** the ***GeoSIG Packet Digitiser***
- Press ***Add/Modify***
- Make sure the selected ***Sample rate*** is the same as in the instrument
- Chose ***Remote host IP address and port*** (in case connected over Ethernet). The IP must be known from the instrument.
- Check the flag ***Use channel parameters provided by the digitizer***
- Press ***OK***
- After a restart of *GeoDAS*, the window *Stations:Data Streams* appears

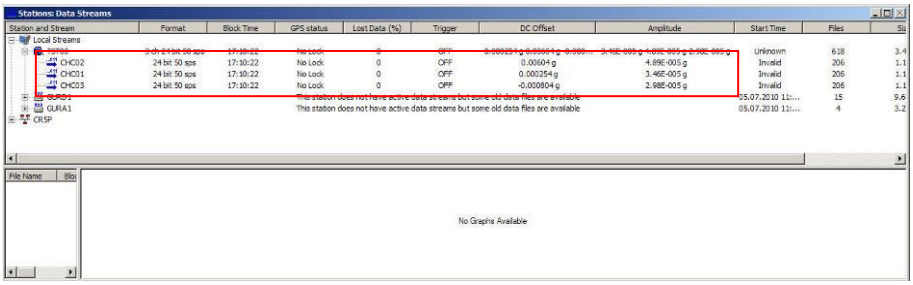


Figure 53. Stations: Data streams

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

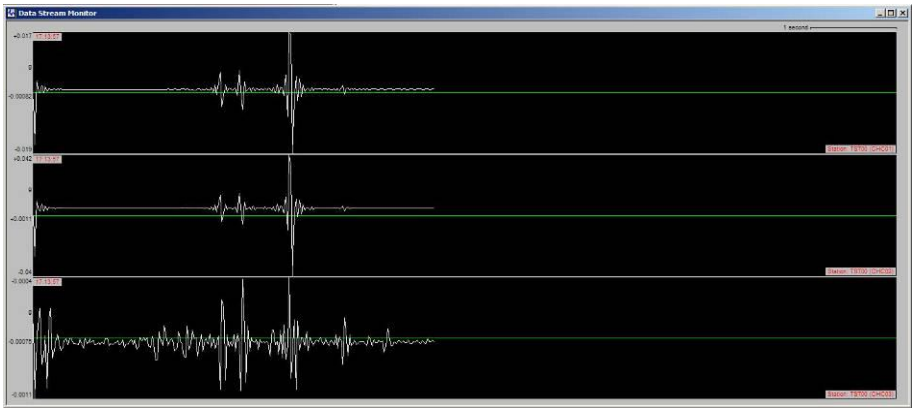


Figure 54. Data stream window

11.5. Trigger Settings

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

11.5.1. In the Web Interface or by GeoDAS

- Go to ***Configuration → armdas Configuration → Event Based Trigger***

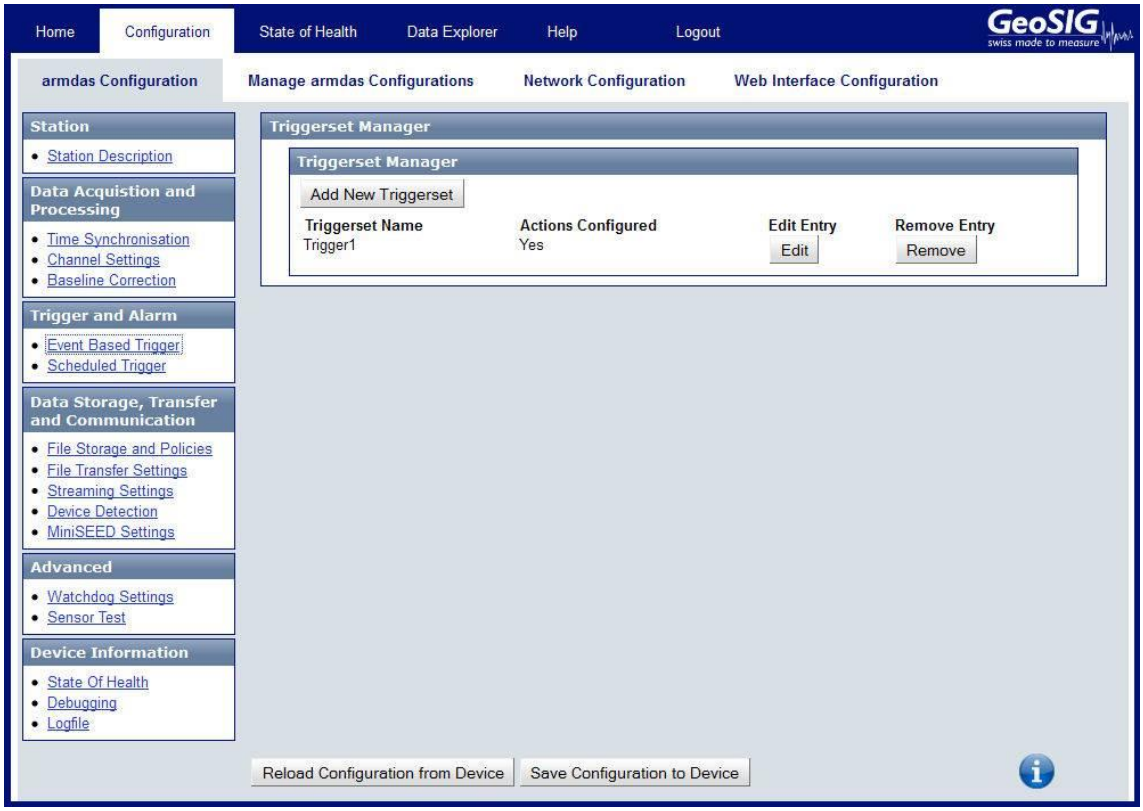


Figure 55. Trigger Settings

- Add new triggerset by the button ***Add New Triggerset.*** Triggersets can be removed again by ***Remove***.
- The edit a triggerset press the button ***Edit*** and adjust the parameters in the pop-up window. See Table 10 for additional information.

11.5.2. Via Local Serial Console

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

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

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) Event recording ..................................... No
  D) Alarm activation .................................... No
  I) Trigger time frame, sec ............................. 3 (0x03)
  K) Monitored channels .................................. 3
  J) Trigger settings .................................... ->
  M) Be a source of network triggers (received from LAN) ... No
  N) Activate on network triggers (received from LAN) ..... No
```

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

Triggerset name	*User selectable*	Name of the trigger set
Event recording	***Yes***	An event file will be recorded on a trigger
	No	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
Stored channels	*User selectable*	Number of channels, which should be stored into an event file in case of a trigger
List of stored channels	*User selectable*	Depending on the number of stored channels different sources can be selected. '**+**' and '**-**' can be used to change the channel, 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 alarm relay
	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
Trigger time frame, sec		*User selectable*	See chapter *11.5.5* for details
***Monitored* channels**		*User selectable*	Number of channels which will be monitored by the selected trigger set
Trigger settings	To go through the monitored channels press '**+**' or '**-**'.		
	Assigned channel name	*User selectable*	
	Trigger filter	***Yes*** ***No***	Trigger filter is used as defined under Filter Parameters Trigger filter is not used
	Filter parameters	*User selectable*	One can select a filter type: Low, High and Bandpass, order of the filter and corner frequency(ies)
	Level Trigger	***Yes*** ***No***	Level trigger is enabled Level trigger is disabled
	Threshold	*User selectable*	As soon the data is above the configured threshold the trigger is activated
	STA/LTA Trigger	***Yes*** ***No***	STA/LTA trigger is enabled STA/LTA trigger is disabled
	STA time frame	*User selectable*	Length of STA time window, seconds
	LTA time frame	*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
	Clamp LTA during event	***Yes*** ***No***	The LTA value will not be updated during the event The LTA value will be updated during the event

	Min. level exceedance	*User selectable*	The threshold or STA/LTA ratio has to be exceeded at least for the configured time in seconds to active the trigger
	Channel trigger weight	*User selectable*	See chapter 11.5.4 for details
Stored channels		*User selectable*	Number of channels, which should be stored into an event file in case of a trigger
List of stored channels		*User selectable*	Depending on the number of *stored channels* different sources can be selected. '**+**' and '**-**' can be used to change the channel, the source can be selected by pressing '***A***'
Be a source of network triggers (received from LAN)		***Yes***	In case the instrument is **interconnected over LAN** with other instruments. All the other instruments will be alerted due to the trigger of this instrument
		No	Other instruments will not be alerted due to the trigger of this instrument A master instrument must be defined to use this functionality. See chapter 11.5.6 for details.
Activate on network triggers (received from LAN)		***Yes***	In case the instrument is **interconnected over LAN** with other instruments. The instrument will trigger in case it receives an alert from the LAN
		No	The instrument will not trigger in case it receives an alert from the LAN A master instrument must be defined to use this functionality. See chapter 11.5.6 for details.
Event processing		***None***	No event processing will be done
		PGM Parameters	Peak ground motion parameters will be calculated in case of an event and will be sent to the server if configured according to chapter 11.7
	Max. summary interval	*User selectable*	The PGM parameters will be sent after an earthquake record has been completed or latest after the defined time in seconds, whichever comes first

Table 10. Trigger configuration menu structure

11.5.3. 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.

11.5.4. Trigger Weight

To activate a trigger the total trigger weight must be equal or bigger than 100%. By default all channel have a weight of 100%, means if a threshold is exceeded on one channel only, then the trigger is activated. If the trigger weight would be reduced on all channels to 50%, then at least on two channels the threshold has to be exceeded to reach 100% (50% + 50%) and activate the trigger. See Figure 56 for details.

11.5.5. Trigger Time Frame

Depending on the settings it can be, that on two or more channels the threshold has to exceed to activate the trigger (see chapter 11.5.4 for details). The time of the threshold-exceedance 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 56 for details.

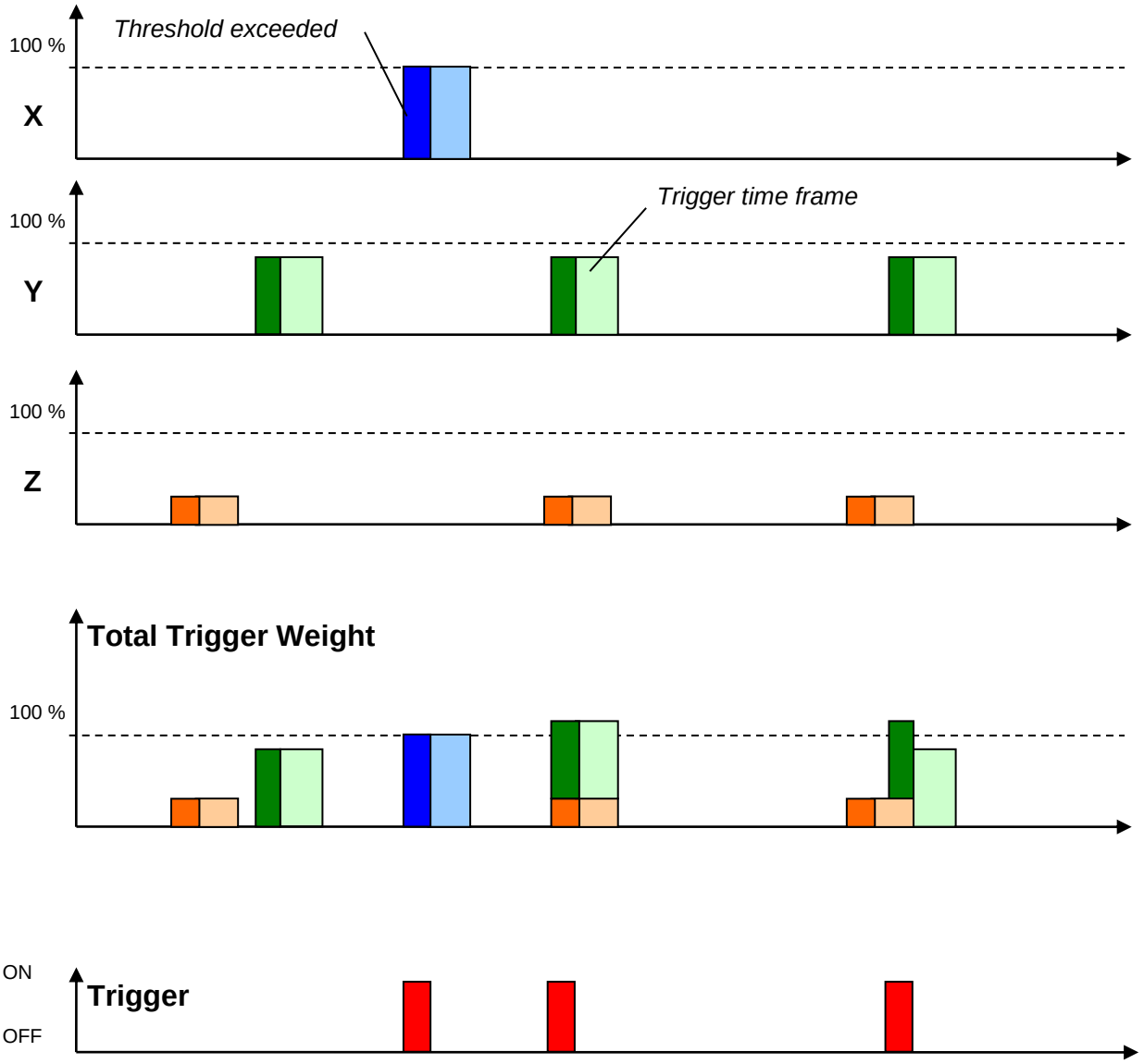


Figure 56. Overview of trigger weight and trigger time frame

11.5.6. Trigger Interconnection over LAN

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

One instrument has to be set up as a master, whereas all other instruments are like slaves, sending the trigger alarms to the master instrument. The master instrument distributes then the trigger alarm to all slaves.

All the communication between the data server and the slave instruments will go via the master instrument. This means that the master instrument will download the requests first and forward it to the appropriate slave instrument. On the other hand, the slave instruments will upload all the files to the master, who will upload it to the data server.

11.5.6.1. Set up of the Master Instrument

- Press 'K' to enter the menu *Communication Parameters and* activate the *Server mode* by pressing '***H***'

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

To do the settings in the Web Interface go to ***Configuration → armdas Configuration → File Transfer Settings*** *and Enable the flag* ***Act as Server****. Then just do the steps described below in the GUI of the Web Interface*

- Specify the *Port of incoming connections* and adjust the number of slaves in the parameter *Number of clients.* Write down the *Port of incoming connections* (use ***3456*** as default) and the *IP of the instrument*, as they are used again during the configuration of the slave instruments.

```
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
```

- The details of every slave instrument have to be filled out. Additionally make sure that the *Data forwarding* and the *Network triggers* is set to ***Yes***. To change the slave (client) instrument press '**+**' or '**-**'.

```
Main Menu | Communication | Client 1 of 2
  A) Client IP Address ....... 0.0.0.0
  B) Client serial number .... 000000
  C) Transfer timeout, sec ... 20 (0x14)
  D) Data forwarding ......... Yes
  E) Network triggers ........ Yes
```

11.5.6.2. Set up of the Slave Instruments

- Press 'K' to enter the menu *Communication Parameters*

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

*To do the settings in the Web Interface go to **Configuration → armdas Configuration → File Transfer Settings**. Then just do the steps described below in the GUI of the Web Interface*

- Press '***A***' and change *Contact remote servers* to **Yes** if not already set and then go to *Server Parameters* menu by pressing '***G***'

```
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 ........................ No
  M) Seedlink Server .................... Yes
```

- IP and Port from the master instrument must be adjusted in the field *Server IP Address* and *Port* (use ***3456*** as default). Make sure the *Network triggers* are activated by putting ***Yes***

```
Main Menu | Communication | Server
  A) Server IP Address ....................... 192.168.10.02 (IP of the Master)
  B) Protocol ................................ Custom
  C) Port .................................... 3456 (0xD80)
  H) Transfer timeout, sec ................... 40 (0x28)
  I) Network triggers ........................ Yes
  J) Keep connected to the Server ............ No

Select <A>...<Q>. <Esc> back to Main Menu | Communication
```

11.5.6.3. Trigger Parameters for Master and Slave instruments

The following settings must be done on the master and the slave instruments.

- Make sure on all instruments that the *Number of Trigger Sets* is not zero and then press '***K***' to enter the menu *Trigger Parameters*

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

*To do the settings in the Web Interface go to **Configuration → armdas Configuration → File Transfer Settings**. Then just do the steps described below in the GUI of the Web Interface*

- Configure the triggerset according to the description in chapter 11.5 and make sure that on all instruments *Be a source of network triggers (received from LAN)* and *Activate on network triggers (received from LAN)* is set to ***Yes***

```
Main Menu | Triggerset
  A) Triggerset name ..................................... Trigger1
  B) Event recording ..................................... Yes
  C) Record on network triggers only ..................... No
  D) Alarm activation .................................... No
  E) Pre-Event, seconds .................................. 5 (0x05)
  F) Post-Event, seconds ................................. 10 (0x0A)
  G) Trigger time frame, sec ............................. 3 (0x03)
  H) Max. event duration, sec ............................ 60 (0x3C)
  I) Monitored channels .................................. 3
  J) Trigger settings .................................... ->
  K) Stored channels ..................................... 3
  L) List of stored channels ............................. ->
  M) Be a source of network triggers (received from LAN) ... Yes
  N) Activate on network triggers (received from LAN) ..... Yes
  O) Event processing .................................... None
```

In case an instrument should trigger on network triggers, but not alarm the other instruments about an own trigger (e.g. in a noisy area) the *Be a source of network triggers (received from LAN)* should be set to ***No***

In case an instrument should alarm the other instruments over the LAN about a trigger, but not be activated on network triggers, then *Activate on network triggers (received from LAN)* should be set to ***No***

11.6. Preset Trigger Settings

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

11.6.1. In the Web Interface or by GeoDAS

- Go to ***Configuration → armdas Configuration → Scheduled Trigger***

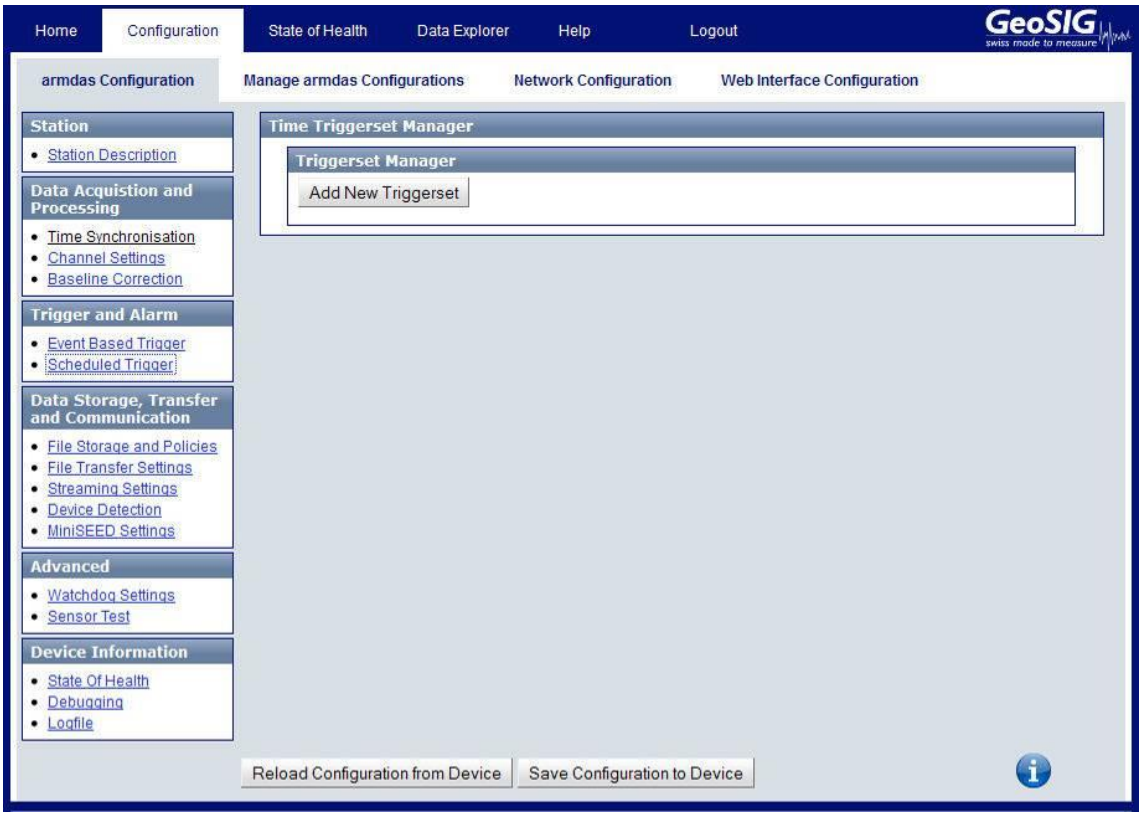


Figure 57. Preset Trigger Settings

- Add new triggerset by the button ***Add New Triggerset.*** Triggersets can be removed again by ***Remove***.
- The edit a triggerset press the button ***Edit*** and adjust the parameters in the pop-up window. See Table 11 for additional information.

11.6.2. Via Local Serial Console

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

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

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

```
Main Menu | TimeTableTrigger
  A) Preset trigger name .......... Trigger1
  B) First trigget 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:

Preset trigger name		*User selectable*	Name of the preset trigger set
First trigger type		There are several possible predefined triggers to choose	
		Manual Trigger	A trigger is activated/stopped by the user command TRIGGERNOW/STOPTRIGGER sent either from the console or remotely from a server
		After Even	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
	Total number of triggers	*User selectable*	After reaching the configured number of triggers the preset trigger will not be activated anymore
	Delay after event	*User selectable*	In case After Event is selected, then the time between the end of the event to the begin of the activation of the preset trigger can be configured
	First trigger time, year	*User selectable*	Date and time of the first trigger
	First trigger time, day	*User selectable*	
	First trigger time, hour	*User selectable*	
	First trigger time, minute	*User selectable*	

Stored channels	*User selectable*	Number of channels which should be stored into an event file in case of a trigger
List of stored channels	*User selectable*	Depending on the number of stored channels different sources can be selected. '**+**' and '**-**' can be used to change the channel, the source can be selected by pressing '**A**'

Table 11. Preset trigger configuration menu structure

11.7. File Storage and Policy

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

11.7.1. In the Web Interface or by GeoDAS

- Go to Configuration → armdas Configuration → Scheduled Trigger

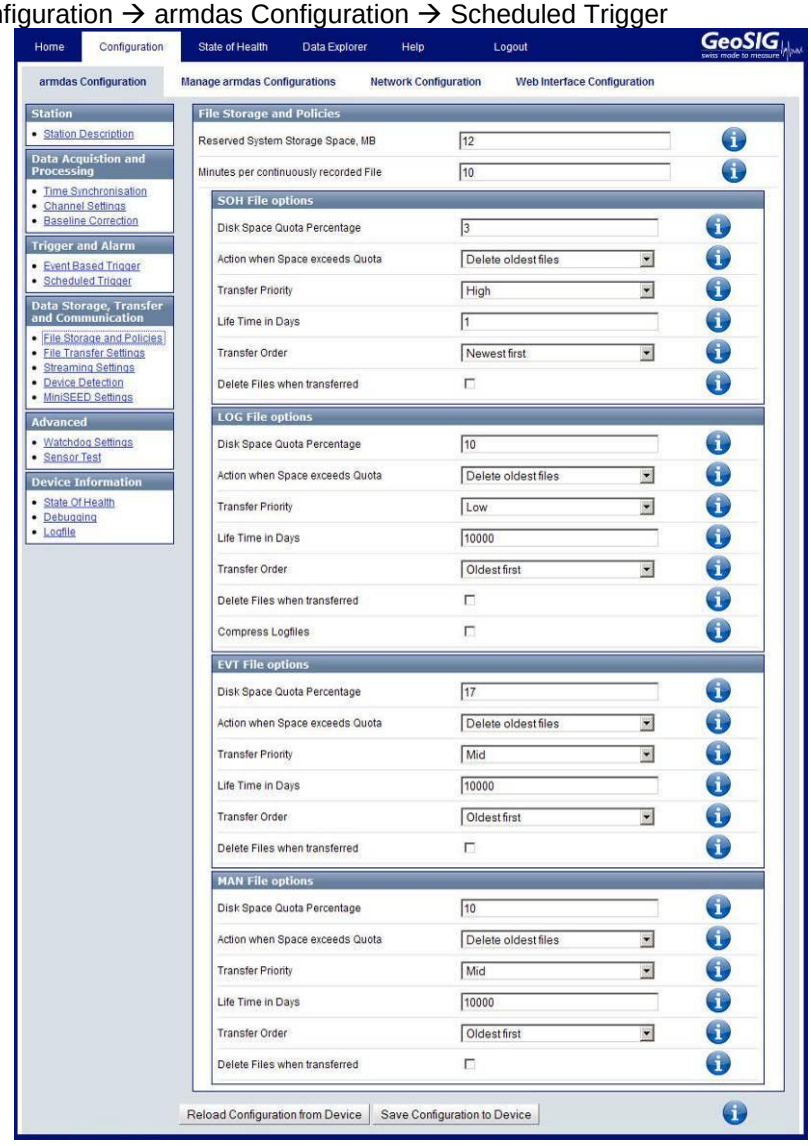


Figure 58. File Storage Settings

- Parameters for the following file types can be configured (see *Filetypes* in Table 12)
  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 12 to get more information about the parameters which can be configured.

11.7.2. Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

- Press ‘M’ to get to the *File Storage and Policy* menu to adjust the settings of the file storage. The following menu appears:

```
Main Menu | 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 15)

  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 12 to get 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 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 12. *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***	Files will be sent gzip-compressed (.gz)
	No	Original text files will be sent (default)

11.8. Communication Parameters

This chapter explains how to set up the server parameters

11.8.1. In the Web Interface or by GeoDAS

- Go to Configuration → armdas Configuration → File Transfer Settings

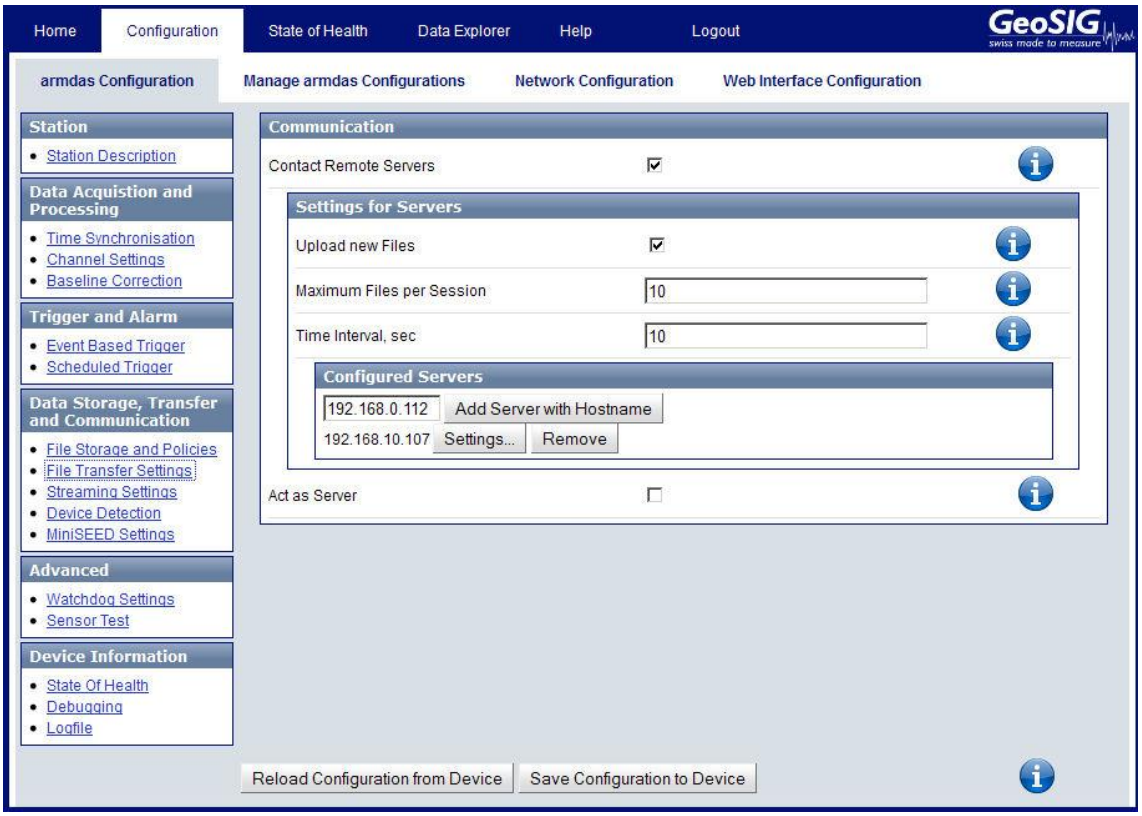


Figure 59. Server parameters

- Tick the flag ***Contact Remote Servers*** to configure a connection to a remote server
- Add the IP of your server and press ***Add Server with Hostname.*** Servers can be removed again by ***Remove***.
- Then press Settings… to adjust the parameters as shown in the Table 13
- In case the instrument should act as Server for other CR-6plus instruments, tick the flag ***Act as Server*** and follow the steps as described in chapter 11.8.2.1

11.8.2. Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

- 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 .................. 20 (0x14)
  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
```

- 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 can not connect to the first data server it will connect to the second data server, if this one is down it connect to the third and so on. Scanning of servers stops after first successful connection
Time interval	*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 connect to the server in case there are new files recorded and are ready to be transmitted
	No	Instrument does not connect to the server in case there are new files. It just connects periodically as defined with the parameter **Time interval**

	Server parameters	**'+'** and **'-'** can be used to change between the clients		
		Server IP Address	User selectable	IP address of the data server
		Protocol	**Custom**	Protocol of communication, can not be changed so far
		Port	User selectable	Communication port of the data server
		Transfer timeout	User selectable	Instruments gives up to contact the server after the configured timeout in seconds
		Network triggers	**Yes** **No**	Triggers are sent to the server, for event detection as described in chapter 15.2 Triggers are not sent to the server
		Keep connected to the server	***Yes*** ***No***	If this flag is enabled, the instrument keeps the channel to the server open. This allows configuring the instrument though the web interface in GeoDAS even over the internet.
	Server mode for other instruments …		***Yes*** ***No***	See chapter 11.8.2.1 for more details
SeedLink server			***Yes*** ***No***	SeedLink server is enabled for all data channels and data streams can be received by any SeedLink client from the instruments IP.
Accept connections			***Yes*** ***No***	Allows GeoDAS to connect to the instrument. Works only if the IP of the instrument is known and reachable.

Table 13. *Communication Parameters* menu structure

11.8.2.1. Instrument acts as a server (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.

The serial numbers and IP's 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.

Server mode		***Yes***	The instrument acts as a data server for other instruments
		No	The instrument does not act as a data server
	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 client instruments which upload data to this instrument
Clients Parameters	'**+**' and '**-**' can be used to change between the clients		
	Client IP Address	User selectable	IP of the client instrument which connects to this instrument
	Client serial number	***Custom***	Serial number of the client instrument. Use 000000 to allow instruments with any serial numbers to connect
	Transfer timeout	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***	Network triggers will be sent to the server
		No	Network triggers will not be sent to the server

Table 14. *Server Parameters* menu structure

11.9. Miscellaneous Parameters

The Time synchronisation, State of Health files, messaging and debugging can adjusted under this menu

11.9.1. In the Web Interface or by GeoDAS

The parameters of this menu item is splitted up in several pages on the Web Interface:

- To adjust the time synchronisation, go to ***Configuration → armdas Configuration → Time Synchronisation***
- To adjust the offset corrections settings, go to ***Configuration → armdas Configuration → Baseline Correction***
- To adjust how many times the SOH information shall be sent, go to ***Configuration → armdas Configuration → State of Health***
- To adjust the type and the number of the sensor test pulses, go to ***Configuration → armdas Configuration → Sensor Test***
- To enable/disable the autodetection of Web Interface, go to ***Configuration → armdas Configuration → Device Detection***
- To enable additonal debug messages in the system log files, go to ***Configuration → armdas Configuration → Debugging***
- To adjust, when the system log files shall be sent, go to ***Configuration → armdas Configuration → Logfile***

Adjust the parameters as shown in the Table 15.

11.9.2. Via Local Serial Console

```
Main Menu
  A) Station description ............. Demo CR-6plus
  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 ........ ->
```

- 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 .............. 0 (0x00)
  C) Offset correction counts ................. 1 (0x01)
  D) MiniSEED record length ................... 512
  E) Extended MiniSEED format ................. Yes
  F) Single channel ringbuffer files .......... No
  G) State of health .......................... ->
  H) Test configuration ....................... ->
  J) Messaging and debugging .................. ->
  I) Time synchronization ..................... ->
  K) Instrument configuration options ......... ->
  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:

Offset detection time	*User selectable*	Time in seconds, which the input values is measured after start-up to define the offset
Offset correction time	*User selectable*	The instrument takes the average over the number of seconds, configured in the *Offset correction time* and adds or subtracts the number of counts defined under *Offset correction counts*
Offset correction counts	*User selectable*	
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. When you open such files with GeoDAS, there is no need to enter LSB factors and units (see the chapter 15.4) as this information is retrieved from files. This feature is supported

			from GeoDAS version 2.21.
State of health	***SOH report type***	***None***	No State-Of-Health file will be created
		No	State-Of-Health files will be created and uploaded to the server according to the settings in chapter 11.7
	SOH reporting interval , days	*User selectable*	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 use 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*	Defines the hour and minute of the first SOH report
	First SOH report time, minutes	*User selectable*	
	Activate alarm on errors	***Yes***	Activates an alarm relay in case of an error
		No	Alarm relay will not be activated in case of an error
	Activate alarm when system is inactive	***Yes***	Alarm relay is activated in case *armdas* is not running (e.g. during startup or after quit)
		No	Alarm relay will not be activated
	Error and inactivity alarm output	***AL1, AL2, AL3, AL4***	Alarm relay which should be activated in case of an error or *armdas* is not running
	Activate alarm on selected errors only	***No***	Selected alarm relay is activated on all errors
		Yes	Selected alarm relay is activated on selected errors only. The errors can be selected by pressing '***L***' to '***T***'
Test configuration	***Sensor test type***	***None***	No test pulse is generated
		Pulse	Test pulse is generated, depending on the following settings
	Sensor test interval	*User selectable*	Interval between two sensor tests
	Time of the first test	***Startup***	First test will be done at startup, 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. This would be critical in case of an earthquake at this time.
		User defined	First test will be done at the user defined time

Messaging and debugging	***Console messages***	***Yes*** ***No***	Enables console messages Disables all console messages
	Debug: memory allocation	***Yes*** ***No***	Enables or disables specific debug messages. These are for service or advances users only. Keep *No* by default.
	Debug: system and processes		
	Debug: flash memory		
	Debug: configuration		
	Debug: network links		
	Debug: data streams		
	Debug: data sources		
	Debug: ring buffers		
	Debug: event triggers		
	Debug: time synchronisation		
	Debug: file manager		
	Debug: cryptographic info		
	Debug: hardware related info		
Time Synchronization	***Time source***	***RTC*** ***GPS*** ***NTP*** ***AUTO*** ***NET1PPS***	RTC is not synchronizing itself to any source RTC is synchronizing to the connected GPS RTC is synchronizing to a NTP server RTC synchronizes to NTP in case GPS is not available RTC is synchronizing to the 1PPS signal distributed by the 433 MHz module or the interconnection network.
	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	*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, do not change** the default value of '***4***'
	NTP network timeout	*User selectable*	Maximum time to receive a reply from the NTP server in [seconds]. **For service and advanced user only, do not change** the default value of '***3***'
	NTP maximum error	*User selectable*	Above this time in [seconds] the RTC will make a time jump to the NTP time. Otherwise the time will be tuned slowly. **For service and advanced user only, do not change** the default value of '***1***'
	GPS reception timeout, min	*User selectable*	If GPS signal is lost, after this time in [minutes] the RTC will change its synchronization to NTP
	GPS check interval in NTP mode, min	*User selectable*	If in the '***Auto***' mode, the RTC is synchronized to the NTP the instruments checks in the configured

	GPS check duration in NTP mode, sec	*User selectable*	interval if the GPS is available again
	Send SOH upon RTC status change	***Yes*** ***No***	In case RTC status changes, a SOH message will be uploaded to the server No SOH message will be sent upon RTC status change
Instrument configuration options	***Enable autodetection of the instrument***	***Yes*** ***No***	Instrument can automatically be found by GeoDAS in the LAN Instrument can not automatically be found by GeoDAS
	Configurable with a browser	***Yes*** ***No***	Web Interface is enabled and instrument can be configured with the browser Web Interface is disabled
Time for sending daily logfile, hour		User selectable	If transfer is activated in chapter 11.7, at this time the daily logfile will be sent to the server. Can be adjusted to avoid that all instruments send the logfile at exactly the same time
Time for sending daily logfile, minutes		User selectable	

Table 15. *Miscellaneous Parameters* menu structure

11.9.3. 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 to provide the most accurate time possible to the system and perform time synchronization with other available external time source as:

- GPS time code receiver on the GPS interface.
- NTP (Network Time Protocol) server from the Ethernet interface.

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

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

11.9.3.1. Temperature compensation

RTC uses the internal temperature sensor of the micro-controller to define the current operating temperature. When good time synchronization occurred, typically using a GPS, the RTC check 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 worst but the same process occurred 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, the unit will learn it self on site the correction parameters according to the ambient conditions at site and also according to the aging of the oscillator.

11.10. 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:

```
CR-6plus s/n 100582 version 26.05.00
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 11 for details
M	***Messages →***	Possibility to configure, what kind of messages are shown in the console.
S	***Shell 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 if 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 11.10.1 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

11.10.1. 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

```
CR-6plus 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
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 11.8).
TRIGGERNOW [trigger_name]	Activate a manual trigger to start recording, the manual trigger must be configured as described in the chapter 11.6
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 0).
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*
CLRTRIM	The instrument will clear the RTC trim table
TCAL <Tcur>	Calibration of the internal temperature sensor by applying the actual temperature in °C. Temperature is used for the learning of the RTC.
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 get corrupted, and CR-6plus 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 CR-6plus and is supposed to be correct. Thus, we recommend sending this command to the instrument after you are sure that your CR-6plus 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 10.3.2
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, which are older than the specified date (and optionally time).
Sensor test and calibration:	
TSTSENSOR 1	The instrument generates a sensor test pulse. When a level trigger is activated an event will be recorded of this test pulse and uploaded to *\\GeoDAS_DATA\Incoming\NNNNNN*
REMOVEDC	Remove offsets from signals
Others:	
CANCEL	Leave the menu

The same request can also be done from GeoDAS by choosing 'Send a Request' from the 'CR-6plus Communication Interface'. See chapter 15.3.4 for details.

12. 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 press and hold the POWER button for 2 seconds.
- Press ***<Ctr> + 'Z'*** as soon 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

```
Press Ctrl+Z to enter the test mode.............
Instrument serial number: 100582
Instrument MAC address: 00:50:C2:77:42:93

-------------------------------------------------------------------------------------------
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'***, once 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 an 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 details. The useful options are highlighted and described below.

```
Bootloader Menu of the CR-6plus s/n 100577
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

-->
```

```
Bootloader Menu of the CR-6plus s/n 100577
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

-->
```

```
Bootloader Menu of the CR-6plus s/n 100577
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

-->
```

12.1. Flash Images and Boot Options

L	***List flash images***	Lists all the current firmwares 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 11.10.1
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

12.2. Hardware Setup and Monitor

K	***Instrument hardware parameters***	Check 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), the PPP settings, enable/disable the SSH and Web Interface and configure the backup server. For details see chapter 8.2.

12.3. Test Functions

P	***Test RTC***	Runs an automatic check of the RTC
N	***Test GPS***	Allows to the see the NMEA messages of the GPS

12.4. Security

O	***Set password***	Setting the password to prevent from unauthorised access to the current level of the test and configuration menu.

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

12.5. 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 16. Comparison of test and configuration menu users

13. Firmware Upgrades

All the firmware for

- Linux operating system
- armdas firmware
- 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 firmwares listed above. Please see *www.geosig.com → Support → Downloads* to download the latest firmware release package.

Even there is no known case of data that has been lost during an upgrade proces, we recommend to back 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 do the following steps:

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

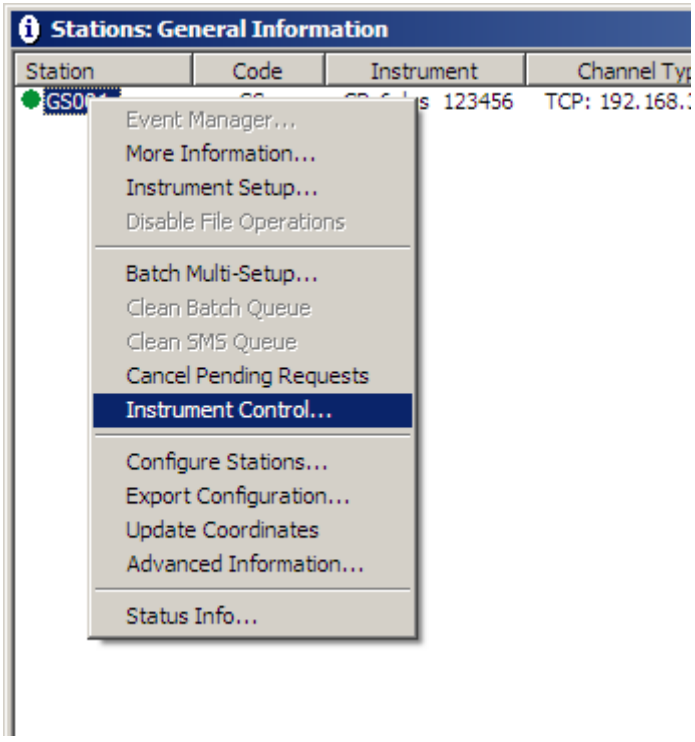


Figure 60. Select Instrument Control

- A list box will appear.

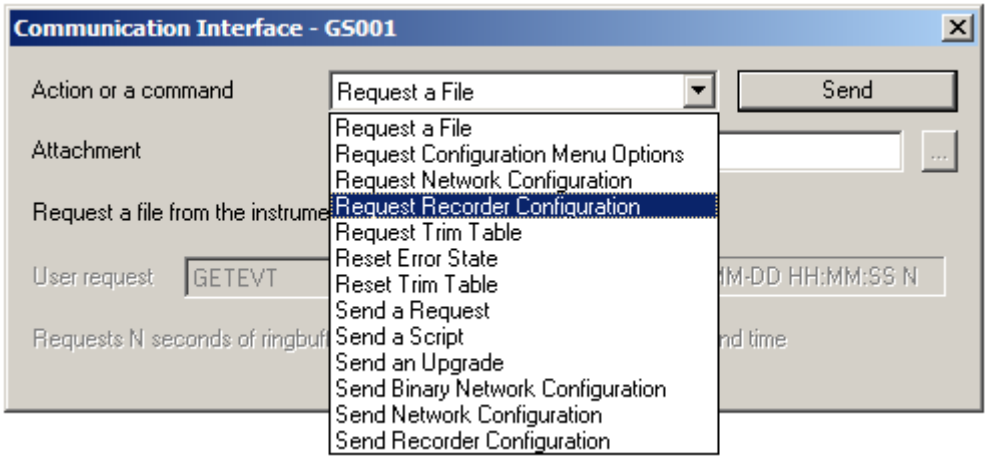
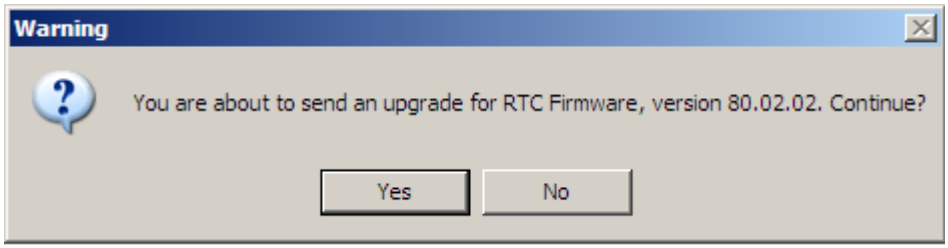


Figure 61. CR-6plus Communication Interface

- Select the item Send an Upgrade
- Press on the button Browse **[…]** to select the required firmware. Select a firmware container with the extension ****.gsfw***.
- If the file is selected, press the ***Send*** button. GeoDAS identifies the firmware and asks for confirmation. Please double check if 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.

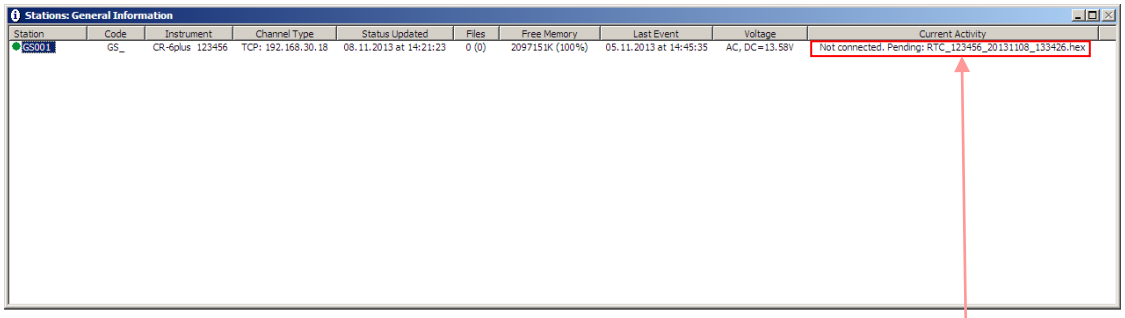


Figure 62, Pending upgrade on the server

- As soon 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. They are possible, too. Please contact GeoSIG support for the exact procedure of such downgrade.

14. Remote Access to the Instrument over SSH

The following chapter is for advanced users only.
Warranty will be void in case the operation of the device is negatively influenced because of changes on the root file system caused by a user.

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

The armdas console interface can not be used with SSH. This is a limitation of the armdas firmware

The instrument supports all types of remote access through SSH. A 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 corresponding password, the login information are

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.

14.1. 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
```

If a different Linux distribution is used, please refer to the documentation of your operating system on how to install the openssh client software.

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

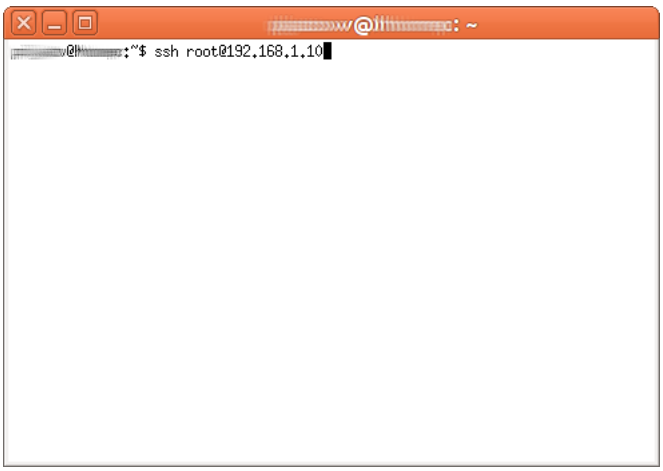


Figure 63. Command line SSH client at terminal emulator

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:

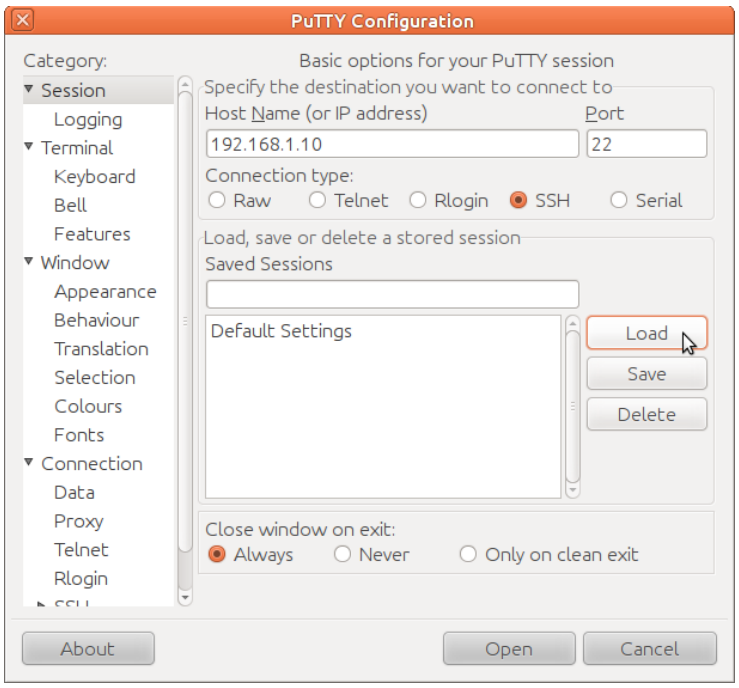


Figure 64. Configuration window of PuTTY

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

14.2. 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

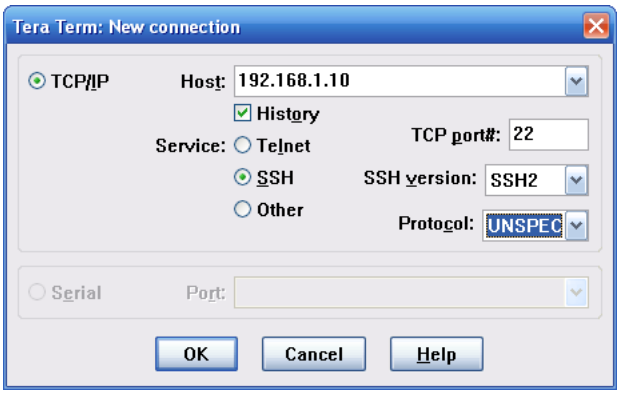


Figure 65. TeraTerm Connection Window

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

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

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

14.3. 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.

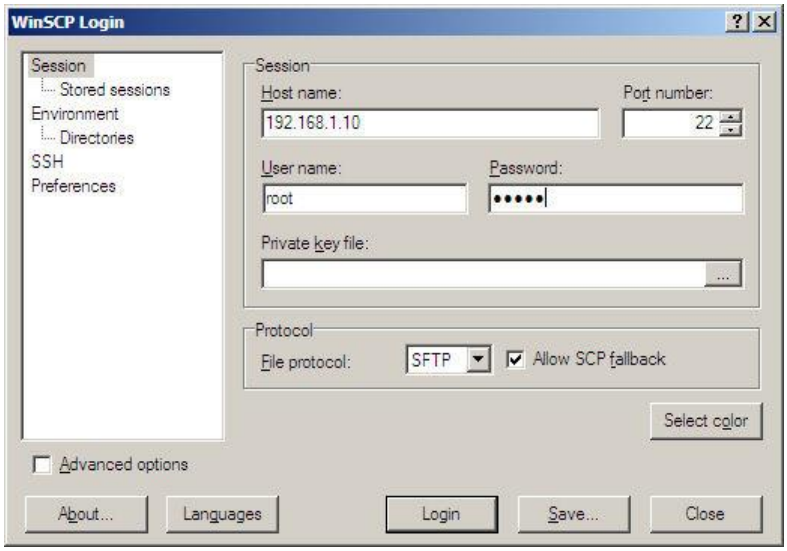


Figure 66. WinSCP login window

To connect to the instrument put the IP of the CR-6plus and enter the following user name and password:

User name: ***root***
Password: ***swiss***

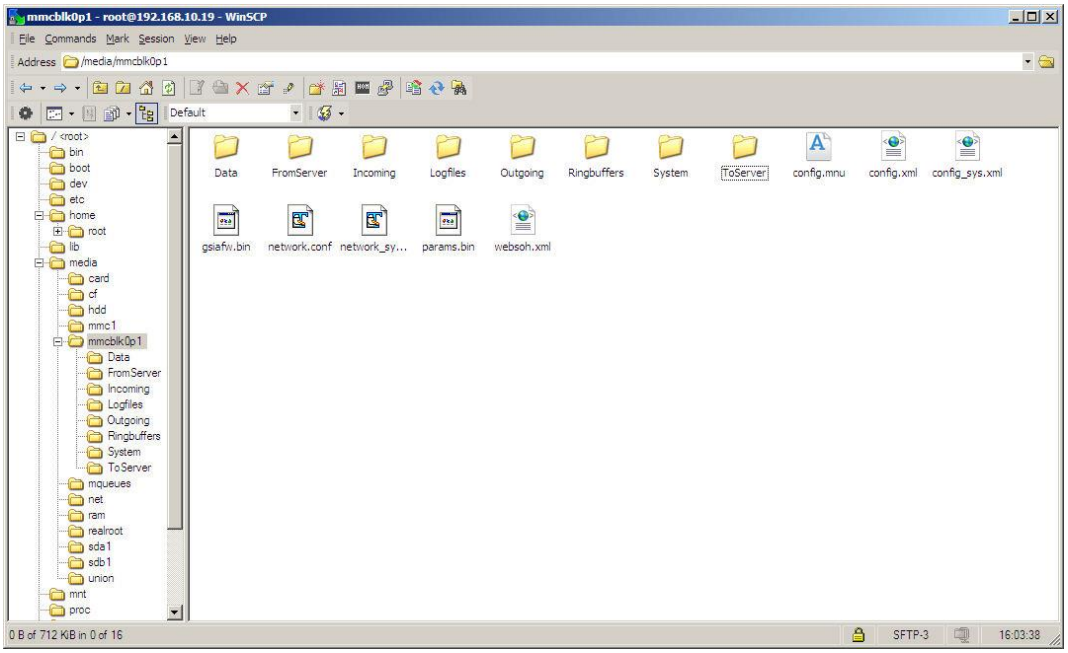


Figure 67. Explorer mode of WinSCP when connected to the instrument

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: http://winscp.net/eng/download.php

14.4. File Structure on the Instrument

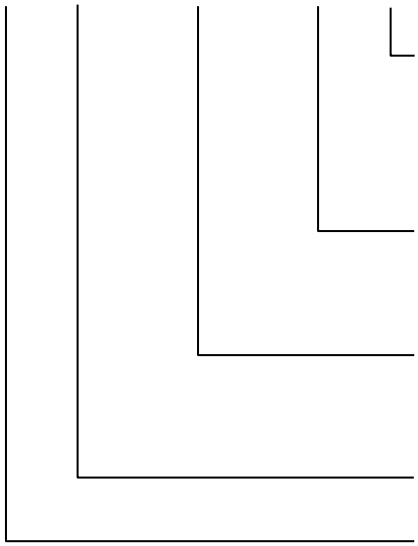
On the instrument the files are organized as following (The '/'-character separates directories):

/media/mmcblk01/... The location of the microSD card content.

… Data/ Event files
… Ringbuffers/ Permanent recording files
… Logfiles/ Log files of armdas

The filenames contain the following information

XXX_SNSNSN_YYYYMMDD_HHMMSS.ext



Extension		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	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

15. GeoDAS Settings

15.1. Configuration of Stations

To be able to communicate with the instrument, the 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

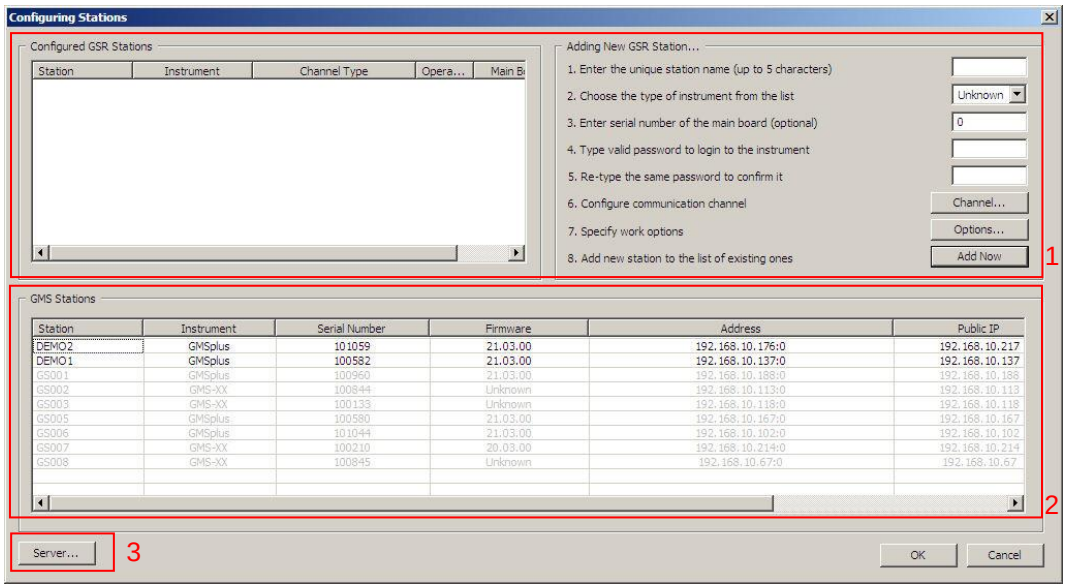


Figure 68. Configuration Stations

Area	***Topic***	Description
1	Configured GSR Stations	Details about the configured GSR-xx and GCR-xx stations. Check separate *GeoDAS Manual* for details.
2	GMS / CR-6plus 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 will be shown. Network settings can be done according to chapter 9. In case one wants to connect manually to the instrument, then GeoDAS is trying on 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 15.2

15.1.1. 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 steps:

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

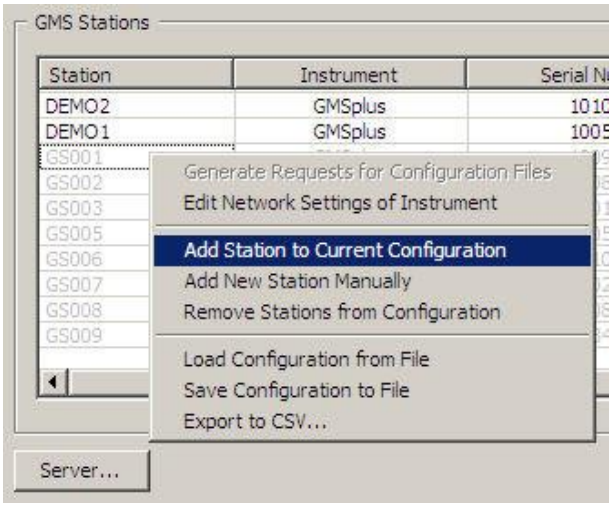


Figure 69. Add Station to Current Configuration

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

15.1.2. Remove an Instrument

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

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

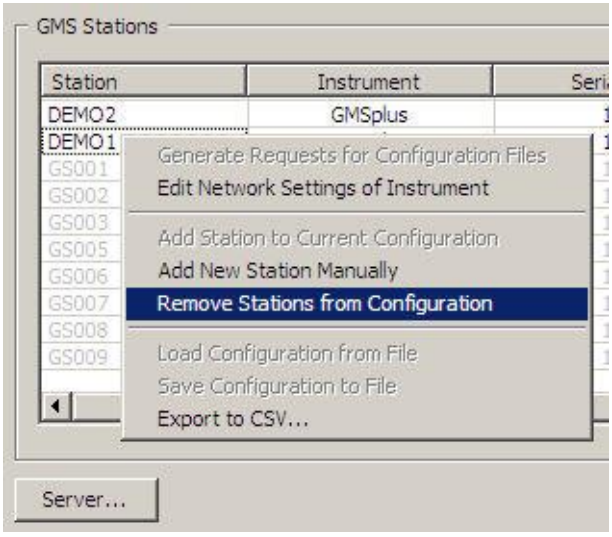


Figure 70. Remove Station to Current Configuration

For more details please see *GeoDAS Manual*

15.2. Configuration of Server Parameters

Press the button ***Server…***, the window below appears

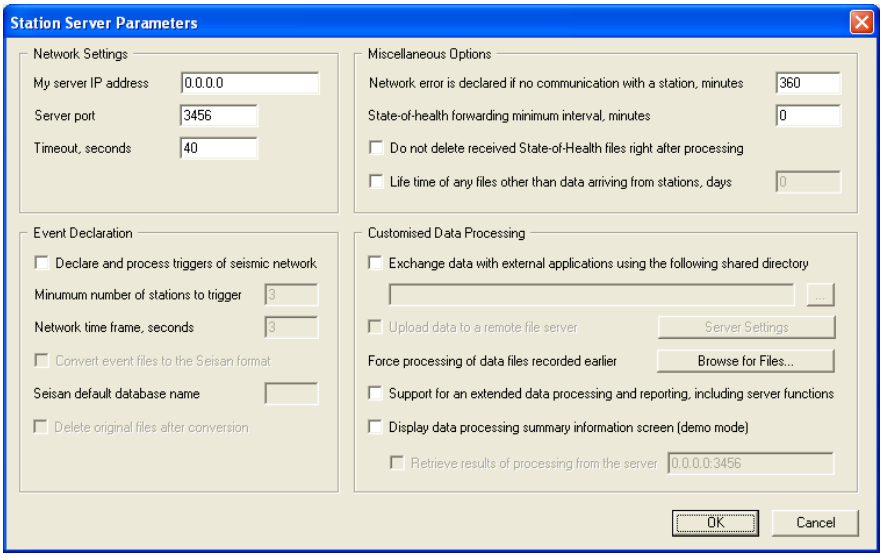


Figure 71. Data server parameter

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 and 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 11.8. 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 SOH reports remain in the directory *\\GeoDAS_DATA\StatusFiles\InfoSOH*
Event Detection	GeoDAS can be instructed to analyse event data files received from configured CR-6plus 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 even 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.

15.3. 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:

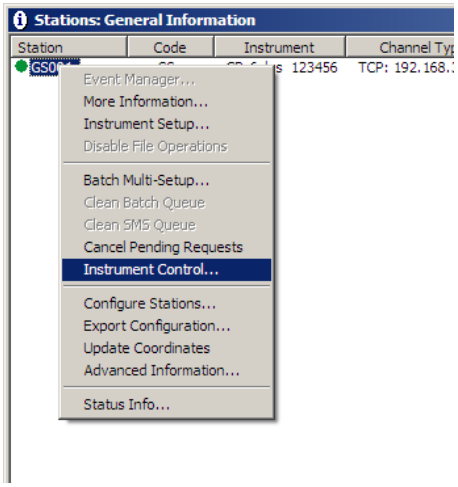


Figure 72, Instrument control of the CR-6plus in GeoDAS

15.3.1. 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 0 and 0).

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

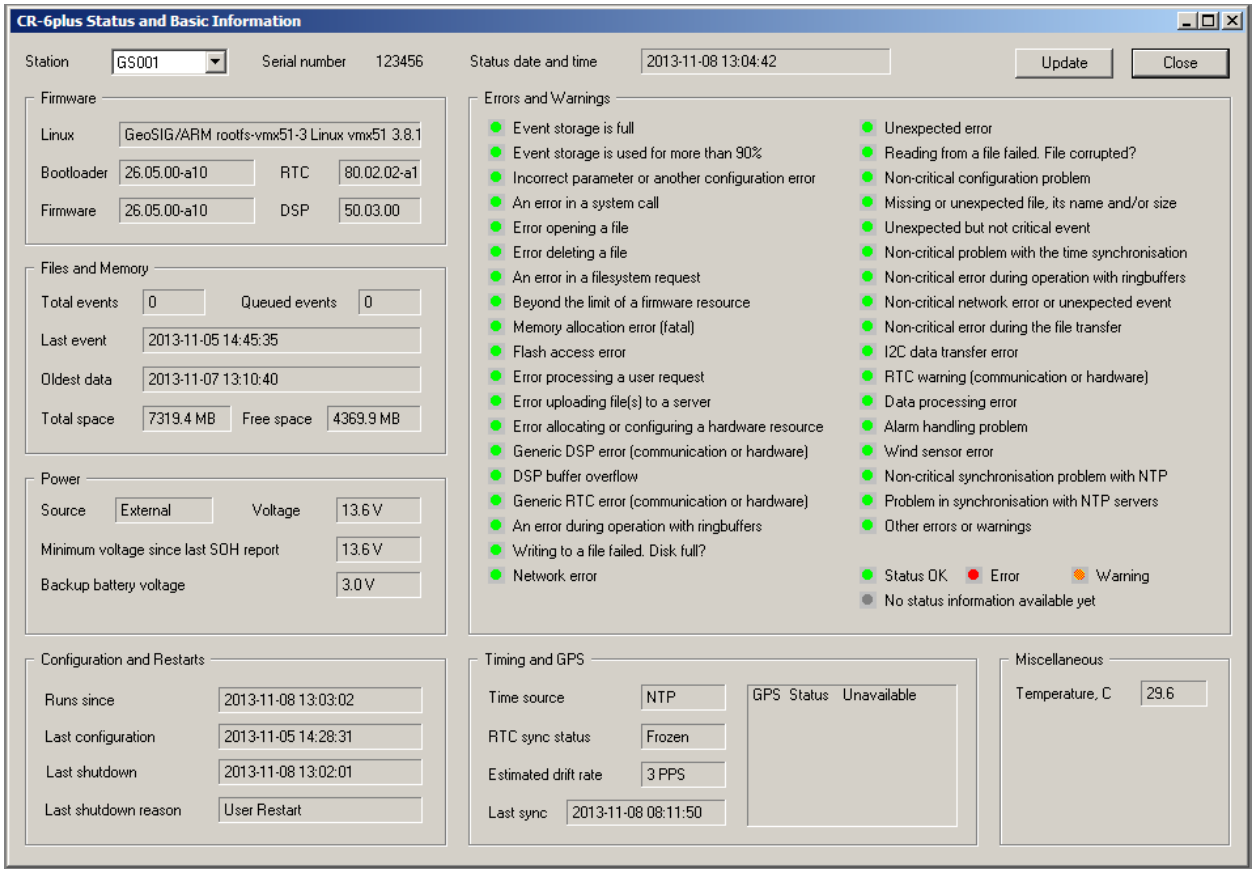


Figure 73. SOH information in GeoDAS

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.
Errors and Warnings	List of all errors and warnings of the instrument.
Timing	Status of the RTC.
Power	Status of the power supply and the battery voltages.

15.3.2. Instrument Setup…

See the chapter 11.2.2 for details.

15.3.3. Cancel Pending Request

The pending requests on the server as shown in the Figure Figure 62 can be cancelled by the user.

15.3.4. CR-6plus Communication Interface

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

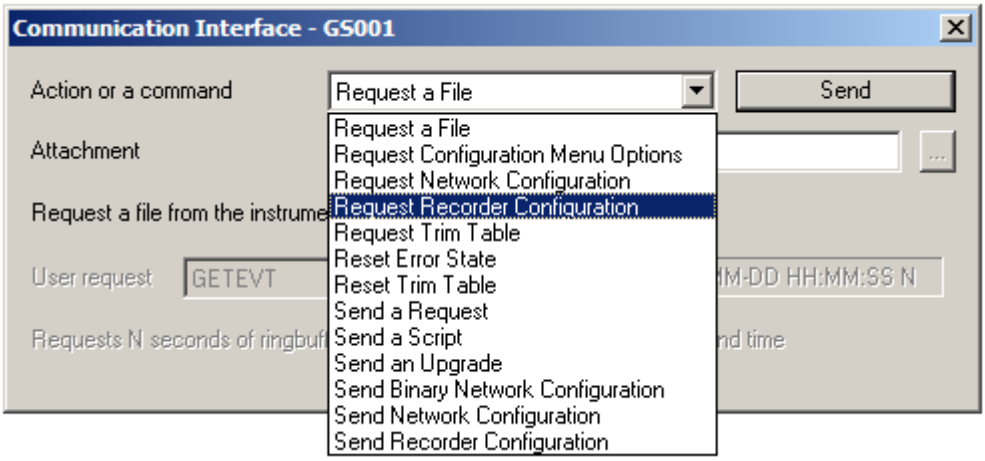


Figure 74. CR-6plus Communication Interface

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 11.2.1.
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 11.2.1.
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 11.10.1
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, main firmware and/or the entire Linux image. More details about the upgrade of the firmware see chapter 13.
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.

15.4. 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 mini-seed 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 0), 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

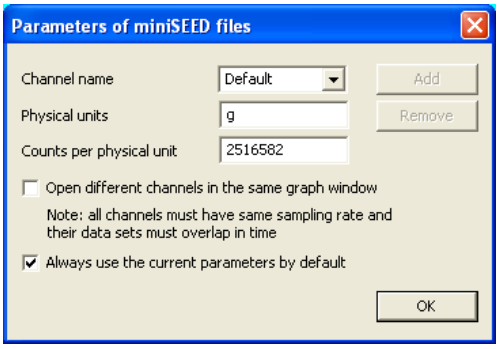


Figure 75, GeoDAS miniSEED parameters

- The values *Physical unit* and *Counts per physical unit* must be set for correct display data in GeoSIG software GeoDAS. The values can be found in the Table 17 or calculated as described in chapter 15.4.2.

Do not tick "Always use the current parameters by default" as it is better to be remembered that scale has to be defined manually for such file type.

- Press ***OK***
- If instead of the scale prompt you get directly the graph, use menu: *Analyse* → *Parameters…* → *Parameters of miniSEED files* and press **Edit**:

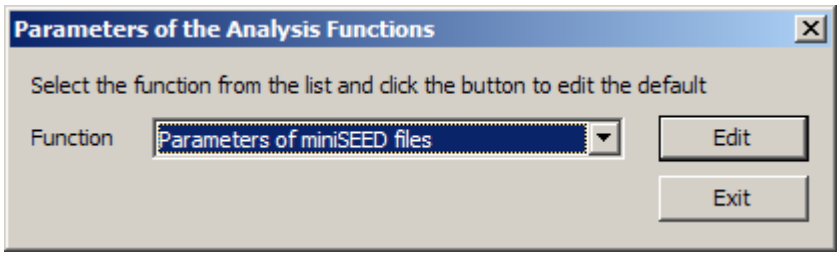


Figure 76, GeoDAS analyses parameters

- 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.

15.4.1. Save predefined Scaling Factors

The scaling factor set under Counts per physical unit is always valid for all channels in the same miniSEED file. In case 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*.

15.4.2. Calculation of the Scaling Factors

If you don't know how to calculate the scaling factor, follow these steps:

15.4.2.1. Sensors with given full scale

Output Voltage of the sensor must be +/- 10 V

$$\text{LSB} = \frac{FullScale}{0.9 \cdot 2^{23}} = \frac{FullScale}{754'9747.2}$$

$$\text{Scale factor} = \frac{1}{LSB} = \frac{0.9 \cdot 2^{23}}{FullScale} = \frac{754'9747.2}{FullScale}$$

Example, 3 g sensor

$$\textit{Scaling factor} = \frac{0.9 \cdot 2^{23} counts}{3g} = \frac{754'9747.2\,\text{counts}}{3g} = \underline{\underline{2516582\,\text{counts/g}}}$$

15.4.2.2. Sensors with given Sensitivity

$$\text{LSB} = \frac{\frac{10V}{Sensitivity}}{0.9 \cdot 2^{23} counts} = \frac{1.324547e-6 \frac{V}{counts}}{Sensitivity}$$

$$\text{Scale factor} = \frac{1}{LSB} = \frac{0.9 \cdot 2^{23} counts}{\frac{10V}{Sensitivity}} = \frac{Sensitivity}{1.324547e-6 \frac{V}{counts}}$$

Example, 1000 V/m/s sensor

$$LSB = \frac{0.9 \cdot 2^{23}}{\frac{10V}{1000 \frac{V}{m/s}}} = \frac{1000 \frac{V}{m/s}}{1.324547e-6 \frac{V}{counts}} = \underline{\underline{150994944\, counts/m/s}}$$

The scaling factors of all GeoSIG sensors can be found in the following table

Sensor type	Full Scale	Output Voltage Range	Scaling factor
AC-xx	0.5 g	+/- 10 V	15’099’494 counts/g
	1 g	+/- 10 V	7’549’747 counts/g
	2 g	+/- 10 V	3’774’874 counts/g
	3 g	+/- 10 V	2’516’582 counts/g
	4 g	+/- 10 V	1’887’437 counts/g
VE-13 VE-23	1 mm/s	+/- 10 V	7’549’747 counts/mm/s
	10 mm/s	+/- 10 V	754’975 counts/mm/s
	100 mm/s	+/- 10 V	75’497 counts/mm/s
VE-33	**Sensitivity:** 27.3 V/m/s (27.3 Vs/m)		20’610’820 counts/m/s 20’611 counts/mm/s
VE-53	**Sensitivity:** 1000 V/m/s (2x 500 V/m/s)		754’974’720 counts/m/s 754’974 counts/mm/s
	Sensitivity: 200 V/m/s (2x 100 V/m/s)		150’994’944 counts/m/s 150’994 counts/mm/s

Table 17. Scaling factors of different sensors

16. Maintenance

The Instrument has been designed in a way that it requires a minimum of maintenance. If the following procedures are performed frequently, the instrument will last for many years:

- The periodic test indicates any irregularity as soon as it occurs. Therefore it is recommended, to check the recorded sensor test at least **once a year**. Compare the signals of the 3 channels with older records. There should not be a distinctive change.
- The physical condition of the Instrument and the sensor should be checked **annually**. Make sure every cable and connector is in good condition and plugged in properly.
- The optional battery should be replaced every **3 years**. After replacement, adjust the date of installation and the date of the next replacement into the Instrument via GeoDAS.
- The backup battery on the CR6-SBC Slot-In Module should be replaced every **5 years**.

Index