

## **Technical Manual**

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*Designed and manufactured by* Güralp Systems Limited 3 Midas House, Calleva Park Aldermaston RG7 8EA England

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## 1 **Preliminary Notes**

## **1.1 Proprietary Notice**

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Whilst every effort is made to ensure the accuracy, completeness and usefulness of the information in the document, neither Güralp Systems Limited nor any employee assumes responsibility or is liable for any incidental or consequential damages resulting from the use of this document.

### 1.2 Cautions and Notes

Cautions and notes are displayed and defined as follows:



**Caution:** A yellow triangle indicates a chance of damage to or failure of the equipment if the caution is not heeded.



Note: A blue circle indicates a procedural or advisory note.

### 1.3 Manuals and Software

All manuals and software referred to in this document are available from the Güralp Systems website: www.guralp.com unless otherwise stated.

### 1.4 Conventions

Throughout this manual, examples are given of command-line interactions. In these examples, a fixed-width typeface will be used:

Example of the fixed-width typeface used.

Commands that you are required to type will be shown in bold:

Example of the fixed-width, bold typeface.

Where data that you type may vary depending on your individual configuration, such as parameters to commands, these data are additionally shown in italics:

Example of the fixed-width, bold, italic typeface.

Putting these together into a single example:

System prompt: user input with variable parameters

#### **System Overview** 2

Thank-you for purchasing a Güralp Certimus digital Seismometer.

This section describes the key components of a Certimus system. The Certimus unit is the main, standard product in the system; other components and accessories are optional and can be purchased separately. Please check your order confirmation to see which components were purchased with your system.

#### **Key features** 2.1

- Digital, three-axis, weak-motion, force-feedback seismometer.
- Flat response to ground acceleration from 120s to 100 Hz.
- Standard gain equivalent to 2000V/ms-1.
- 24-bit digitiser with a nominal sensitivity of 0.2 µV per count.
- Selectable sample rates from 1 sample per hour to 1000 sps.
- Data streaming in real-time using GCF (Scream!), GDI-link and SEEDlink.
- Compact form, measuring just 175 × 175 × 95 mm.
- Internal ±2 g MEMS accelerometer for orientation.
- Identification of I.P. address via Güralp Discovery software and, optionally, a cloud-based or organisational registry server.
- Remote instrument and data management via Discovery software and/or WEB interface.
- Android app for installation integrity checking via Bluetooth.
- Low-latency mode for Earthquake Early Warning (< 40 ms).
- Hot-swappable data storage with dual redundant 128 GB microSD cards.
- GNSS time-synchronisation, compatible with Navstar (GPS), GLONASS, BeiDou and Galileo constellations, with PTP available as an alternative time-source.
- Touch-sensitive, 2.4 inch colour LCD for monitoring and control operations.

#### 2.2 **Typical applications**

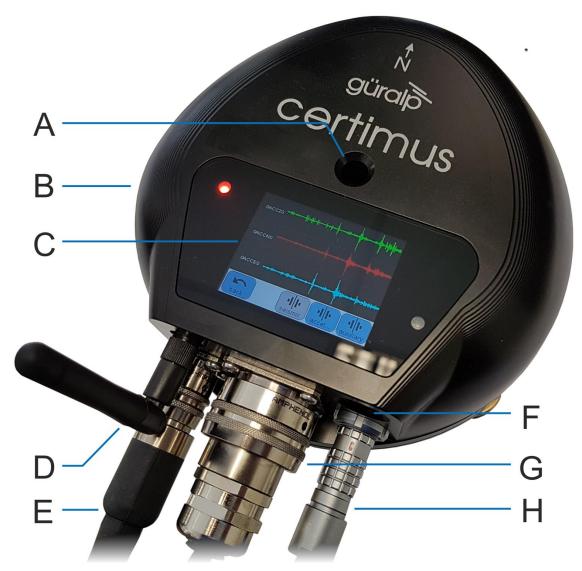
- Earthquake Early Warning systems. •
- Multi-scale seismic networks and arrays.
- Rapid response/aftershock study
- Surface and vault installation.
- Surface or buried deployment.

9

## **3** System description

## 3.1 Güralp Certimus digital seismometer

The Güralp Certimus is a broadband triaxial seismometer combined with a Minimus digitiser frontend. The Minimus acquires data from – and allows direct control of – the instrument.



The labelled parts are:

- B Status LED
- C Touch-screen display
- D WiFi antenna

- **E** Power connection
- **F** Cover for SD card
- **G** Ethernet connection
- H GNSS connection

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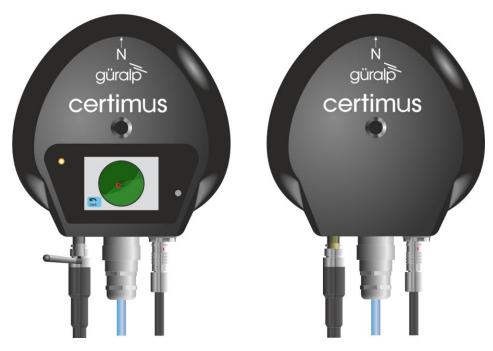
#### **Revision History**

#### **Güralp Certimus**

The hard-anodised aluminium casing protects the instrument from water, allowing it to be deployed in a range of environments. Installation is simple as the system will operate over a very wide range of angles. If required, you can also level the sensor using its adjustable levelling feet. An integrated digital bubble-level – available in the display menu – provides quick visual feedback during levelling. This is not essential for operation of the sensor.

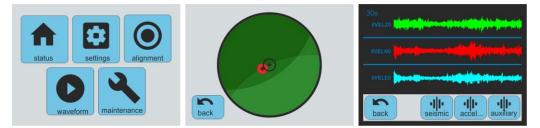


The Certimus is also available in a version without the LCD touch-screen, more suitable for direct burial.



#### 3.1.1 Liquid Crystal Display

The Certimus is equipped with a multi-touch sensitive, 2.4 inch, full colour LCD touch-screen which shows waveforms and a virtual instrument level. Its menu system allows control of instrument state of health, gain settings and network configurations.



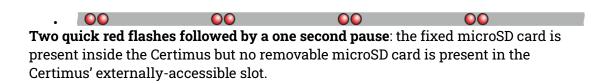
The LCD features are described in detail in chapter 5 on page 35.

#### 3.1.2 LED indicator

The Certimus has an LED indicator on the upper surface, which provides status and configuration information.

This information is encoded in sequences of coloured flashes. In general, red flashes indicate that initialisation is in progress or that the instrument has encountered a problem, green flashes indicate normal operation and blue flashes show trigger activity. The various codes are:

• One quick red flash followed by a one second pause: the removable microSD card is present in the Certimus' external slot, but no fixed microSD card is present inside the Certimus.



• **OOO OOO OOO OOO COO Three quick red flashes following by a one second pause**: both microSD cards are present but either the GNSS receiver is disconnected or the GNSS lock is not sufficiently accurate.

• O A green flash every four seconds: this is the standard operating heartbeat. GNSS and both internal and external microSD cards are present, which indicates that the Certimus can be successfully deployed and left to record data.



**Note:** Depending on the digitiser's recent history, it can take up to ten minutes to reach this state after power-up.

1 blue flash: a trigger event has been detected.

#### 3.1.3 Bluetooth connectivity

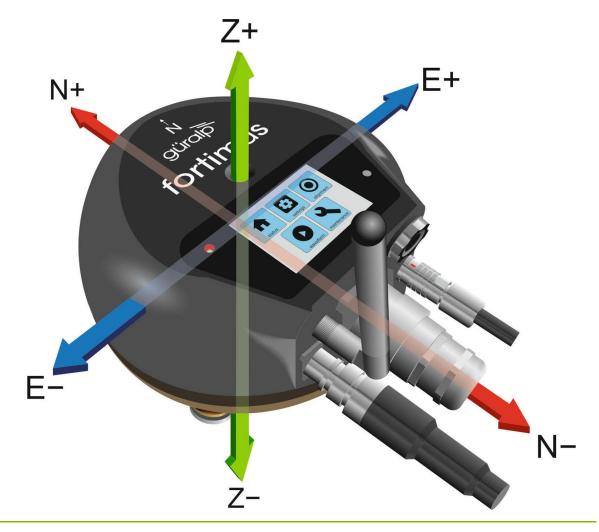
The Certimus features Bluetooth connectivity, allowing sensor and state-of-health data to be monitored using the Güralp GüVü app (see Section 3.4 on page 22) running on an Android mobile phone or tablet.

Bluetooth can be disabled via software to save processor usage but the hardware module cannot be switched off. BLE (Bluetooth Low Energy) technology is used to minimise the power requirement. The Bluetooth transmitter/receiver is in permanent standby mode and always ready to receive a connection from a phone or tablet.

See Chapter 9 on page 141 for further details on connecting to the Certimus using a phone or tablet.

#### 3.1.4 MEMS accelerometer

The Certimus digital accelerometer is equipped with a triaxial Micro Electro-Mechanical System (MEMS) accelerometer with a measurement range of ±2 g. The three axes of sensitivity, Z, N and E, align with those of the main accelerometer outputs and are orientated as illustrated below:



#### 3.1.5 Data storage

The Certimus uses microSD (non-volatile) memory technology to store seismic data within the instrument. The Certimus features two such microSD cards in order to provide redundancy; this helps to protect the recorded data in the unlikely event of any corruption or problem with the memory cards. One card is internal and cannot be removed by the customer; the other is hot-swappable and easily accessible without any technical knowledge.

The Certimus is supplied with two microSD cards that are of equal storage capacity (e.g. two 64 GB cards).

# 3.1.5.1 Primary (removable / hot-swappable) microSD card slot

To remove a card, follow the sequence below:



The microSD card is protected by a screwin cap, located next to the Ethernet connector and above the GNSS connector

Remove the cap by unscrewing it anticlockwise, as shown.



**Caution:** Finger pressure is sufficient. Do not use tools.

The horizontal edge of the microSD card is now visible

The card slot has a spring lock: pushing the card firmly inwards locks it into place; a second push releases the card so that it can be withdrawn.

Lightly push the edge of the microSD card with a fingertip or soft implement. Once the initial spring resistance has been overcome, the card will partially eject itself.

MAN-CER-0001 202 15 Issue Error! Reference source not found. - June,



The card should now protrude enough that it can be grasped and withdrawn.

To replace the card, remove any existing card, as shown previously, and then:



Gently insert the replacement card into the slot with the logo facing upwards and the straight edge of the card on the left, as shown. The card must be perfectly horizontal in order to align properly.



Push the card gently into place until the pressure of the spring lock is felt. If it does not glide into place, remove and start again. Do not force the card.

Check that the card is fully engaged by pressing lightly to unlock it and then pressing to lock it again. The card should be engaged firmly when locked and slide freely otherwise. Ensure the card is locked before proceeding.

Offer the cap to the opening, taking great care to align the screw-thread correctly. Replace the cap by screwing it in clockwise, as shown.



**Caution:** Finger pressure is sufficient. Do not use tools.



**Note:** In order to ensure data integrity and security, Güralp only recommend using the supplied industrial-grade microSD cards.



**Caution:** When the external microSD card is removed, the internal card keeps recording data, unless recording is stopped using Unmount Cards button (see Section 7.10.3 on page 60). However, when the external card is reconnected, any data written to the internal card while the removable card was absent will overwritten.

#### 3.1.5.2 Internal (back-up) microSD card

The second microSD card is factory-installed in a slot inside the Certimus.



**Caution:** The internal microSD card is not accessible by the user. Attempts to remove or replace it will void the Certimus' warranty.

#### 3.1.6 WiFi connectivity

The Certimus is provided with a Siretta Delta 7A omnidirectional antenna, suitable for both 2.4 GHz and 5.8 GHz networks.



The antenna connects directly to the Certimus using an SMA connector. It can be removed and replaced with a high-gain, directional antenna if required. To remove, grasp the knurled locking sleeve and turn anti-clockwise, as shown.

See Section 7.5 on page 52 for further details on how to configure the Certimus to connect to a wireless network.



**Note:** It is not necessary to have the antenna fitted if wireless operation is not required.

#### 3.1.7 Web interface

The Certimus contains on-board firmware that presents monitoring and configuration interfaces. These are accessible through Güralp's Discovery software (see Section 3.3 on page 21) or, with the built-in web server, via Discovery's browser interface or any standards-conformant web browser.

		Mum	VVV	•	;	güralp	ROTECT
							Certim
			Status Lo	ogin Help			
				- 3			
System type: Certim	us   Host label: Fl	XED PLATE TEST TIN	Host name: CERT	-4D5C (10.30.0.15)   Seri	ial number: 004D	5C	
System Status							
			General in	formation			
Host name	CERT-4D5C	Host label	FIXED PLATE TEST TIN	System type	Certimus	Product type	Certimus
Serial number	004D5C	Firmware version	2.1-1186	IPv4 address	10.30.0.15 (DHCP)	SEED network and station	DG.BOLLO (No site)
Digitiser temperature	31.142 °C	Digitiser humidity	32.60%	Input voltage	8.386 V	Power over Ethernet voltage	0.000 V
System time	3:56:09 PM Tue 17-Nov- 2020	Uptime	1d 5h 43m 27s	ETH status	sckt: 13/20 data: 1/6		
		<u>.</u>	GNSS	Status			
GNSS connection status	Disconnected	Last timestamp	0000-00-00 00:00:00	1 the second	A A	the set	SUS
Last lock time	Never	GNSS stability	Disconnected	+	th Wessex	South	London
Latitude	51.361237	Longitude	-1.164040		Downs AONB	PERSON	AXA
Altitude	-12.340000	Horizontal dilution of precision	Undefined		T A	8 XP	ALL
GNSS PPS status	Not Trusted No Pulse	GNSS NMEA stream	Bad input	A	DAG		100
GNSS Lock state	No lock	Number of satellites	Used: 0 In view: 0	18 1000	R	eport a problem   © Open:	StreetMap contribut
		1	PTP S	Status			
PTP state	Phase Locked	Last PTP timestamp	2020-11-17 15:56:08Z	Last PTP lock time	2020-11-17 15:47:03Z	PTP stability	100%
Master IPv4 address	10.30.255.35	Master clock class	PRI_REF_PTP	Master clock accuracy	< 100ns (0x21)	Master time source	GPS
Network path delay	32.3 us	Network jitter estimate	± 649 ns	Network outliers	7%		
			Data reco	ord status			
microSD status	Recording	microSD total	60686336 KiB	microSD used	904 KiB	microSD free	99%
		1	Sen	sors			
Number of sensors detected	1						
Senso	or1	Serial number (1)		Firmware ver (1)	1.2-392	Temperature (1)	36.98 °C
		Yaw (1)	0.000°	Pitch (1)	0.000°	Roll (1)	0.000°
		Orientation (1)		00. X0000. 0000.			
		Integrator Z (1)	3457	Integrator N (1)	-4163	Integrator E (1)	-5387
		Seismometer Z (1)	292147	Seismometer N (1)	-217531	Seismometer E (1)	227313

The web interface allows a number of instrument monitoring, control and configuration options:

- Sensor readings and instrument State-of-Health
- Network configuration and authentication
- Sensor, timing, and station configuration/information
- Remote data-streaming configuration
- Local data-storage configuration

Please refer to Chapter 7 on page 48 for full usage instructions.

## 3.2 Accessory package

#### 3.2.1 Ethernet cable

The Ethernet connector allows use of 10BASE-T, 100BASE-T or 1000BASE-T networks. The metal gland shell-type connector that connects to the Certimus is IP68-rated and ensures consistent connection in harsh installation environments. At the other end of the blue Ethernet cable, there is a standard 8P8C modular jack (often incorrectly called an RJ45) for attachment to all common networking devices (e.g. PC, laptop, router, switch, modem etc.).

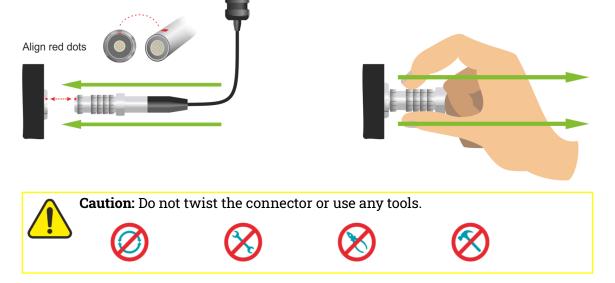
Please see Section 13.1 on page 160 for the pin-out and further details.

#### 3.2.2 Compact GNSS receiver and cable

The Certimus is supplied with a new-generation compact GNSS receiver with an in-built antenna that supports the GPS (Navstar), GLONASS, BeiDou and Galileo satellite constellations.

The receiver comes with a black RS-422 cable that has an overmoulded 14-way LEMO connector. LEMO connectors use an innovative latching mechanism which is different to the bayonet connectors used elsewhere. To mate, simply line up the red marks – one on the chassis and one on the free connector – and gently push the connector into place until they latch together with a click. To disconnect (un-mate), grasp the outer sleeve of the connector and pull gently.





Please see Section 13.3 on page 161 for pin-out details.

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#### 3.2.3 Power cable

The Certimus comes with a dedicated power cable with a standard militaryspecification bayonet connector on one end and bare ends at the other.



**Note:** The Certimus does not use a grey/blue combined power/data cable, as used with many other Güralp products.

Please see Section 13.2 on page 161 for the pin-out details.

#### 3.2.4 Diagnostic GNSS to Serial cable adapter

The Certimus comes with an adapter to connect the GNSS LEMO connector to a female nine-pin D-subminiature connector (DE9f), which can be used with a standard serial port to allow diagnosis and debugging of the Certimus using a serial terminal emulator. (See Section 10 on page 147).



**Note:** This facility should rarely be required. It is primarily intended for use by the Güralp Support Team to help diagnose any problems with the Certimus that may be experienced by the user.

A serial-to-USB converter (not supplied) may need to be used to connect to PCs or laptops that don't have a nine-pin serial connector. Please see Section 13.3 on page 161 for full pin-out details.

#### 3.2.5 Optional accessories

The Certimus offers a range of accessories suitable for different types of installation:

The Surface Storage Module (SSM) gives access to the external removable storage without disturbing the sensor, when installed under the ground. The SSM is connected in line with the GNSS and can be positioned up to 3 m apart from the Certimus, due to the cable length.

The Portable Power Module (PPM) is a compact rechargeable battery pack suitable for direct connection to solar panels. If running free, it can provide power to the Certimus for up to 6 weeks, when in low-power mode.



#### **Revision History**

The rugged back-pack protects the Certimus during transport to field deployments, with additional space for accessories and paperwork.



### 3.3 Güralp Discovery software

Güralp Discovery is a software application for seismometer configuration and control, state-of-health monitoring, and waveform viewing and acquisition.

	_	Status	_	Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude		
	0	0		NO LABEL	Minimus	MIN-2757	10071	1.2-257	89.213.16.113	10.30.0.132	15:25:49	0.0000	0.0000		
	Ø	0		NO LABEL	Minimus	MIN-C457	50263	1.2-230	89.213.16.113	10.30.0.68	00:29:13	0.0000	0.0000		
	0	0		NO LABEL	Minimus Plus	FMUS-9655	38485	1.2-194	89.213.16.113	10.30.0.61	1 days 19 Hrs	0.0000	0.0000		
	0	0		NO LABEL	Minimus	MIN-1456	5206	1.2-181	89.213.16.113	10.30.0.43	2 days 21 Hrs	0.0000	0.0000		
	0	0		NO LABEL	Minimus	MIN-D457	54359	1.2-146	89.213.16.113	10.30.0.58	15:17:39	0.0000	0.0000		
	Ø	0		NO LABEL	Minimus	MIN-D357	54103	1.2-146	89.213.16.113	10.30.0.31	00:03:11	0.0000	0.0000		
	0	0		NO LABEL	Minimus	MIN-C355	50005	1.1-8	89.213.16.113	10.30.0.75	16:56:08	0.0000	0.0000		
	0	0		RAD Comp Soak	Minimus	MIN-E256	57942	1.1-1022	89.213.16.113	10.20.0.232	17:53:49	51.3604	-1.1634		
	0	0		NO LABEL	Minimus	MIN-E656	58966	1.1-1022	89.213.16.113	10.30.0.21	7 days 18 Hrs	51.3612	-1.1641		
1	0	0		Support	Minimus	MIN-C555	50517	1.1-1022	89.213.16.113	10.10.0.13	00:02:18	0.0000	0.0000		
	0	0		DEMO 83	Minimus	MIN-C456	50262	1.1-1022	89.213.16.113	10.10.0.36	6 days 17 Hrs	0.0000	0.0000		
1	0	0		NO LABEL	Minimus	MIN-CF57	53079	1.1-1022	89.213.16.113	10.20.0.37	00:09:48	51.3607	-1.1635		
8	0	0		NO LABEL	Minimus	MIN-D157	53591	1.1-1022	89.213.16.113	10.20.0.102	00:09:48	51.3607	-1.1634		
ŧ [	0	0		NO LABEL	Minimus	MIN-2857	11095	1.1-1022	89.213.16.113	10.30.0.87	7 days 18 Hrs	51.3612	-1.1640		
5	0	0		TR1191-4A7	Minimus	MIN-AA57	43607	1.1-1022	89.213.16.113	10.30.0.152	2 days 17 Hrs	51.3612	-1.1640		
-	an Loo	cally I Syste		Registry	52.34.40.123	•							gi	Jralp	5

An important benefit of Discovery is that it allows the user to identify the instruments' I.P. addresses on a LAN or via a cloud-based or organisational registry server without the need for static I.P. addresses at the stations.

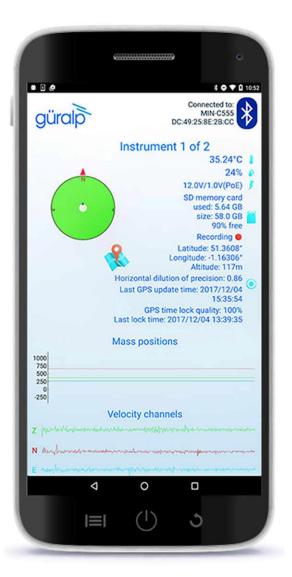
Discovery also provides simple, convenient instrument and data management with access to hardware State-of-Health (SoH), data streaming; GNSS location; response and calibration data.

Discovery can download Certimus firmware from the Internet and remotely install it onto any connected Certimus.

## 3.4 Güralp GüVü Android and iOS app

For added confidence during deployments in the field, Güralp GüVü, a Bluetooth App, displays waveforms, orientation, temperature and humidity data for instant checking of installation integrity.

Please refer to Chapter 9 on page 141 for installation and usage instructions.



## 4 Getting started

## 4.1 Unpacking and packing

The Certimus is delivered in environmentally-friendly, flat-packable, suspension packaging. The packaging is specifically designed for the Certimus and should be reused whenever you need to transport the sensor. Please note any damage to the packaging when you receive the equipment and unpack on a clean surface. The package should contain the digital accelerometer, the pigtail power cable, the GNSS receiver and cable, the Ethernet cable and the fixing bolt.



**Caution:** The Certimus is precision seismic sensor. It contains sensitive mechanical components which can be damaged by mishandling. If you are at all unsure about the handling or installation of the device, you should contact Güralp Systems for assistance.

- Do not bump or jolt any part of the sensor when handling or unpacking.
- Do not kink or walk on the data cable (especially on rough surfaces such as gravel), nor allow it to bear the weight of the sensor.
- Do not connect the instrument to power sources except where instructed.
- Never ground any of the output signal lines from the sensor.

## 4.2 System set-up

Güralp highly recommends exploring and gaining familiarity with the Certimus inside your lab before installation in an outdoors environment.



A typical set-up for the Certimus is shown in the figure below:

To get started, connect the cables as shown in the figure above and as described in Section 3.2 on page 19.

Power up the Certimus using a power supply with a DC output of between 10 and 36 Volts.

**Caution:** Observe the correct polarity when connecting the power supply. The red lead (from pin B) must be connected to the positive terminal, typically labelled "+", and the **black** lead (from pin A) must be connected to the **negative terminal**, typically labelled "-". An incorrect connection risks destroying the instrument, the power supply and any connected accessories.

If the Certimus is directly connected to a laptop or PC using the blue Ethernet cable, make sure that the laptop or PC is configured to obtain an I.P. address automatically. More details on how to correctly configure the connection using APIPA (Automatic Private I.P. Addressing) are in Section 15 on page 177.

## 4.3 Güralp Discovery software installation

To view live waveforms, and to control and configure the Certimus, you will need to use Güralp Discovery software.

Visit www.guralp.com/sw/download-discovery.shtml for links for all available platforms (currently Windows 32-bit and 64-bit, macOS 64-bit and Linux 64-bit).

Download the installer appropriate for your architecture and operating system, run the installer and follow the instructions on screen. (Full details of installation and upgrading are in Section 14 on page 163.)

**Note:** Windows users may have to reconfigure the Windows FireWall in order to allow Discovery to communicate properly. Please see Section 14.4 on page 170 for full details. Brief instructions are below.

Under Windows, the first time that you start Discovery, Windows may ask you to specify how you wish Discovery to interact with the Windows Firewall. Because Discovery requires network communication in order to function, it is important that you understand the options available.

The following screen is displayed:

Windows Sec	urity Alert		×
💓 Windo	ws Firewa	I has blocked some features of this app	
Windows Firewall h networks.	as blocked som	e features of discovery on all public, private and domain	
	Name:	discovery	
	Publisher:	Unknown	
	Path:	C:\program files (x86)\guralp systems\discovery \discovery.exe	
Allow discovery to	communicate or	these networks:	
🗸 Domain netv	vorks, such as a	workplace network	
Private netv	vorks, such as n	iy home or work network	
		ose in airports and cafés (not recommended en have little or no security)	
What are the risks	of allowing an a	pp through a firewall?	
		Allow access	cel

The screen provides three check-boxes which indicate whether Discovery can communicate with networked devices in the "Domain" profile, the "Private" profile or the "Public" profile. (Profiles are also known as "network locations".)

The "Domain" profile applies to networks where the host system can authenticate to a domain controller. The "Private" profile is a user-assigned profile and is used to designate private or home networks. The default profile is the "Public" profile, which is used to designate public networks such as WiFi hotspots at coffee shops, airports, and other locations.

For a more complete discussion of this topic, please see www.tenforums.com/tutorials/6815-network-location-set-private-public-windows-10-a.html or your Windows documentation.

Once you have specified your firewall preferences, Discovery displays a main window which normally shows a list of both locally and remotely connected instruments. If you close this main window, Discovery will quit.

Discovery will initially "listen" for connected instruments on your local network.

This mode can b short-cut keys	oe re Ctrl	efr	res] +						e	ident	ified			by pres	sin	ıg the
			alp System											- 0	×	]
	1		Statu	_	Label	System	Name	Serialt	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude	^	
		13	90		TR1207-487	Minimus	MIN-8657	34391	1.1-1022	89.213.16.113	10.30.0.65	7 days 19 Hrs	51.3612			Å
		14	00		TR1204-484	Minimus	MIN-8757	34647	1.1-1022	89.213.16.113	10.30.0.67	6 days 17 Hrs	51.3612	-1.1640		Connected
		15	00		TR1205-485	Minimus	MIN-8857	34903	1.1-1022	89.213.16.113	10.30.0.40	7 days 19 Hrs	0.0000	0.0000		
		16	00		NO LABEL	Minimus	MIN-9355	37717	1.1-1022	89.213.16.113	10.30.0.77	18:01:29	51.3612	-1.1640		instruments
		17	00		NO LABEL	Minimus	MIN-A957	43351	1.1-1022	89.213.16.113	10.30.0.131	7 days 19 Hrs	51.3612	-1.1640	~	1
Scan the local network for locally-connected	R	• Registe	n Locally ered Syste 0 systems	ms	Registry	52.34.40.12	3							güral	้ด	
-	Load from	lis a c	t of cent	/ reg ral	gistered registry ntact th	y and	ms		Specify of the c (cloud s	entral r	e I.P ad egistry	dress				3

You can add instruments to the list by right-clicking in the blank area and selecting "Add device" or choosing this option from the Edit menu:

e Ed	dit V	/iew	Help										
S	Status	_	Label	System	Name	Firmware Ver	LAN Address	Uptime	Last Contact	Latitude	Longitude	Altitude	Timing qualit
9)	0		SPRT-FMUS	Fortimus	FMUS-DE5B	2.0-7544	10.10.0.25	01:36:27	Just Now	51.3605	-1.1632	133.70	0
9	0		NO LABEL	Minimus	MIN-AF55	1.2-8707	10.10.0.6	6 days 1 Hrs	Just Now	0.0000	0.0000	0.00	0
9	0		DEMO 83	Minimus	MIN-C456	2.0-7544	10.10.0.17	01:19:32	Just Now	51.3606	-1.1633	130.70	0
9)	0		SPRT-MIN	Minimus	MIN-C555	2.0-7545	10.10.0.10	00:55:04	Just Now	51.3606	-1.1633	103.10	100
								Data V CAP R Add D	eceiver				
Scan cal Sy	Locall vstem	<u>.</u>	Registry	5	2.34.40.123			Power	EED Extractor board control dyne Debugger			g	üralp

The following dialogue is displayed:

Add device - Discovery	-		×
Device IP address:			
	Cancel	Ad	d
	Cancel	Ad	d

Enter the IP address of the Certimus (or other device, such as Güralp Minimus) to be added and click the Add button. The newly added device will appear in the device list.



**Note:** The newly added device will be removed from the list and not automatically re-added if a local network scan is performed.

You can choose which information is shown for each device in the main window. You can select which columns to display – and hide unwanted ones – by clicking on "Show" from the "View" menu.

ile	Edit	Viev	v He	elp											
			Live	√iew	+	Svs	tem Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude	^
11	0		Scan Regi		Ctrl+L Ctrl+R	nim		50517	1.1-1022	89.213.16.113	10.10.0.13	02:03:18	51.3607	-1.1629	
12	0	)	Show	,	•	him		50262	1.1-1022	89.213.16.113	10.10.0.36	6 days 19 Hrs	0.0000	0.0000	
13	0	ভ		NO LABEL	M	ž	Status Label	1095	1.1-1022	89.213.16.113	10.30.0.87	7 days 20 Hrs	51.3612	-1.1640	
14		0		TR1191-4/	47 M	~	System	3607	1.1-1022	89.213.16.113	10.30.0.152	2 days 19 Hrs	51.3612	-1.1640	
15	0	O		NO LABEL	м	ž	Name Serial# Firmware Ver Connection Type	3351	1.1-1022	89.213.16.113	10.30.0.131	7 days 21 Hrs	51.3612	-1.1640	
16		O		NO LABEL	м	~		1287	1.1-1022	89.213.16.113	10.20.0.182	1 days 0 Hrs	51.3607	-1.1635	
17	0	0		NO LABEL	м			)775	1.1-1022	89.213.16.113	10.20.0.180	1 days 0 Hrs	51.3606	-1.1635	
18	0	O		GSL Minim	us M	Š	WAN Address LAN Address	7477	1.1-1022	62.49.27.35	192.168.254.246	7 days 22 Hrs	51.3613	-1.1637	
19	0	O		NO LABEL	м		Netmask	1831	1.1-1022	89.213.16.113	10.20.0.242	01:34:24	51.3607	-1.1635	
20		0		NO LABEL	м	~	Uptime Last Contact	1575	1.1-1022	89.213.16.113	10.20.0.243	01:34:53	51.3607	-1.1635	
21	0	0		NO LABEL	м	~	Last contact	1031	1.1-1022	89.213.16.113	10.20.0.181	1 days 0 Hrs	51.3606	-1.1635	
22	0	0		NO LABEL	м	~	Longitude	1543	1.1-1022	89.213.16.113	10.20.0.185	1 days 0 Hrs	51.3606	-1.1635	
	an Lo stered	ocally d Syste	-	Registry	52		Altitude GNSS Quality Voltage Humidity Temperature							gür	alþ

The "Status" column is composed of three icons that represent the digitiser connectivity status (whether Certimus is reachable/active or not), timing status (GNSS/PTP/PPS) and storage status (primary/secondary) respectively.

Hovering the mouse over any of these three icons will display tool-tips giving a brief description of the status including, for the timing indicator, details of which timing subsystems are operating:

	Status	Label	System	Name	Serial#	Firmw 1.2-215	
1		NO LABEL	Fortimus	FMUS-9655	38485		
2		NO LABEL	Fortimus	FMUS-C457	50263	1.2-379	
	Timin (GNSS Storag	OK., PTP Error., PPS	ок.)				

### 4.4 Viewing waveforms and system state-of-health

Waveform data recorded by the Certimus' internal sensors and other connected sensors can be viewed using several methods, which are described in the following sections.

#### 4.4.1 Using Discovery's "Live View" window

#### 4.4.1.1 Main features

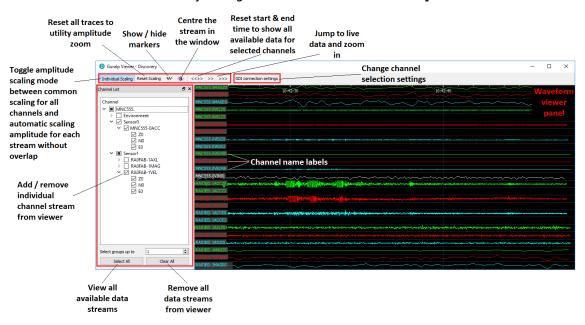
Discovery offers a versatile live waveform/data viewer. To open the Viewer, in Discovery's main window, select an instrument and, from the View tab in the toolbar, select "Live View". The menu will then present three options for data streaming:

- GDI and GCF channels
- GDI only
- GCF only

The GCF option uses the Scream! Protocol to stream data in GCF packets of, typically, 250, 500 or 1,000 samples. The GDI protocol streams data sample-by-sample and also allows the sending of each instrument's calibration parameters so that data can be expressed in terms of physical units rather than digitiser counts.

Güralp recommends using the "GDI only" option for waveform viewing.

The main features of – and the key buttons within – the Live View window are shown in the following screen-shot. Basic amplitude and time zoom functions are given in the Window zoom controls panel and streams can be easily added to or removed from the window by using the check-boxes in the left panel.



The channels are divided in groups with different hierarchical importance. The most important are the velocity/acceleration channels with higher sample rates: these belong to group 1. The least important belong to group 6, which includes humidity, temperature, clock diagnostics *etc*. When the live view is launched, only the channels in group 1 are selected. It is possible to change this setting by selecting a different group number from the "Select group up to" box at the bottom of the channel list.

> _ MAG > _ TMP _ VINIO > _ CLK	U
Select groups up to	2
Select All	Clear All

When only few channels are selected for viewing, the channel name labels also show data statistics, including the maximum, minimum and average amplitudes in physical units.

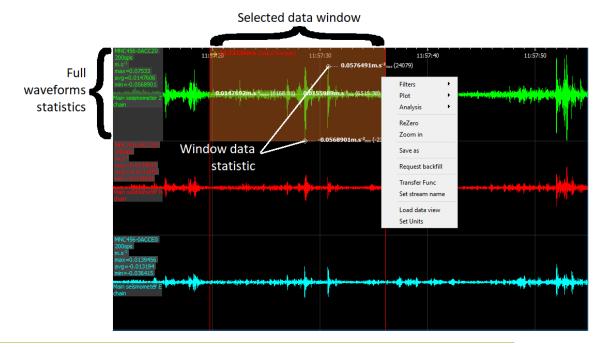
If too many channels are in view for this information to be visible, you can left-click on a label and the label and trace will then expand to half the height of the screen, revealing these statistics. The other channels will be compressed into the remaining space. Another left-click on the same channel will return the window to normal. Alternatively, a left-click on a different channel will shrink the original one and expand the newly-selected one.

By selecting and dragging the mouse over a window of waveform data, the viewer will display similar statistics for the data within the selected window. When a

window of data is selected, use the the key to subtract the ADC offset from the

maximum, minimum and average values. Use the Alt key to calculate the integral of the selected data. By right-clicking on the window, you can perform advanced

analysis on the data, including plotting power spectral density graphs (PSDs), spectrograms and discrete Fourier transforms (DFTs), as shown below:



#### 4.4.1.2 Window control short-cuts

You can change the display of the waveforms with based on a combination of keystrokes and mouse-wheel scrolling (or track- / touch-pad scrolling on a laptop).

These commands are shown in the table below:

Command	Window control
Amplitude control	
1	Increase/decrease amplitude of all traces2
🕯 + hover cursor over channel label	Increase/decrease amplitude of individual trace
Ctrl + + hover cursor over channel label	Shift individual trace offset up/down
Time control	
	Pan time-scale right/left
	Zoom time-scale in/out
Trace focus	
on trace label	Focus on individual trace

30 Issue Error! Reference source not found. - June,

#### Trace selection

Del + hover cursor over on individual trace / trace label	Remove / de-select trace from Viewer window
---	--

#### 4.4.1.3 GDI connection settings

The GDI protocol allows a receiver, such as Discovery, to select which channels to receive by use of a "channel subscription list". This feature can be useful in cases where the connection between Certimus and Discovery has limited bandwidth. To subscribe to specific channels, right-click on a digitiser in Discovery's main window and select "GDI Configuration" from the context menu.

The resulting window has two very similar tabs. The "Subscription configuration" tab refers to channels selected for transmission and the "Storage configuration" tab affects which channels are selected for recording.

Click on the **Connect** button to connect to the Certimus GDI server.

By default, Discovery subscribes to all channels. To alter this behaviour, change the radio-button from "Automatically subscribe to all available channels" to "Use subscription list". In subscription list mode, the channels in the list on the left-hand side are those to which Discovery subscribes. All available channels are listed on the right-hand side.

General				
Automatically connect wh	en server is available		1 new data samples	Disconnect for FM8859-0MAGE0 (22020101/850
Subscription configuration	Storage configuration			
Automatically subscribe t	o all available streams			
Use subscription list				
Subscribed streams				Available stream
		<< < > >>	FM8859-0ACCE0 FM8859-0ACCE2 FM8859-0ACCN0 FM8859-0ACCN2 FM8859-0ACCZ0 FM8859-0ACCZ2 FM8859-0ACL20 FM8859-0AXLE0 FM8859-0AXLZ0 FM8859-0CAL0 FM8859-0CGPS0 FM8859-0CGPS0 FM8859-0CGPSP FM8859-0CPDMS FM859-0CPDMS	^

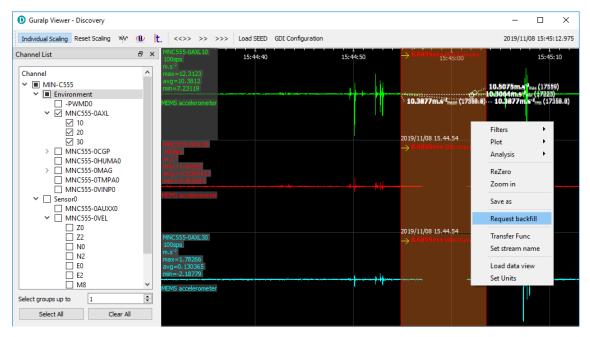
Channels can be moved between lists -i.e. switched between being subscribed and being unsubscribed - by using the arrow buttons on the middle:

<<	Subscribe to all channels shown in the <b>Available channels</b> list
<	Subscribe to all selected channels in the <b>Available channels</b> list
>	Unsubscribe from all selected channels in the <b>Subscribed channels</b> list
>>	Unsubscribe from all channels in the <b>Subscribed channels</b> list

#### 4.4.1.4 Backfill from microSD card

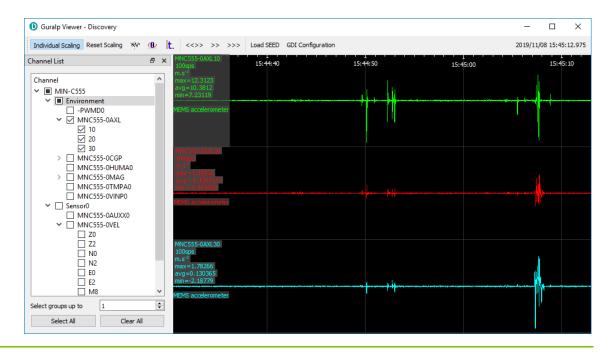
Gaps in the waveforms due to network disconnections can be backfilled by requesting missing data to the local storage.

In the Discovery GDI "Live View", highlight the portion of data including the gap, right-click and select "Request backfill".



The gaps are backfilled automatically for all the streams selected, if the requested data is available in the microSD card.

#### **Revision History**



#### 4.4.2 Using Scream!

Data from the Certimus can also be viewed and analysed using Güralp's Scream! Software.

For full usage information on Scream!, please refer to the on-line Güralp manual **MAN-SWA-0001**.

In Scream!'s Network Control window, add a UDP or TCP Server using the address reported under "LAN Address" in Discovery's main window (as described in Section 4.3 on page 24).



Right-click on the newly-added server and select GCFSEND: B (or Connect) from the context menu. This sends a command to the Certimus to start data transmission. Once the GCFSEND: B (or Connect) command has been issued, the instruments and their associated streams should begin to appear in Scream!'s main window.

#### **Revision History**

🔁 Scream!							_		<
<u>File View Windows H</u> elp									
🛱 🔜 MIN-6855		Stream ID	Rec.	Comp.	SPS	End Time	Date	RIC	
🖻 🔊 Sensor0		1AXLE0	No	16 bit	100	13:30:55	14/07/2016	130	
BMN6B55-AXL		1AXLN0	No	8 bit	100	13:30:58	14/07/2016	-8237	
MN6B55-CLKC		1AXLZ0	No	16 bit	100	13:30:56	14/07/2016	14271	
BMN6855-HUM		1INTE0	No	8 bit	100	13:30:59	14/07/2016	-12068	
		1INTN0	No	8 bit	100	13:30:58	14/07/2016	-8782	
BMN6B55-INT		1INTZ0	No	8 bit	100	13:30:57	14/07/2016	-22655	
- OMN6B55-MAG		1MAGE0	No	8 bit	5	13:29:23	14/07/2016	-5322	
BMN6B55-MAS		1MAGN0	No	8 bit	5	13:29:51	14/07/2016	-6660	
BMN6B55-OVIN	_	1MAGZ0	No	8 bit	5	13:28:55	14/07/2016	-1344	
BMN6B55-PLLC		1MASE0	No	16 bit	100	13:30:55	14/07/2016	-4506	
BMN6B55-ROT		1MASN0	No	16 bit	100	13:30:56	14/07/2016	3732	
BMN6B55-TMP		1MASZ0	No	16 bit	100	13:30:59	14/07/2016	-1655	
MN6B55-VEL		1ROTP0	No	8 bit	5	13:28:11	14/07/2016	0	
		1ROTRO	No	8 bit	5	13:28:11	14/07/2016	0	
G MN6B55-XAXL		1ROTY0	No	8 bit	5	13:28:11	14/07/2016	-30336	
⊟ J Sensor1		1TMPA0	No	8 bit	5	13:28:11	14/07/2016	4222	
BRA03ED-1AXL		1VELE0	No	32 bit	200	13:31:00	14/07/2016	-590772	
BRA03ED-1INT	•	1VELEC	No	32 bit	200	13:31:00	14/07/2016	-2006039	•
Server: 10.10.0.5:1567		51 streams		1,372,1	40 Kb s	stream buffer	PC Time (UTC)	: 13:31:06	///

To configure the Certimus, double-click on its entry to open its web page.

Note: If stream recording is enabled, make sure that the file-name format in Scream! (on the Files tab of the <u>File→Setup</u> dialogue) is set to YYYY\YYYMM\YYYMMDD\I\_A\_YYYYMDD\_HHNN in order to prevent file names conflicting. More information can be found in Scream! manual MAN-SWA-0001 available on the Güralp website.

## 5 LCD Display menu

The Certimus is equipped with a multi-touch, 2.4 inch (61 mm), full colour LCD display that shows the instrument's state of health, inclination and real-time output waveforms. It also allows configuration of the instrument as well as some control operations.

While the Certimus is booting up, it displays a white screen with the Güralp logo in the middle and a progress-bar at the bottom.



Once the Certimus has booted up completely, the LCD automatically displays the "status" page.

To move back to the main menu, touch anywhere in the screen and the main menu will be displayed.



**Note**: When using the touch screen, keep your finger in place on each button for approximately half a second to ensure that your touch is registered. This delay helps prevent accidental triggering of menu functions. The LCD's touch features can be disabled completely if desired: see Section 5.6.3 on page 42 for details.

The LCD behaviour can be configured in the Certimus web interface, see Section 7.8 on page 55 for more details.

The complete LCD menu map is illustrated in Section 16 on page 180.

## 5.1 Main menu

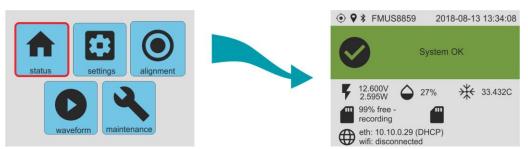
The main menu offers the following options:

- status
- settings
- alignment
- waveform
- maintenance

These are discussed in the following sections.



## 5.2 Status



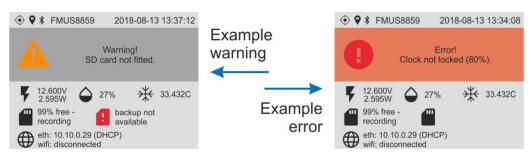
The "status" page shows information about serial number, Bluetooth status, time and date, GNSS/PTP status, input voltage and power, humidity, temperature, microSD cards recording status, I.P. address.

The top of the status display shows a series of icons:



These, from left to right, correspond to synchronisation (), GNSS location (), WiFi reception () and Bluetooth status (). The icon does not appear if the relevant service is disabled. If the service is enabled but in a fault condition (i.e. not connected or no GPS fix found), the icon is shown with a line through it.

Warning and errors are shown here when necessary. Warnings are shown with an amber triangle on a grey background ( ), as shown on the left below. Errors are show with a red circle on an amber background ( ), as shown on the right.



The messages that can be displayed are:

- Normal operation:
  - System OK : GNSS or PTP are locked, microSD cards are recording.
- Warnings:

- **Warning! SD card not fitted** : At least one of the microSD cards is not recording.
- Warning! Waiting for PPS lock : PPS signal is unstable.
- Errors:

•

- Error! Clock not locked (0%) : GNSS quality is less than 95% and PTP is not available.
- **Error! Clock not locked (PTP 0%)** : PTP quality is less than 80% and GNSS is not available.
- **Error! Clock not locked (NTP only)** : GNSS quality is less than 95% and PTP quality is less than 80%.

## 5.3 Settings

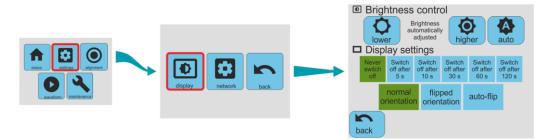


The "settings" menu offers the following options:

- display; and
- network.

These are discussed in the following sections.

### 5.3.1 Settings $\rightarrow$ display



The "display" page allow control of brightness, the inactivity time-out and the orientation of the display.

• The brightness can be set to be adjusted automatically, based on the ambient light level, or manually adjusted with the "lower" and "higher" buttons.

•

The display can be set to stay on permanently (with a consequent increase in power consumption) or to automatically switch off after 5 s, 10 s, 30 s, 60 s or 120 s of inactivity. The currently-selected mode is indicated by the green background.

When the display has been switched off, it can be switched on again by touching and holding for a second.

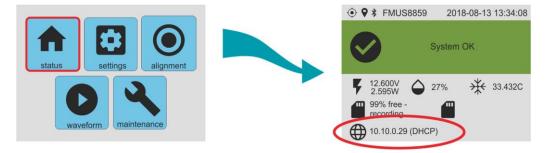
The orientation can be set to be normal or flipped. Selecting "auto-flip" will instruct the instrument to flip the display automatically based on attitude as determined by the internal MEMS accelerometer. The currently-selected mode is indicated by the green background.

### 5.3.2 Settings $\rightarrow$ network

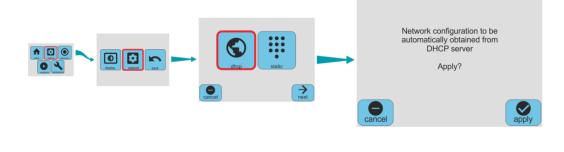


The network page allows you to choose between DHCP mode, where the networking parameters are set by an external DHCP server, or static mode, where the network parameters must be typed in manually.

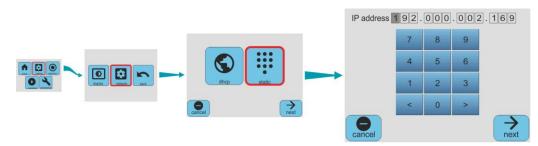
The current network mode is shown on the main status display:



If you select DHCP mode from the network page, you are asked for confirmation but no other configuration is required:

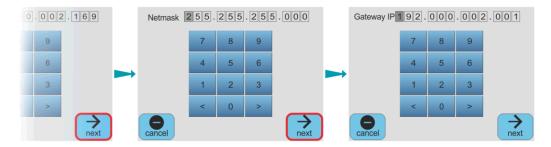


If you select static mode from the network page, you are prompted first for the IP address:

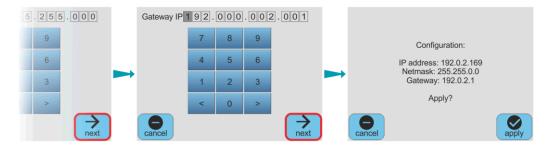


Enter the desired IP address using the on-screen virtual numeric keypad and then press "next", which takes you to the netmask screen.

Enter the desired netmask in the same way. Pressing "next" again takes you to the "Gateway IP" screen:



After entering the IP address of your gateway (default router), press "next" again to reach the confirmation screen:



Pressing "apply" here configures the Certimus with the parameters that you have just entered. Pressing "cancel" discards all of the changes and the Certimus' networking configuration is not affected.

# 5.4 Alignment



The "alignment" page shows a virtual bubble level based on the output of the MEMS accelerometer built-in the Certimus. The red circle moves around the screen as the position of the Certimus is altered, mimicking the bubble in a real bubble level; i.e. the red circle moves towards the highest part of the top of the instrument.



**Note:** The virtual bubble level works if and only if the MEMS accelerometer channels are enabled for streaming and/or recording.

See Section 6.1 on page 43 for more details about using the alignment tool.

# 5.5 Waveform



The "waveform" page shows real-time data in graphical format. The horizontal axis represents time and the display constantly scrolls to the left as the latest data are plotted on the right-hand side of the graph. Three modes are available:



In "seismic" mode, the signals from the main acceleration outputs of the Certimus are displayed.



In "accel..." mode, the outputs from the internal MEMS accelerometer are displayed.



In "auxiliary" mode, the display graphs the output from the internal temperature sensor, the internal supply voltage and the power consumption.

# 5.6 Maintenance

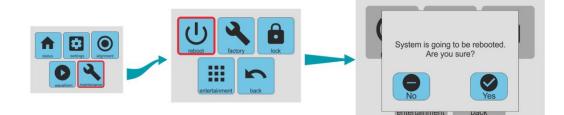


The "maintenance" page allows the user :to

- reboot the system;
- reset the configuration to factory values; and
- lock the "settings" and "maintenance" pages to prevent undesired alteration.

These are discussed in the following sections.

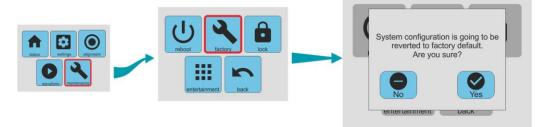
### 5.6.1 Reboot



This option reboots the processor in the Minimus digitiser without interrupting power. Because this will interrupt digitisation and potentially affect the configuration (some changes only take effect after a reboot), it is protected by a confirmation screen.

Click if you wish to continue and if you have arrived at this screen unintentionally and wish to return to the main menu.

### 5.6.2 Restore factory settings

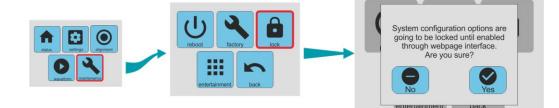


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This option restores the configuration to the state in which the instrument was delivered. Because this will interrupt digitisation and affect the configuration, it is protected by a confirmation screen.

Click if you wish to continue and if you have arrived at this screen unintentionally and wish to return to the main menu.

### 5.6.3 Lock the configuration



This option locks the LCD interface so that the instrument can only be reconfigured via its web interface. This can be useful when physical access to the instrument cannot be fully controlled. Because this can be disruptive, this option is protected by a confirmation screen.

Click if you wish to continue and if you have arrived at this screen unintentionally and wish to return to the main menu.



**Note:** Once "settings" and "maintenance" are locked, they can only be reenabled from the Certimus web page. See Section 7.8 on page 55 for more details.

# 6 Installation

# 6.1 **Permanent installation**

You will need a hard, clean surface such as a concrete floor, to install the Certimus.

If you are in any doubt about how to install the sensor, you should contact Güralp Systems' Technical Support, via support@guralp.com.

1. Prepare the surface by scribing an accurate N/S orientation line and installing a grouted-in fixing bolt on the line, near the middle. An anchor terminating in a 6 mm or 8 mm (1/4 or 5/16 inch) threaded stud is suitable.

The exposed thread should project approximately 100 mm (4 inches) above the surface. Significant excess length should be removed.

2. Place the seismometer on the surface and rotate to bring the orientation line and pointers accurately into registration with the scribed base-line.

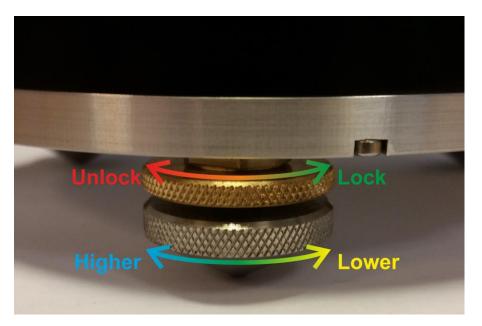
For more accurate alignment, a long, thin rod or a length of stiff wire can be aligned with a slot machined into the base of the instrument. It can be held in place by hand or, if preferred, by inserting two 3 mm screws into the threaded holes provided.

- 3. Connect all the cables as described in Section 4.2 on page 23 and power on the Certimus.
- 4. Touch the alignment button at the top right of the LCD screen: This will display the digital levelling tool



The red circle behaves like the bubble in a traditional bubble-level, moving towards the highest edge of the instrument. The further from the centre it is, the more adjustment is needed.

5. Level the sensor, using its adjustable feet, until the red circle lies entirely within the inner circle of the indicator.



The feet are mounted on screw threads. To adjust the height of a foot, turn the brass locking nut clockwise (when viewed from above) to loosen it and rotate the entire foot so that it screws either in or out. When you are happy with the height, tighten the brass locking nut anti-clockwise to secure the foot.

6. Secure the instrument to the mounting stud using the conical washer provided and a wing-nut.



Caution: Hand-tighten only: do not use tools.

The instrument is now installed and transducing ground motion.

# 6.2 **Temporary installations**

The Certimus is ideal for monitoring vibrations at field sites, owing to its ruggedness, high sensitivity and ease of deployment. Temporary installations will usually be in hand-dug pits or machine-augered holes. Once a level base is made, the accelerometer can be sited there and covered with a box or bucket. One way to produce a level base is to use a hard-setting liquid:

- 1. Prepare a quick-setting cement/sand mixture and pour it into the hole.
- 2. "Puddle" the cement by vibrating it until it is fully liquefied, allowing its surface to level out.
- 3. Follow the cement manufacturer's instructions carefully. Depending on the temperature and type of cement used, the mixture will set over the next 2 to 12 hours.
- 4. Install the sensor as above, then cover and back-fill the emplacement with soil, sand, or polystyrene beads.

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5. Cover the hole with a turf-capped board to exclude wind noise and to provide a stable thermal environment.

If you prefer, you can use quicker-setting plaster or polyester mixtures to provide a mounting surface. However, you must take care to prevent the liquid leaking away by "proofing" the hole beforehand. Dental plaster, or similar mixtures, may need reinforcing with sacking or muslin.

# 6.3 Direct Burial



# 6.4 Installation in Hazardous environments

The fully enclosed, aluminium case design of the Certimus makes it suitable for use in hazardous environments where electrical discharges due to the build-up of static charge could lead to the ignition of flammable gasses. To ensure safe operation in these conditions, the metal case of the instrument must be electrically bonded ('earthed') to the structure on which it is mounted, forming a path to safely discharge any static charge.

Where electrical bonding ('earthing') is required during the installation of a Certimus, this can be done by using a ring tag on one of the screws mounting the power connector.

Alternatively, the negative connection of the DC in is connected to case internally.

# 7 System configuration

Advanced system configuration control and configuration tools are available by selecting an instrument in Discovery, right-clicking its entry and selecting "View Web Page". Alternatively, the web interface can be viewed by navigating to the LAN address of the instrument from any standard web browser.

Note: Some changes in the settings require a system reboot to be applied. This is notified on the top right of the Certimus web page with the message *Reboot Required*. It is suggested to perform all the modifications and reboot the Certimus when the configuration is completed clicking on any of the Reboot buttons.

# 7.1 Web Page login

The web interface supports multiple logins. If you do not log in, only a status display is available.

							Certimu
			Status Lo	ogin Help			
System type: Certim	us   Host label: F	IXED PLATE TEST TIN	Host name: CERT	-4D5C (10.30.0.15)   Seri	al number: 004D	5C	
System Status							
			General ir	nformation			
lost name	CERT-4D5C	Host label	FIXED PLATE TEST TIN	System type	Certimus	Product type	Certimus
Serial number	004D5C	Firmware version	2.1-1186	IPv4 address	10.30.0.15 (DHCP)	SEED network and station	DG.BOLLO (No site)
Digitiser temperature	30.660 °C	Digitiser humidity	32.53%	Input voltage	8.351 V	Power over Ethernet voltage	0.000 V
System time	4:54:32 PM Tue 17-Nov- 2020	Uptime	1d 6h 41m 51s	ETH status	sckt: 17/20 data: 1/6		
			GNSS	Status			
GNSS connection status	Disconnected	Last timestamp	0000-00-00 00:00:00		S-AX	A	LUK.
Last lock time	Never	GNSS stability	Disconnected	+ Nor	th Wessex	South	London
Latitude	51.361237	Longitude	-1.164040		Downs	PERSON	AXAS
Altitude	-12.340000	Horizontal dilution of precision	Undefined		AONB	A KY	THE .
GNSS PPS status	Not Trusted No Pulse	GNSS NMEA stream	Bad input	A	SAG	THE	1TA
GNSS Lock state	No lock	Number of satellites	Used: 0 In view: 0	18 1	R	eport a problem   © OpenSt	reetMap contributo
		1	PTP 9	Status			
PTP state	Phase Locked	Last PTP timestamp	2020-11-17 16:54:32Z	Last PTP lock time	2020-11-17 15:47:03Z	PTP stability	100%
Master IPv4 address	10.30.255.35	Master clock class	PRI_REF_PTP	Master clock accuracy	< 100ns (0x21)	Master time source	GPS
Network path delay	32.3 us	Network jitter estimate	± 749 ns	Network outliers	3%	1	
		•	Data reco	ord status			
nicroSD status	Recording	micro SD total	60686336 KiB	microSD used	904 KiB	microSD free	99%
			Sen	sors			
Number of sensors detected	1						
	or1	Serial number (1)		Firmware ver (1)	1.2-392	Temperature (1)	36.31 °C
Senso		Yaw (1)	0.000°	Pitch (1)	0.000°	Roll (1)	0.000°
Senso		Orientation (1)		00. X0000. 0000.	D0Y .0000Z		
Senso					-7886	Integrator E (4)	-9909
Senso		Integrator Z (1)	-500	Integrator N (1)	-7000	Integrator E (1)	-9909

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Clicking on "Login" opens allows to type in a user-name and password to access advanced features of the web page.

	güralþ
Re	quired fields are marked *
Userna	me: *
Passwo	ord: *
	Login

There are two users: a normal user and an administrator.

Logging in with the normal user account unlocks only the basic configuration and control features and prevents any advanced settings from being modified. The default user-name for the normal user is user with password user.

Logging in with the administrator account unlocks all the configuration and control features available in the Certimus web page. The default user-name for the administrator user is admin with password admin.

Once logged in, the "Web Login" drop-down menu in the Network tab allows you to disable the requirement for logging in, if you don't require security. The user-names and passwords for both users are configurable from the "Network" tab.

	- güralp UNDERSTAND OPTIMISE PROTECT		
			<b>Reboot Required - Certimus</b>
Status Network	Setup Power Trigger D	ata Stream Data Record	Storage Logout Help
System type: Certimus   Host label: FIX	ED PLATE TEST TIN   Host name: CEF	RT-4D5C (10.30.0.15)   Serial numb	er: 004D5C
Network			
Reboot			
Network configuration			
DHCP Enabled V	Static IP addr 169.254.92.77	Net Mask 255.255.0.0	Gateway 169.254.0.1
DNS1 209.244.0.3	DNS2 84.200.69.80		
Webpage access configuration			
Web Login Required V Not Required	Username (Normal) user	Password (Normal)	HTTP Port 80
Web Timeout Required	Username (Admin) admin	Password (Admin) *******	
TFTP settings			
TFTP Server 10.30.255.197	TFTP File		
Network Timing			
PTP Due shows ourselds one set	PTP Offset	PTP Transmission	

# 7.2 System status

The "Status" tab of the web browser interface provides state-of-health information about the Certimus. These parameters are described as follows:

Host name: the serial number of the Certimus;

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- · Host label: the customisable name of the Certimus system;
- System type: the name of the connected instrument, e.g. "Certimus";
- Product type: the type of the connected instrument, e.g. "Certimus";
- Serial number: the serial number of the Certimus;
- Firmware version: the DIG firmware version running on the Certimus;
- IPv4 address: the static or Dynamic LAN I.P. address of the Certimus;
- SEED network and station: Network and Station SEED codes of the Certimus;
- **Temperature**, **humidity**, **Input voltage** and **PoE voltage**: the internal temperature and humidity of the Certimus; input voltage supplied and optional PoE voltage supplied to the Certimus;
- System time: the current internal system date and time;
- Uptime: the time the Certimus has been running since the last reboot;
- **ETH status**: the number of total active TCP connection in use and connection used for data transmission;
- GNSS status, last GNSS timestamp, last GNSS lock time since significant timing drift or re-boot, GNSS stability of the lock, horizontal dilution of precision (based on satellite coverage), GNSS PPS status, GNSS NMEA stream, GNSS lock state (2-D or 3-D), number of satellites used and in view;
- Latitude, longitude and altitude of the system, as provided by the GNSS receiver;
- PTP state, last PTP timestamp, last PTP lock time since significant timing drift or re-boot, PTP stability in time accuracy, master IPv4 address (I.P. address of the PTP master), master clock class and accuracy, master time source, network path delay, network jitter estimate (quality indicator in ns), network outliers;
- MicroSD card recording status, total storage capacity, used storage space and available storage space;
- **Real-time sensor values** from the accelerometer.

### 7.3 Station meta-data

Discovery provides a number of flexible station meta-data inputs. These are accessible from the "Setup" tab of the instrument's web page.

**"Label**" and **"Site Name**" are used in Discovery only and appears in the list of instruments in the main window.

**"Station Name**", **"Network Code**" are all standard meta-data header values used by the miniSEED file format, which will be included in locally-stored miniSEED files (see Section 7.9 on page 57).

# 7.4 Network configuration

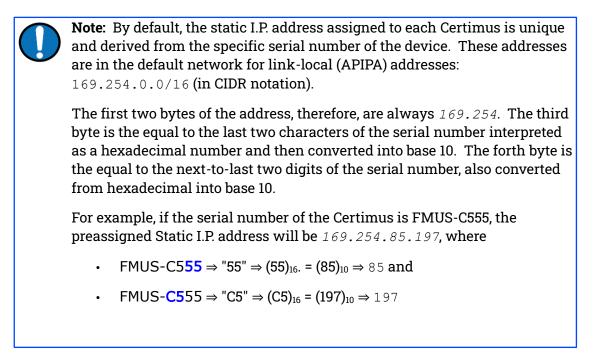
### 7.4.1 I.P. address and gateway

By default, the Certimus uses DHCP (Dynamic Host Configuration Protocol) to acquire its network configuration but static addressing can be used if required.

To configure static addressing, visit the "Network" tab of the instrument's web page and, under "DHCP", change the mode from "Enabled" to "Disabled" in the drop-down menu. In this mode, it is possible to specify the I.P. address, the Net Mask and the address of the Gateway (default router), as shown:

	- güralp UNDERSTAND OPTIMISE PROTECT			
Stat System type: Minimus   Hos Network Config		Setup Trigger Data	Stream Data Record Stora	<b>Minimus</b> age Logout Help
DHCP DNS1 209.244.0.3	Disabled V Disabled	Static IP addr 10.10.0.10	Net Mask 255.255.255.0	Gateway 10.10.255.1

Before any changes made here will take effect, the Certimus must be re-booted. To do this, click the Reboot button on the "Data Record" tab.



Network settings are also available in Discovery by right-clicking on the Certimus' entry in Discovery's main window and selecting "Edit Network Address".

Edit Network Address - Discovery									
Device Serial #: 50517									
10 .10 .0 .31									
255.255.0 .0									
<keep existing=""></keep>									
Obtain IP address automatically (DHCP)									
б ОК	Cano	cel							
	17 ation: 10 .10 .0 .31 255.255.0 .0 <keep existing=""> s automatically (DHCP)</keep>	17 ation: 10 .10 .0 .31 255.255.0 .0 <keep existing=""> s automatically (DHCP)</keep>							

### 7.4.2 NTP (Network Timing Protocol) configuration

**Note:** Network Timing Protocol (NTP) is only used for setting the system's internal clock at boot-up, it is *not used for sample timing*. See Section 7.12 on page 78 for details about synchronising the sample clock.

However: if neither GNSS nor PTP are available but NTP is locked and the sample clock's time is more than five seconds different from NTP's time, the sample clock will be adjusted (in a step-change) to NTP time.

By default, the NTP server option under the "Setup" tab of the instrument's web page is set to "Pool" which uses the virtual server pool pool.ntp.org. This accesses a dynamic collection of networked computers that voluntarily provide moderately accurate time via the NTP to clients worldwide.

MAN-CER-0001 202 Alternatively, it is possible to specify the I.P. address of your preferred NTP server. To do this, select the "Static" option from the "NTP server" drop-down menu, which activates the "NTP IP Addr" setting, and enter the I.P. address of your NTP server here.

Network Timing						
PTP Mode Disabled		PTP Offset Correction 0	nanoseconds	PTP Transmission Mode	Multicast 🗸	
NTP Server	Pool 🗸					
Registry	Disabled					
Registry Update Eve	Pool Static	Group ID		Registry Address	52.34.40.123	

# 7.5 WiFi

The Certimus can act as a WiFi client, connecting to an existing WiFi network. Both open and secure (WEP, WPA and WPA2) networks are supported.



**Note:** The Certimus does not function as WiFi access point (AP) so it is not possible to connect a WiFi-enabled laptop, for example, directly to the unit. A separate WiFi AP is required in this case so that both laptop and Certimus can connect to the same network.

The WiFi connection is configured and monitored from the "Network" tab of the Certimus web page:

WiFi			_	
Status	WiFi Standby	🗹 WiFi Enable	Access Points Select Network	~
Requested AP	gold	Password	Connect	Auto Connect
Connected to		WiFi IP	]	

### 7.5.1 Connecting to a WiFi network

Visit the "Network" tab of the Certimus web page and ensure that:

• the "WiFi Enable" check-box is ticked; and

Connect

the "Auto Connect" check-box is clear as high-lighted above.

Use the "Access Points" drop-down menu to select the desired network and enter the password or passphrase in the "Password" text field, if required.

Click the

•

button to connect to the network.

**Note**: A Certimus connect to a WiFi network automatically appears in Discovery's "Scan Locally" section only when (a) the computer running Discovery is connected to the same WiFi network **and** (b) the Certimus' Ethernet is disconnected or disabled.

### 7.5.2 WiFi connection status

The status of the WiFi connection is displayed at the top left of the WiFi section of the Network tab of the web page:

WiFi				
Status	WiFi Off	🗌 WiFi Enable	Access Points Select Network	~
Requested AP	gold	Password	Connect	Auto Connect
Connected to		WiFi IP		

The possible values for the status are:

- WiFi off the WiFi interface is disabled. Tick the "WiFi Enable" check-box to enable the interface, if required.
- WiFi Standby the WiFi interface is enabled but not currently connected to any network. If no connection is required, clear the "WiFi Enable" check-box to disable the interface.
- WiFi Connecting the WiFi interface is in the process of connecting to the selected network.
- WiFi Connected the WiFi interface is connected to the network shown in the box below and the DHCP server has allocated the IP address displayed in the adjacent box. (Static IP addressing is not supported).

Once a successful connection is established, tick the "Auto Connect" check-box so that the Certimus will attempt to reconnect to the same network whenever possible. The name of the selected network appears in the "Requested AP" box.

### 7.5.3 Changing WiFi networks

WiFi						
Status	WiFi Connected	🗹 WiFi Enable		Access Points	Select Network	~
Requested AP	gold	Password	MidasTouchLobby	Connect		Auto Connect
Connected to	gold	WiFi IP	192.168.254.120			

A different network can be selected from the "Access Points" drop-down menu – and the new password entered – while the Certimus is still connected to a network. The

instrument will not connect to the new network until the **Connect** button is clicked.

## 7.6 GDI push (auto-connection)

A Certimus normally acts as a GDI server, where a client initiates a connection in order to pull data from it. This is the mechanism used when the GDI viewer in Discovery is launched.

The "GDI auto-connection" feature enables the Certimus to establish *outgoing* network connections in order to *push* data to one or more remote clients, such as Platinum systems or an Earthworm system running the gdi2ew plug-in.

To configure an auto-connection, type either the I.P. address or the host-name of the target client, a colon (':') and the port number (*e.g.* 192.0.2.91:1566 or *affinity10.example.com:1566*), into any of the connection fields in the "Network" tab of the web page.

GDI auto-connection settings							
Connection		Connection		Connection		Connection	

When auto-connection from a Certimus to a host is configured, the Certimus will attempt to open a connection to the host. If it fails, it will re-try every 60 seconds. A suitably configured host will accept the connection and the Certimus will then negotiate a link and start streaming data.

If the connection drops, the Certimus will attempt every 60 seconds to reconnect.



**Note:** The default port number for a GDI-link receiver is 1566. Push servers will normally connect to this port. The default port number for a GDI-link transmitter is 1565. Receivers wishing to pull data will normally connect to this port. See Chapter 12 on page 159 for a list of the network ports used by the Certimus.

# 7.7 QSCD

The Certimus can push data in QSCD format (**Q**uick **S**eismic **C**haracteristic **D**ata) to one or more clients, using outgoing network connections.

To configure a connection, locate the QSCD section of the Network tab of the web page, as shown below. Type either the I.P. address or the host-name of the target client into any of the "Server" fields. This will push data using UDP port 9908, which is the default. If you wish to use a different port number, add a colon (':') and the port number to the end of the specification. For example, *192.0.2.91:9876* or *qscd.server.com:9876*.

QSCD						
QSCD code sensor	Sensor 0 🗸	QSCD code	QSCD0			
Connection		Connection		Connection	Connection	

The Certimus does not automatically send all data when using the QSCD protocol. Channels to be transmitted must be selected (in Z/N/E triplets) and each channel passed through a QSCD transform. See Section 7.16.12 on page 106 for details on how to configure this transform.

# 7.8 Controlling the LCD from the web interface

In the "Setup" tab of the Certimus web page, the user can remotely control the LCD display settings.

Locking and unlocking of the "settings" and "maintenance" features can be selected using the drop-down menu named "Display settings":

				Display				
Display settings	Unlocked 🗸	Display brightness	Auto 🗸	Display switch-off	Never $\sim$	Display flip	Auto	$\sim$
Touch sense	Unlocked			•		•		
	Locked		G	uraln Systems Limited				

The display brightness is adjustable using the drop-down menu named "Display brightness":

3611501	Sensor u V	קוט		Azimuui	V	vepui	V
Fortimus			Auto				
			10%	ensor Status			
Initialisation	Complete	Sensor State	20%				
			30%	dentification			
Model	Fortimus	Serial Number 0	40%	Firmware	0.3	Configuration	1
			50%	Response			
Fortimus Range	-1.0g; +1.0g 🗸	Fortimus Loop	60%				
				ass Centring		•	
Centre Mass			70%				
			80%	Calibration			
Calibration	Off ~	Amplitude	90%	Calibration Signal	Disabled ${\scriptstyle \lor}$		
			100%	Display			
Display settings	Unlocked $ \sim $	Display brightness	Auto 🗸	Display switch-off	Never $\sim$	Display flip	Auto ~
Touch sense	Enable ~						

The display can be set to switch off after a selectable period of time while it is untouched. When the display is off, it can be switched back on by touching it for a couple of seconds.

				sensor status					
Initialisation	Complete	Sensor State	Idle			Never			
				Identification		5s			
Model	Fortimus	Serial Number	0 (0x0)	Firmware	0.3	10s	Configuration	1	
				Response		20s			
Fortimus Range	-1.0g; +1.0g $ \smallsetminus $	Fortimus Loop	Normal $\sim$			30s			
			1	Mass Centring					
Centre Mass						45s			
				Calibration		60s			
Calibration	Off ~	Amplitude	100% ~	Calibration Signal	D	90s			
				Display		120s			
Display settings	Unlocked $ \sim $	Display brightness	Auto 🗸	Display switch-off		Never ~	Display flip	Auto	~
Touch sense	Enable $\sim$								

The LCD is, by default, oriented with the top of the screen pointing North (relative to the instrument). The orientation can be flipped by 180 degrees if required or it can be set to "automatic". When the auto-flip is enabled the orientation changes according to the MEMS output.

	Display								
Display settings	Unlocked $ \sim $	Display brightness	Auto 🗸	Display switch-off	Never $\sim$	Display flip	Auto 🗸		
Touch sense	Enable 🗸						Normal		
			0	Buralp Systems Limited			Auto		
		Midas H	louse, Calleva	Park, Aldermaston, Reading, RG 981 9056, Fax: +44 118 981 994			Flip		

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For security reasons, the LCD's touch sensor can be disabled using the option "Touch sense". Once disabled, touching the screen has no effect and no commands can be issued via the LCD.

To restore normal operation, set "Touch sense" to "Enable" from the Certimus web page.

	Display										
Display settings	Unlocked $ \smallsetminus $	Display brightness	Auto 🗸	Display switch-off	Never 🗸 Display flip	Auto ~					
Touch sense	Enable 🗸										
	Enable		0	uralp Systems Limited							
	Disable	Midas	House, Calleva	Park, Aldermaston, Reading, RG 981 9056, Fax: +44 118 981 994							
S Not	a. "Taval	h	. h	an ablad an lar	from the web interf	inco Thiomat					



**Note:** "Touch sense" can be re-enabled only from the web interface. It is not possible to re-enable it using the LCD screen.

i.

# 7.9 Data storage

The main panel of the "Data Record" tab in the web interface is shown here:

		Marriem	V	güralp UNDERSTAND OPTIMISE PROTECT
				Reboot Required - Certimus
	Status Network	Setup Power Trigger Da	ita Stream Data Record Storag	e Logout Help
		ED PLATE TEST TIN   Host name: CER	F-4D5C (10.30.0.15)   Serial number: 004	4D5C
Data Rec	:ora		The "Disable All" and "Restore default"	
Disa	ible All	Restore default	button will ALSO affect settings of any other sensors	Reboot
Copy to I	Data Stream	Copy FR to all	Recording status Recording	For more information about microSD cards status please visit "Storage" tab
Display Streams	All	Apply configuration for tap groups		Display On Page Sensor 1 🗸
	s configuration			
	annel sampling rate	Data transform	SEED name - please use check-box to	RESPonse file - if available
			modify the default	
S1 SeisZA	250.0000 Hz 🗸	Tap Disabled 🗸	DG.BOLLO.01 .CHZ	RESP file 10
S1 SeisNA	250.0000 Hz 🗸	Tap Disabled 🗸	DG.BOLLO.01 CHN	RESP file 15
S1SeisEA	250.0000 Hz 🗸	Tap Disabled 🗸	DG.BOLLO.01 .CHE	RESP file 20
S1 SeisZB	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . AHZ	RESP file 11
S1 SeisNB	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . AHN	RESP file 16
S1SeisEB	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO.01 .AHE	RESP file 21
S1SeisZFR	250.0000 Hz 🗸	Transforms Disabled for this tap 🗸	DG.BOLLO. 01 . CHZ	RESP file 12
S1 SeisNFR	250.0000 Hz 🗸	Transforms Disabled for this tap 🗸	DG.BOLLO.01 .CHN	RESP file 17
S1SeisEFR	250.0000 Hz 🗸	Transforms Disabled for this tap 🗸	DG.BOLLO. 01 . CHE	RESP file 22
		Mass positi	on channels	
S1IntZ	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . AMZ	
S1IntN	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . AMN	
S1IntE	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . AME	
S1IntZFR	5.0000 Hz 🗸	Transforms Disabled for this tap $\checkmark$	DG.BOLLO. 01 . MMZ	
S1IntNFR	5.0000 Hz 🗸	Transforms Disabled for this tap 🗸	DG.BOLLO. 01 . MMN	
S1IntEFR	5.0000 Hz 🗸	Transforms Disabled for this tap $\checkmark$	DG.BOLLO. 01 . MME	
			ometer channels	
S1AccZA	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . ANZ	RESP file 39
S1AccNA	Disabled V	Tap Disabled 🗸	DG.BOLLO.01 .ANN	RESP file 44
S1AccEA	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO.01 .ANE	RESP file 49
S1AccZB	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . ANZ	RESP file 40
S1AccNB	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . ANN	RESP file 45
\$1AccEB	Disabled 🗸	Tap Disabled 🗸	DG.BOLLO. 01 . ANE	RESP file 50

This page allows to configure the recording channels available in the Certimus.

The names and contents of each file are described in Section 11 on page 156.



**Note:** When changing a setting in the Certimus web page, ensure that you wait until the page refreshes before changing another setting. This allows time for the previous change to take effect.

The drop-down box at the top-left of the page named "Display Streams" filters out visible channels among All, Enabled and Disabled. The option "Apply configuration

for tap groups" automatically apply the same configuration to three streams that belong to the same tap, e.g. SOSeisZA, SOSeisNA, SOSeisEA.

The page is divided in four columns:

in most-left column, drop-down boxes are available for each channel to either select a sample rate or to exclude the channel from streaming (by selecting the "Disabled" option). All streaming can be stopped by clicking the

Disable All button. Same configuration can be applied to real-time transmission channels by clicking the **Copy to Data Stream** button. Default channel configuration can be applied by clicking the **Restore default** button.

- in second column from the left, drop-down boxes are available for each channel to enable/disable transforms and, once transform is enabled, to select the transform to apply (see Section 7.16 on page 94);
- in third column from left, Location and Channel SEED codes can be configured. Cells are greyed out by default (default values applied) and they can be edited by clicking on the check-box;
- in most-right column contains links to the RESP files associated to each of the seismic channels (see Section 7.14.5 on page 88).

Upon changing the sample rate, enabling a transform or changing Location and Channels codes, the Certimus will need to be restarted for the changes to come into effect; this can be done by pressing the Reboot button.

During the reboot, the LEDs will flash, displaying the starting-up sequence (see Section 3.1.2 on page 12) and the instrument web page will display the following screen.

### CERT-4D5C is rebooting ...

Once the Certimus has successfully restarted, the full web browser display and controls will be available for use again.

# 7.10 Storage

### 7.10.1 Recording status

MicroSD cards need to be specifically formatted to operate with the Certimus. The cards shipped with the Certimus and with Radian systems are supplied pre-formatted.

Data are stored on the microSD cards in miniSEED format. Each channel is saved as a series of 128 MiB files. Instrument and station meta-data (e.g. instrument response, coordinates, compression type etc.) are stored in "Dataless SEED" format.

The MicroSD card and data recording status can be monitored in the upper panel of the "Storage" tab.

The left-hand column provides details of the external (primary, removable) microSD card and the right-hand column shows the status of the internal (backup, fixed) card.

SD Cards status								
External microSD card present	PRESENT	Number of 128-MiB miniSEED files	452					
External microSD card usable	USABLE	Internal microSD card usable	USABLE					
External microSD card init count	1	Internal microSD card init count	1					
External microSD card is primary microSD card	PRIMARY	Internal microSD card is primary microSD card	BACKUP					
Primary microSD card is recording samples	RECORDING	Backup microSD card is recording samples	RECORDING					

Sections of this panel indicate the status of the following:

- Whether a card is inserted;
- Whether an inserted card is usable (i.e. correctly formatted); and
- Whether the card is recording data.

Note: If the recording status of the cards is marked NOT RECORDING,

clicking on clicktormat cards or clicking on may solve the issue. Note that the quick format simply moves the write-pointer to the beginning of the recording space, hence overwriting any existing data. The full format, in contrast, erases all the existing data (and can take several hours).

### 7.10.2 MicroSD card re-formatting

The card re-formatting process fills the card with 128 MiB files containing zeroes. Each file is given a temporary, place-holder name. When data are written, these files are renamed and then over-written with data.

There are two methods for card reformatting: "Quick format" and "Full format". The quick format mode should be used for pre-deployment tests (e.g. stomp/huddle tests) to ensure that the instruments are operating properly. This mode simply marks the existing files as empty without deleting their contents. Full formatting should be used prior to a long-term deployment to ensure that all headers are included and files are fully clean before writing.

The Full format writes every byte of storage. It is therefore a thorough test of the integrity of the entire card which is a good thing to do before a long deployment. A quick format only writes the file structure and not the contents.

The formatting process formats both fixed and removable cards, sequentially.

**Note:** A series of tests separated only by quick formats can leave some files with residual data in them. This is not normally a problem because a deployment will typically create data-sets longer than any test, over-writing any data remaining from the tests. The miniSEED extractor utility described in Section 7.11.3.1 on page 77 can be used to remove the residual data if they cause any problems.

### 7.10.2.1 Quick format

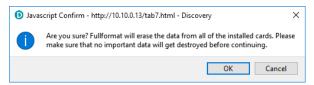
Ensure that the external microSD card is correctly inserted. Click the button in the "Storage" tab: a dialogue box will appear to confirm the formatting

operation – click on	OK	button to	continue
D Javascript Confirm - http://10.10.0.13/tal	o7.html - Discovery	×	
Are you sure? Quickformat will era Please make sure that no importan			
	ОК	Cancel	

The instrument web page will refresh and return to the "Status" tab. The reformatting operation is now complete.

### 7.10.2.2 Full format

Ensure the external microSD card is correctly inserted. Click the buttom in the "Storage" tab and a dialogue box will appear to confirm the formatting operation – click on to continue.



The process takes several hours: check the status countdown indicators on the topright of "Storage" tab.

SD Card control			
Flush data	Unmount Cards	Quickformat Cards	Fullformat Cards
			Formatting progress: 0% ~196 minutes remaining

**Caution:** Do not remove or insert the external microSD card while formatting is taking place.

### 7.10.3 MicroSD card data flushing and unmounting

The Flush data button flushes data still in the buffer into the microSD card storage. Perform a flushing before downloading data from the Storage tab (see Section 7.10.4 on page 61) or event table (see Section 7.17.5 on page 117).

The Unmount Cards button flushes the data from the buffers into the microSD cards and interrupts the recording. The recording restarts if a new card is inserted in the slot or if a quick-format (or full-format) is performed.

### 7.10.4 Download recorded data

The "Storage" tab of the web browser interface displays the miniSEED files stored on the microSD card:

#### **Revision History**

~~~~			Mmm	güralp UNDERSTAND OPTIMISE PROTECT
				Minim
	Status	Network Setup Trigge	er Data Stream Data Rec	ord Storage Logout Help
Svete	em type: Minimus I Host Ia	ibel: SPRT-MIN   Host name: MIN-C	555 (10 10 0 10)   Serial number	000555
-				
30 1	Card control			
	Flush data	Unmount Cards	Quickformat C	ards Fullformat Cards
				Formatting status: idle
SD (	Cards status			
xter	nal microSD card present	PRESENT	Number of 128-Mi	B miniSEED files 463
xter	nal microSD card usable	USABLE	Internal microSD	card usable USABLE
	nal microSD card init cour		Internal microSD	
		ry microSD card PRIMARY		card is primary microSD card BACKUP
Prima	ary microSD card is recor	ding samples <b>RECORDING</b>	Backup microSD o	card is recording samples <b>RECORDING</b>
Cha	innel data download	by time selection		
	Channel:	DG.TEST.00.HDF 🗸 From: dd / 1	mm / yyyy: To: dd ,	/mm/yyyy: Download
SD (	Card files			
50	card mes			
\$		Filename	Size (bytes)	Last data timestamp
	00C555_S0AccEA	00100_00000.mseed	76726272	2019-11-07 16:38:35.110000000
	00C555_S0SeisEA	00200_00001.mseed	102752256	2019-11-07 16:35:58.270000000
	00C555_S0SeisNA	00200_00002.mseed	102764544	2019-11-07 16:40:54.145000000
	00C555 SOSeisZA	00200 00003.mseed	115785728	2019-11-07 16:40:58.610000000
	00C555_S0SeisXA	00200_00004.mseed	95154176	2019-11-07 16:36:31.360000000
	00C555_S0AccNA	00100_00005.mseed	68460544	2019-11-07 16:37:06.540000000
	00C555_S0AccZA	00100_00006.mseed	77713408	2019-11-07 16:37:21.240000000
	00C555 SOIntE	00100 00007.mseed	47247360	2019-11-07 16:36:38.200000000
	00C555_S0IntN	00100_00008.mseed	47206400	2019-11-07 16:36:38.200000000
	00C555_S0IntZ	00100_00009.mseed	47185920	2019-11-07 16:36:38.200000000
	status.log		3594107	2019-11-07 16:32:00.000000000
	system.log		233008	2019-11-07 16:28:52.000000000
	init.log		232796	2019-11-07 16:28:53.00000000
	table of events.bin		537600	2019-11-07 16:10:56.000000000
_				
Dov	wnload selected files			
Aux	iliary files			
	Filename	•	Page	cription
G d	ataless	Dataless SEED f		cription
Fram	log	FRAM log file		
	als.txt zero.txt	SCREAM! calibra	tion values poles and gains	
	zero.txt b.txt	Calibration tex		
		Tel: +4	Guralp Systems Limited alleva Park, Aldermaston, Reading, RG 14 118 981 9056, Fax: +44 118 981 994 sales@guralp.com, support@guralp.co	13

Clicking on the file from the list automatically starts a download using your browser's standard mechanism:

Opening Sensor0SeismoZSm_000000200_00003.mseed								
You have chosen to open:								
Sensor0SeismoZSm_000000200_00003.mseed								
which is: mseed File (128 MB)								
from: http://10.10.0.36								
What should Firefox do with this file?								
O Open with Browse								
Do this <u>a</u> utomatically for files like this from now on.								
OK Cancel	OK							

Multiple files can be downloaded simultaneously by ticking the boxes on the left of each link and clicking on Download selected files button.

The microSD cards are formatted with empty files which are filled with data as they become available. The file-names are also changed when the files are written to. Until they are written to, they are marked as "hidden" files, so that it is easier to see how many files contain data when looking at the contents of the card.

### 7.10.5 Downloading data for specific time-intervals

Data for a single stream spanning a specific time-interval can be downloaded from the Storage page of the web interface. To do this, start by selecting the desired stream from the drop-down menu:

Cha	Channel data download by time selection									
	Channel:	DG.TEST.00.HDF	~ F	om: dd / mm / yyyy	: To: dd/mm/	עצעע: Download				
SD (	Card files	DG.TEST.00.HDF	^							
		DG.TEST.00.HDF								
\$		DG.TEST.00.HHZ		\$	Size (bytes) 💠	Last data timestamp 🔶				
	00C555_S0AccEA	DG.TEST.00.HHZ		d	76812288	2019-11-07 16:53:08.470000000				
	00C555_S0SeisEA	DG.TEST.00.HHN		d	102875136	2019-11-07 16:52:23.195000000				
	OOC555_SOSeisNA	DG.TEST.00.HHN		d	102842368	2019-11-07 16:51:18.075000000				
	00C555_S0SeisZA	DG.TEST.00.HHE		d	115867648	2019-11-07 16:51:30.735000000				
	00C555_S0SeisXA	DG.TEST.00.HHE		d	95268864	2019-11-07 16:51:50.500000000				
	00C555_S0AccNA	DG.TEST.00.HMZ		d	68534272	2019-11-07 16:50:45.090000000				
	00C555_S0AccZA	DG.TEST.00.HMZ		d	77799424	2019-11-07 16:51:14.460000000				
	00C555_S0IntE			d	47296512	2019-11-07 16:49:50.320000000				
	00C555_S0IntN	DG.TEST.00.HMN		d	47255552	2019-11-07 16:49:50.320000000				
	00C555_S0IntZ	DG.TEST.00.HMN		d	47235072	2019-11-07 16:49:50.320000000				
	00C555_SOHumidA	DG.TEST.00.HME		d	4960256	2019-11-07 16:45:55.700000000				
	00C555_S0Voltage	DG.TEST.00.HME		d	8941568	2019-11-07 16:47:53.500000000				

... then select the start and end dates and times using the pop-up calendars:

Cha	Channel data download by time selection										
	Channel: DG.TEST.00.HDF 🗸 From: dd / mm / yyyy 🛛 : To: dd / mm / yyyy 🛛 : Download										
SD (	Card files		1	ſ	Noven	her 2	010	$\overline{}$	>		
¢		Filename	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Last data timestamp 🔶	
	00C555_S0AccEA	00100_00000.mseed					r II			2019-11-07 16:53:08.470000000	
	00C555_S0SeisEA	00200_00001.mseed	28	29	30	31	1	2	3	2019-11-07 16:52:23.195000000	
	OOC555_SOSeisNA	00200_00002.mseed	4	5	6	7	8	9	10	2019-11-07 16:51:18.075000000	
	00C555_S0SeisZA	00200_00003.mseed	11	12	13	14	15	16	17	2019-11-07 16:51:30.735000000	
	00C555_S0SeisXA	00200_00004.mseed	18	19	20	21	22	23	24	2019-11-07 16:51:50.500000000	
	00C555_S0AccNA	00100_00005.mseed							-	2019-11-07 16:50:45.090000000	
	00C555_S0AccZA	00100_00006.mseed	25	26	27	28	29	30	1	2019-11-07 16:51:14.460000000	
	00C555_S0IntE	00100_00007.mseed	2	3	4	5	6	7	8	2019-11-07 16:49:50.320000000	
	00C555 SOIntN	00100 00008.mseed			-	2000	52			2019-11-07 16:49:50.320000000	

Lastly, click the <u>Download</u> download button to initiate a file transfer using your browser's standard mechanism.



**Note:** The pop-up calendars are not supported by Discovery's built-in browser. The required dates can simply be typed in or the entire operation can be performed in an external web browser.

### 7.10.6 Bulk data extraction via network

Files stored on the SD card can be downloaded using HTTP. The example bash script below can be used from a Linux PC or from the WSL shell on a Windows PC: It extracts all files from the SD Card into a directory named after the date and the network address of the Certimus.

```
#!/bin/bash
# Invoke with one argument: the network
# address of the Certimus
set -x
if [ "$#" -ne 1 ] ; then
    echo "Usage: $(basename $0) network address"
    exit 1
fi
NET ADDRESS=$1
DATE=$(date --iso-8601)
SAVEDIR = ${DATE}_${NET_ADDRESS}
echo Saving to $SAVEDIR
mkdir $SAVEDIR
cd $SAVEDIR
wget -rnp http://$NET_ADDRESS/tab9.html
cd ..
echo Done
```

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#### 7.10.7 Time based data extraction via network

The example Python script below will extract seismic data from the SD card based on a specified time interval. This is similar to the FDSN data archive retrieval service: https://www.fdsn.org/webservices/fdsnws-dataselect-1.1.pdf

Channel names are as given on the "Recording" tab of the web interface and the times are specified as UNIX Epoch seconds since 1970 (UTC). The resulting file is in MiniSeed format.

The script forms an http request to the instrument in the form http://192.168.254.101/data?channel=DG.TEST.01.CHZ&from=1605810714&to=1605810814

```
import os
        import wget
        from obspy import read, read inventory, UTCDateTime
        from obspy.signal import PPSD
        temp = os.environ["TEMP"]
        sensor = "192.168.254.101"
        channel = "DG.TEST.01.HHZ"
        start = UTCDateTime("2020-10-19T00:00:00.0")
        end = UTCDateTime("2020-10-19T06:00:00.0")
        startUNIX = UTCDateTime(start).timestamp
        #We use the 'start'&'end' to cut the data using Obspy
        endUNIX = UTCDateTime(end).timestamp
        # We use the 'startUNIX'&'endUNIX' to pull the
        # data from the Certimus
        if os.path.exists(r"{0}\tt.mseed".format(temp)):
        # See if temp file exists, if so delete.
          os.remove(r"{0}\tt.mseed".format(temp))
        print(r"http://{0}/data?channel={1}&from={2}&to={3}".format(sens
        or, channel, startUNIX, endUNIX))
        wqet.download(r"http://{0}/data?channel={1}&from={2}&to={3}".for
        mat(sensor, channel, startUNIX, endUNIX),
        r"{0}\tt.mseed".format(temp))
        st = read(r'{0}\tt.mseed'.format(temp), starttime=start,
        endtime=end, format='MSEED')
        print(st)
        st.plot()
        dataless =
        read inventory(r'http://{0}/DG.dataless'.format(sensor))
        ppsd = PPSD(st[0].stats, metadata=dataless)
        ppsd.add(st)
        ppsd.plot()
MAN-CER-0001
                               66 Issue Error! Reference source not found. - June,
```

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The following example in bash allows you to extract from the SD card the three seismic components at a given date and time, and specify the length of the miniSEED files. It then combines the three component in an individual miniSEED file, which name includes the network code, station code, start date and time :

```
#! /bin/bash
# Invoke with one argument: the IP address
set -x
# enter your network details
net code=DG
station code=04D67
location code=0L
# choose the day
day=2024-04-28
# choose the start time in 24-hours format (e.g. 16 = 4pm)
start hour=16
# choose the length of the miniSEED in hours (e.g. 1 = 1-hour-long
miniSEED)
step=1
utc=$(date --date ${day} +%s)
start utc=(expr \ utc + 3600 \ \ start \ hour)
end utc=$(expr ${start utc} + 3600 \* ${step})
echo $utc
echo $start utc
echo $end utc
wget -v -Oz component.mseed
http://$1/data?channel=${net code}.${station code}.${location code}
.HNZ\&from=${start utc}\&to=${end utc}
wget -v -On component.mseed
http://$1/data?channel=${net code}.${station code}.${location code}
.HNN\&from=${start utc}\&to=${end utc}
wget -v -Oe component.mseed
http://$1/data?channel=${net code}.${station code}.${location code}
.HNE\&from=${start utc}\&to=${end utc}
# Convert from Unix timestamp to date and time
date string=`date -d @${start utc} +'%Y.%m.%d-%H.%M.%S'`
# In this example, the 3-components miniSEED file will be named
"DG.04D67-2024.04.28-16.00.00.mseed"
cat z component.mseed n component.mseed e component.mseed >
${net code}.${station code}-${date string}.mseed
```

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### 7.10.8 Bulk data extraction

To view files saved on the external microSD card, remove the card as described in Section 3.1.5 on page 14. Insert the card into a microSD card reader (external or inbuilt) on your PC/laptop. Within a few seconds, the card should appear as a removable disk/drive.

A microSD card formatted for the Certimus contains many "hidden" files. They are created at format time with no contents and then renamed, unhidden and filled with data as required.

When viewing files in Windows Explorer, it may be helpful to configure your system so that "hidden" files are not shown. In Windows 10, this can be done by clearing the "Hidden items" check-box within the ribbon of Windows Explorer.

🕳   🗹 File	<mark>→</mark> <del>→</del>   Home	Share	View	Drive Tools Manage	Removable Disk (D:)					_	□ × ^ ?
Navigation pane •	🔲 Detail	Preview pane Details pane		arge icons icons	Large icons E Medium-sized icons		Sort	<ul> <li>Group by ▼</li> <li>Add columns ▼</li> <li>Size all columns to fit</li> </ul>	<ul> <li>☐ Item check boxes</li> <li>✓ File name extensions</li> <li>☐ Hidden items</li> </ul>	Hide selected items	Options
	Panes				Layout			Current view	Show/hide		
$\leftarrow \rightarrow$	· ↑ -	∎ → Thi	s PC → Rer	movable Disk	(D:)	<u>ــــــــــــــــــــــــــــــــــــ</u>			マ Ö Search Re	movable Disk (	(D:) ,0

### 7.10.9 The contents of the microSD card

The root directory of the disk contains seven items:

- a file named init.log. This "write-once" file contains the first 32 MiB of system log information since the card was last formatted;
- a file named system.log. This "re-use" file contains the last 64 MiB of the system log;
- a file named status.log. This "re-use" file contains the last 32 MiB of damps of system state of health information. A new dump is generated every 20 minutes.
- a disk image file which Güralp technical support may ask you to use if you have problems with the card;
- a file named table\_of\_events.bin. This is not human readable: it is used by the Seismic Events Table in the "Trigger" tab
- a directory named all\_miniSEED\_files\_are\_in\_here. Within this directory, there will be a miniSEED file for each recording channel. The file-name prefix is the same as the channel name description given in the "Data Record" tab. Each file is 128 MiB in size.

#### **Revision History**

🛖 Removable Disk (D	:)			- 🗆 ×		
$\leftarrow \rightarrow \cdot \uparrow \blacksquare$	> This > Removable D	isk (D:) 🗸 🗸	Search Removable Disk (D:) 🔎			
Name	^	Date modified	Туре	Size		
all_miniSEED_file	s_are_in_here	20/07/2016 03:00	File folder			
GU.dataless		20/07/2016 03:00	DATALESS File	4,608 KB		
use_this_file_with	_Win32Disklmager.exe_t	20/07/2016 03:00	Disc Image File	1,184 KB		
init.log		20/07/2016 03:00	Text Document	65,536 KB		
system.log		28/07/2016 03:00	Text Document	65,536 KB		
5 items						

The typical contents of the <code>all\_miniSEED\_files\_are\_in\_here</code> directory looks like this:

┃   📝 🔜 듖   all_miniSEED_files_are_in_here File Home Share View			×							
← → → ↑ 📙 « Removable Dis → all_miniSEED_file:	✓ ↑									
Name	Date modified	Туре	Size							
Sensor0AccelERou_0000000100_00013.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0AccelNRou_0000000100_00015.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0AccelZRou_0000000100_00017.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0HumidBRou_0000000010_00023.mseed	22/07/2016 09:14	MSEED File	131,072 KB							
Sensor0IntERough_0000000100_00007.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0IntNRough_0000000100_00009.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0IntZRough_0000000100_00011.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0MassPosER_000000100_00018.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0MassPosNR_000000100_00002.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0MassPosZR_000000100_00004.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor0TemprCRou_000000010_00021.mseed	22/07/2016 09:14	MSEED File	131,072 KB							
Sensor0VoltageRo_000000010_00022.mseed	22/07/2016 09:12	MSEED File	131,072 KB							
Sensor1AccelERou_0000000100_00006.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1AccelNRou_0000000100_00008.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1AccelZRou_0000000100_00010.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1IntERough_0000000100_00001.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1IntNRough_0000000100_00003.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1IntZRough_0000000100_00005.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1MassPosER_000000100_00012.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1MassPosNR_000000100_00014.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1MassPosZR_000000100_00016.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1VelocESmo_0000000200_00019.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1VelocNSmo_000000200_00020.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
Sensor1VelocZSmo_000000200_00000.mseed	22/07/2016 09:21	MSEED File	131,072 KB							
'4 items										

The file-name consists of four components:

 The stream name, truncated to 16 characters – see Section 11 on page 156 for a full list of these;

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- The sample rate, (in samples per second), as a ten-digit decimal number, leftpadded with zeroes;
- A number which functions as a counter to ensure unique name for all files. Each time a file is created, this number is incremented so that the next file to be created will use the next value; and
- The .mseed extension which identifies this as a miniSEED file.

The "Storage" tab also shows links to five auxiliary files, which are either saved in the Certimus' flash RAM or are dynamically generated:

Auxiliary files			
Filename	\$	Description	¢
DG.dataless	Datal	ess SEED file	
fram.log	FRAM	log file	
calvals.txt	SCREA	M! calibration values	
polezero.txt	SCREA	M! zeros, poles and gains	
calib.txt	Calib	ration text file	

- *network*.DATALESS: where *network* is the two-character Network code defined in the "Setup" tab (e.g. GU.DATALESS). This file is a Dataless SEED volume that contains meta-data including instrument responses, coordinates, compression type etc. The Dataless SEED volume is generated from the .RESP files for each channel;
- fram.log: FRAM log file (stored in FRAM);
- calvals.txt: calibration values in the format compatible with the Scream! Software package (dynamically generated);
- polezero.txt: poles, zeros and normalising factors in the format compatible with the Scream! software (dynamically generated);
- calib.txt: calibration text file with poles, zeros and gains expressed in hexadecimal (stored in FRAM);

### 7.10.10 Request data from microSD card

Discovery can be used as viewer of seismic data locally recorded in the microSD card of a Certimus.

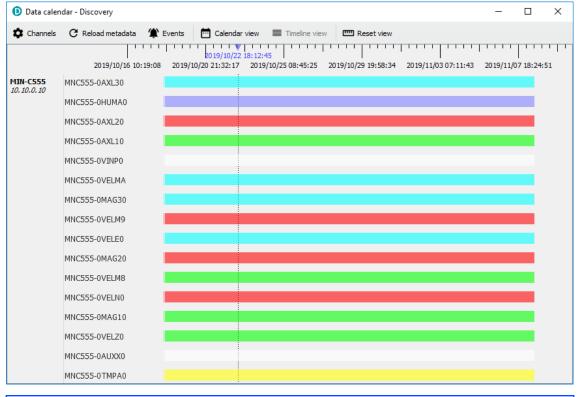
Select the Certimus of interested, right-click and choose "Data calendar view" to open the complete list of streams.

#### **Revision History**

#### Güralp Certimus

	iralp Systems - Edit View															
	Status	Label	System	Name	Firmware Ver		ddress	Uptime	Last Contact	Latitude	Longitude	Altitude	Timing quality			
9	0	SPRT-MIN	Minimus	MIN-C555	2.0-7548	10.	Contro	l Centre		51.3608	-1.1632	123.90	100			
9		SPRT-FMUS	Fortimus	FMUS-DE5B	2.0-7548	10.	Live View		•	1.3605	-1.1632	-12.34	0			
9	0	NO LABEL	Minimus	MIN-AF55	1.2-8707	10.				).0000	0.0000	0.00	0			
00		DEMO 83	Minimus	MIN-C456	2.0-7548	10.	-	n Configuration	n	51.3606	-1.1633	-12.34	0			
								alendar view								
								etwork Address :hange								
Scan Locally Registry 52.34.40.123						Show On Map View Web Page						aürald		5		
al	Systems						View W Calibra		stem browser)	-				0		

The calendar shows two weeks of data preceding the time when the request is sent and it includes all the available channels recorded in the microSD card, distinct by stream name and predefined colour.



**Note:** Any gap in the calendar view is symptom of a gap in the recorded data.

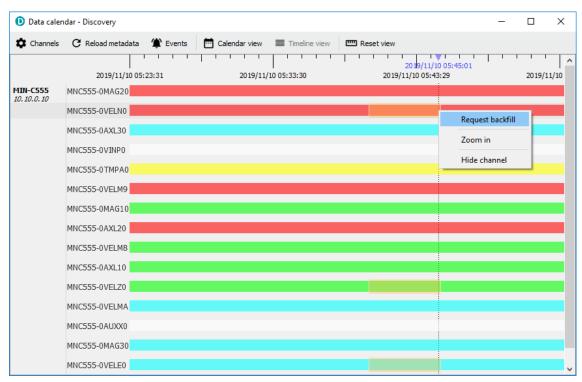
Use the mouse-wheel scrolling (or track- / touch-pad scrolling on a laptop) or highlight a portion of data, right-click and select "Zoom in" to zoom into the data.

Multiple channel are selectable using key

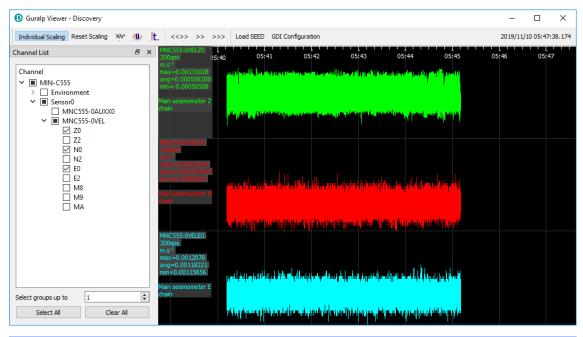
In Discovery, right-click on the Certimus of interest and select "Live View"  $\rightarrow$  "GDI" to open a data viewer window. Select the streams that are going to be backfilled with recorded data.

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In the calendar window select the portion of data to backfill into the viewer. Rightclick and select "Request backfill".



The requested data is automatically imported in the GDI data viewer in Discovery.





**Note:** The time required to upload the data depends on the window duration and the sample rate. Subsequent requests are queued and a new one is served once the previous one is completed.

# 7.11 Data transmission

The monitoring and configuration of transmitted data is handled using the "Data Stream" tab of the instrument's web page.

		M	V	güralp UNDERSTAND OPTIMISE PROTECT
				Fortimus
	Status Netw	vork Setup Trigger Data Str	eam Data Record Storage	Logout Help
		1 55		
	nus   Host label: SPI	RT-FMUS   Host name: FMUS-DE5B (10.	10.0.25)   Serial number: 00DE5B	
Data Stream			The "Disable All" and "Restore default"	1
Disable All Stream	ms	Restore default	button will ALSO affect settings of any other sensors	Reboot
Copy to Data Rec		"Copy to Data Record" will apply settings from this page to recording configuration of all of the sensors.		
Display Streams	All ~	Apply configuration for tap groups		Display On Page Sensor 0 🗸
Channels config	guration		·	
Channel sa	mpling rate	Data transform	SEED name - please use check-box to modify the default	RESPonse file - if available
		Seismic	channels	
0CAL0	200 Hz 🗸	Transforms Disabled for this tap $ \smallsetminus $	DG.TEST. 00 HCA	<u>RESP_file_5</u>
0ACCZ0	200 Hz 🗸 🗸	Transforms Disabled for this tap $ \sim$	DG.TEST. 00 .HNZ	<u>RESP_file_7</u>
0ACCN0	200 Hz 🗸 🗸	Transforms Disabled for this tap $ \smallsetminus $	DG.TEST. 00 . HNN	RESP_file_11
0ACCE0	200 Hz 🗸	Transforms Disabled for this tap $ \smallsetminus $	DG.TEST. 00 .HNE	RESP_file_15
0ACCZ2	5 Hz 🗸	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST.00 .MNZ	<u>RESP_file_8</u>
0ACCN2	5 Hz 🗸	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST. 00 .MNN	RESP_file_12
0ACCE2	5 Hz 🗸	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST. 00 .MNE	RESP_file_16
		MEMS accelero	meter channels	
0AXLZ0	100 Hz 🗸	Transforms Disabled for this tap $$	DG.TEST. 99 .HNZ	<u>RESP_file_25</u>
OAXLNO	100 Hz 🗸	Transforms Disabled for this tap $$	DG.TEST. 99 .HNN	<u>RESP_file_29</u>
0AXLE0	100 Hz 🗸	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST. 99 . HNE	RESP_file_33
			ter channels	
0MAGZ0	5 Hz 🗸	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST. 99 .MFZ	<u>RESP_file_37</u>
OMAGNO	5 Hz 🗸	Transforms Disabled for this tap $$	DG.TEST. 99 .MFN	RESP_file_39
0MAGE0	5 Hz 🗸	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TE ST. 99 .MFE	RESP_file_41

This page allows to configure the transmitted channels available in the Certimus.

The names and contents of each channel are described in Section 11 on page 156.



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**Note:** When changing a setting in the Certimus web page, ensure that you wait until the page refreshes before changing another setting. This allows time for the previous change to take effect.

The drop-down box at the top-left of the page named "Display Streams" filters out visible channels among Enabled and Disabled. The option "Apply configuration for tap groups" automatically apply the same configuration to three streams that belong to the same tap, e.g. 0ACCZ0, 0ACCN0, 0ACCE0.

The page is divided in four columns:

in most-left column, drop-down boxes are available for each channel to either select a sample rate or to exclude the channel from streaming (by selecting the

"Disabled" option). All streaming can be stopped by clicking the Disable All button. Same configuration can be applied to recorded channels by clicking the Copy to Data Record button. Default channel configuration can be applied by clicking the Restore default button.

- in second column from the left, drop-down boxes are available for each channel to enable/disable transforms and, once transform is enabled, to select the transform to apply (see Section 7.16 on page 94);
- in third column from left, Location and Channel SEED codes can be configured. Cells are greyed out by default (default values applied) and they can be edited by clicking on the check-box;
- in most-right column contains links to the RESP files associated to each of the seismic channels (see Section 7.14.5 on page 88).

Upon changing the sample rate, enabling a transform or changing Location and Channels codes, the Certimus will need to be restarted for the changes to come into effect; this can be done by pressing the **Reboot** button.

During the reboot, the LEDs will flash, displaying the starting-up sequence (see Section 3.1.2 on page 12) and the instrument web page will display the following screen.

# CERT-4D5C is rebooting ...

Once the Certimus has successfully restarted, the full web browser display and controls will be available for use again.

# 7.11.1 Scream! (GCF format + Scream protocol)

The Certimus can act as a Scream! Server and streams data by sending GCF (Güralp Compressed Format) packets over a network connection using the scream data transmission protocol.

This is primarily intended to support Güralp's Scream! Software (see Section 4.4.2 on page 33) or any software that can communicate using the Scream! Protocol, including SeisComP3.

These include:

- Güralp instruments with embedded acquisition modules (e.g. 40TDE)
- Güralp DM24 and CD24 digitisers with embedded acquisition modules (e.g. Güralp DM24SxEAM[U])

- Affinity digitiser
- Network Acquisition Module (Güralp NAM)

Data can also be received by software that can communicate using the Scream! Protocol, including SeisComp3 and Earthworm.



**Note:** Güralp devices running the Platinum software *can* receive GCF data over the Scream protocol, but the GDI-link protocol is preferred in these cases.

# 7.11.2 GDI-link protocol

The Certimus can also transmit data using the GDI-link protocol. GDI-link can currently be used with:

- Güralp instruments with embedded acquisition modules (e.g. 40TDE)
- Güralp DM24 and CD24 digitisers with embedded acquisition modules (e.g. Güralp DM24SxEAM[U])
- Güralp Affinity digitisers
- Güralp NAM (Network Acquisition Module)
- Earthworm software (www.isti.com/products/earthworm/)

GDI-link supports both data push and pull from/to the Certimus. See Section 7.6 on page 54 to configure data push to one or more remote clients, e.g. NAM.

GDI-link provides a highly efficient, low latency method of exchanging data via TCP between seismic stations and data centres. The protocol allows state-of-health information to be attached to samples during transmission. A receiver can accept data from multiple transmitters, and a single transmitter can send data to multiple receivers, allowing maximum flexibility for configuring seismic networks. GDI-link streams data sample-by-sample (instead of assembling them into packets) to minimise transmission latency.

A significant advantage of GDI-link is that it has the ability to stream data preconverted into real physical units instead of just as raw digitiser counts, obviating a requirement for receivers to be aware of calibration values.

For more information on GDI-link, please refer to Güralp manual **SWA-RFC-GDIL**. A sample GDI receiver in source code form is available on request.

## 7.11.3 SEEDlink protocol

The Certimus can act as a SEEDlink server to send miniSEED data packets over a network connection. The SEEDlink server is enabled by default but it can be disabled and re-enabled if desired. The server has a configurable back-fill buffer.



Note: The Certimus SEEDlink back-fill implementation is packet-based.

CertimusIn the "Network" tab of the Certimus web page, select the desired SEEDlink mode.

Network Co	nfig						
DHCP	Enabled $\sim$						
DNS1 209.24	14.0.3	DNS2 84.200.69.80				Reboot	
Web Login	Required $\sim$	Username (Normal)	user	Password (Normal)	******	HTTP Port	80
Web Timeout	Never $\checkmark$	Username (Admin)	admin	Password (Admin)	******		
	nabled, 65536 records 🗸	Send status.txt Every 300	seconds	SeedLink Data Packet Format	Optimal ~	Send SeedLink EEW Packet Every	0 deciseconds
TFTP Server	isabled	TFTP File					
Network	ebug, 512 records						
PTP De	ebug, 2048 records	PTP Offset				1	
Mode Disa De	ebug, 65536 records	Correction 0	nanoseconds	PTP Transmission Mode	Multicast $$		
NTP Server De	ebug, 139264 records					-	
Registry De	ebug, 622592 records						
	nabled, 2048 records	0		Registry			
Registry Upd Er	nabled, 65536 records	Group ID		Address 52	.34.40.123		
Tunnel (p	nabled, 139264 records						
LNS url Er	nabled, 622592 records	LNS Username		LNS Password		Start Test	

The choices are:

- "Enabled" This is the normal operating mode. Choose between backfill buffer sizes of 2,048 records, 65,536 records, 139,264 records or 622,592 records;
- "Disabled" turns off the SEEDlink server; and
- "Debug" this mode produces additional messages in the *seedlink.log*. which may be helpful if trying to diagnose a problem. It is available with backfill buffer sizes as before and, additionally, 512 records.



**Note:** As a general guide, we find that 139,264 records is normally sufficient to store around one day of triaxial, 100 sps data.

Standard SEEDlink has a fixed packet size of 512 Bytes and each miniSEED packet is completely populated with data before it is transmitted. The Certimus supports a modified version of SEEDlink that allows the transmission of incomplete packets. This improves latency.



**Note:** The modified SEEDlink is only available for EEW channels - i.e. the main seismic channels (generated with causal low latency filters) and the STA, LTA, STA/LTA ratio channels.

The user can specify the rate at which miniSEED packets must be transmitted. If populating complete packets would result in this rate not being achieved, incomplete packets are transmitted instead. The number of samples in each packet, therefore, depends both upon this setting and on the sample rate.

In the "Network" tab of the Certimus web page select the interval in deciseconds (1 decisecond = 100 ms or 0.1 seconds) between miniSEED packets.

Network Config			
DHCP Enabled ~			
DN S1 209.244.0.3	DNS2 84.200.69.80		Reboot
Web Login Required 🗸		Password ******** (Normal)	HTTP Port 80
Web Timeout Never 🗸		Password (Admin)	
SeedLink Enabled, 65536 records 🗸	Send status.txt Every 300 seconds	Packet Format	Send SeedLink EEW Packet 10 deciseconds Every
Data Record Size 512 Bytes 🗸	TFTP Server 10.30.255.197	TFTP File	

The modified SEEDlink protocol also allows the use of 256-byte records as an alternative to the standard 512-byte format. The "Data Record Size" drop-down menu on the "Network" tab of the Certimus web page controls this behaviour.



**Note:** Not all SEEDlink clients can accept 256-byte records. Consult your client's documentation if in doubt.

Network Config				
DHCP	Enabled $\sim$			
DNS1 209.244.0.3		DNS2 84.200.69.80		Reboot
Web Login	Required ~	Username (Normal) User	Password ******** (Normal)	HTTP Port 80
Web Timeout	Never ~		Password (Admin)	
SeedLink Enabled, 65			SeedLink Data Packet Format Optimal ~	Send SeedLink EEW Packet 10 deciseconds Every
Data Record Size	512 Bytes 🗸	IFTP Server 10.30.255.197	TFTP File	
Network Timing	512 Bytes			
РТР	256 Bytes	PTP Offset	РТР	

To test the SEEDlink server, Güralp recommends using the *slinktool* software for Linux, which is distributed by IRIS. For more information and to download a copy, see http://ds.iris.edu/ds/nodes/dmc/software/downloads/slinktool/.

To show a list of available miniSEED streams, issue the command:

#### slinktool -Q IP-Address

which produces output like the following:

DG	TEST	00	CHZ	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	01	HHZ	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	00	CHN	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	01	HHN	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	00	CHE	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	01	HHE	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	00	MHZ	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	00	MHN	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
DG	TEST	00	MHE	D	2016-09-13	10:42:18	-	2016-09-13	10:46:56
÷									

To print miniSEED data records of a single channel, you will need the following command:

#### slinktool -p -S DG TEST:00HNZ.D IP-Address

which produces the following output:

```
DG_TEST_00_HNZ, 412 samples, 100 Hz, 2016,257,10:43:42.000000
(latency ~2.9 sec)
DG_TEST_00_HNZ, 415 samples, 100 Hz, 2016,257,10:43:46.120000
(latency ~2.6 sec)
DG_TEST_00_HNZ, 416 samples, 100 Hz, 2016,257,10:43:50.270000
(latency ~3.0 sec)
DG_TEST_00_HNZ, 413 samples, 100 Hz, 2016,257,10:43:54.430000
(latency ~2.6 sec)
DG_TEST_00_HNZ, 419 samples, 100 Hz, 2016,257,10:43:58.560000
(latency ~3.0 sec)
DG_TEST_00_HNZ, 418 samples, 100 Hz, 2016,257,10:44:02.750000
(latency ~2.6 sec)
DG_TEST_00_HNZ, 418 samples, 100 Hz, 2016,257,10:44:02.750000
(latency ~2.6 sec)
DG_TEST_00_HNZ, 415 samples, 100 Hz, 2016,257,10:44:06.930000
(latency ~3.0 sec)
```

The SEEDlink server on the Certimus also supports the use of the "?" character as a wild-card within network, station and channel codes. This allows you to request multiple streams using a single command.



**Note:** Because the '?' character has special meaning to the shell, it is safest to quote this character with a preceding backslash ('\') when used in command arguments.

# 7.11.3.1 MiniSEED extractor

E	Edit View Help										
	Data Viewer CAP Receiver	tem	Name	Firmware Ver	LAN Address	Uptime	Last Contact	Latitude	Longitude	Altitude	Timing qualit
2	Add Device	imus	FMUS-DE5B	2.0-7548	10.10.0.25	00:10:05	Just Now	51.3605	-1.1632	-12.34	0
2	miniSEED Extracto	or mus	MIN-AF55	1.2-8707	10.10.0.6	6 days 6 Hrs	Just Now	0.0000	0.0000	0.00	0
2	Power board con Sonardyne Debug	mus	MIN-C456	2.0-7548	10.10.0.17	00:16:36	Just Now	51.3606	-1.1633	-12.34	0
9]	SPRT-M	N Minimus	MIN-C555	2.0-7548	10.10.0.10	01:00:01	Just Now	51.3606	-1.1632	120.80	100
Scar	n Locally Registr	γ 5	2.34.40.123							g	üralþ

The miniSEED extractor serves two purposes:

- When an SD card is quick-formatted, each file is marked as unused but previously recorded data can still remain in them. Subsequent recordings overwrite these files from the beginning but, if the previous recording had a longer duration, old data will remain in the files. When the files are copied from the SD card to a PC, these older data can cause problems.
- The format used on the SD cards consists of fixed-length, 128 MiB files. Some recordings might not use all of this space. When the files are copied from the SD card to a PC, this can cause wasted disk space.

The miniSEED extractor reads miniSEED files on the PC and copies them to a selected Destination folder, keeping track of the latest block time-stamp as it goes. If it encounters either an unused block or a time-stamp which is earlier than the previous one, it stops copying, truncating the output file at that point. This guarantees that each output file contains only blocks in time order and contains no wasted space.

D miniSEED Extractor -	Dis — 🗆 🗙						
Choose Files to Process	Browse						
Select Destination Folder	Browse						
Gap Search Trim F	-iles Close						

To use the tool, select "miniSEED Extractor" from the Edit menu. Click the first
Browse button to select which files you wish to process and then the
second Browse button to select the folder into which you wish the

output files to be written. Finally, click the Trim Files button to extract the valid data from the selected files into new files in the selected destination folder.

The same tool can also generate a report of any gaps in the data from the input files. To use, select the input files as before and then click Gap Search to view the report.

# 7.12 Synchronisation of the sample-clock

The Certimus system synchronises its sample clock using an attached GNSS receiver or, if that is not available, Precision Time Protocol (PTP).

The currently supported GNSS systems are Navstar (GPS), GLONASS, BeiDou and Galileo.



**Note:** The GNSS can use only three different types of satellites simultaneously and GPS is always used, if available. The other two spots available can be either GLONASS, BeiDou or Galileo.

If visibility of the satellite constellation is available, this is the most accurate way to synchronise your digitiser. The Certimus accessory pack includes a combined GNSS antenna and receiver for this purpose: see Section Error: Reference source not found on page **Error! Bookmark not defined.** for details.

## 7.12.1 GNSS lock status

This is available in the "Status" tab of the instrument's web page.

A number of GNSS reporting parameters are given, including:

- Connection status
- Last GNSS update (sync) & last GNSS lock date/time
- GNSS Stability:
  - 0% = no receiver connected;
  - 1% = receiver connected, but waking up (this can occur if the GNSS receiver has been moved a long distance since last power-up).
  - 2-99% = view of sky obstructed.
  - 100% = normal operation with clear view of sky
- Latitude, longitude, altitude
- Horizontal dilution of precision (quality of satellite fix due to position of satellites relative to receiver)

- GNSS PPS status
- GNSS NMEA streaming
- GNSS lock state (2D/3D)
- Number of available satellites (in use / in view)

							PTIMISE	
							Certimu	
	Status Ne	twork Setup Ti	inner Dete S	Data Dacard	Starses	anin Haln		
	Status Ne	twork Setup Ti	rigger Data S	ream Data Record	Storage I	Login Help		
System type: Certim	us i Host label: NO	) LABEL   Host name: (	CERT-AE5C (10.30	.0.39)   Serial number: 0	OAE5C			
System Status								
System Status			Conoral i	nformation				
Host name	CERT-AF5C	Host label	NO LABEL	System type	Certimus	Product type	Certimus	
					10.30.0.39	SEED network and	DG.0AF5C	
Serial number	00AF5C	Firmware version	2.1-28	IPv4 address	(DHCP)	station	(No site)	
Digitiser temperature	e 27.539 °C	Digitiser humidity	30.19%	Input voltage	15.200 V	Power over Etherne voltage	<sup>t</sup> 0.000 V	
System time	11:19:34 AM Fri 14-Feb-2020	Uptime	2d 27m 1s	ETH status	sckt: 10/20 data: 0/6			
			GNSS	Status				
GNSS connection status	Connected d	Last timestamp	2020-02-14 11:22:05	ALLAN NY		A DAVI		
Last lock time	2020-02-13 01:26:10	GNSS stability	100%	+	th Wessex	LILA	London	
Latitude	51.3608	Longitude	-1.1635		Downs AONB	MAK	AXA	
Altitude	114.2	Horizontal dilution of precision	0.86	and the	TA-	E KO	REAL	
GNSS PPS status	Trusted Pulsing	GNSS NMEA stream	Input OK		DAG			
		Number of satellites	Used: 10	18 1 1 1	Repo	rt a problem   © OpenStre	etMap contributo	
GNSS Lock state	3D locked	number of satellites	In view: 14					
GNSS Lock state	3D locked	number of satellites		ord status				
	3D locked Recording	microSD total	Data rec 60686336 KiB	microSD used	4318916 KiB	microSD free	92%	
microSD status			Data rec 60686336 KiB		4318916 KiB	microSD free	92%	
microSD status Number of sensors			Data rec 60686336 KiB	microSD used	4318916 KiB	microSD free	92%	
microSD status Number of sensors	Recording 2	microSD total	Data rec 60686336 KiB	microSD used	4318916 KiB	microSD free	92%	
microSD status Number of sensors detected	Recording 2		Data rec 60686336 KiB	microSD used		microSD free	<b>92%</b>	
microSD status Number of sensors detected	Recording 2	microSD total Serial number (0)	Data rec 60686336 KiB Ser	microSD used sors Firmware ver (0)	0.1			
microSD status Number of sensors detected	Recording 2 pr0	microSD total Serial number (0) Integrator Z (0)	Data rec 60686336 KiB Ser 0	microSD used ISOTS Firmware ver (0) Integrator N (0)	0.1 0	Integrator E (0)	0	
microSD status Number of sensors detected Senso	Recording 2 pr0	microSD total Serial number (0) Integrator Z (0) Seismometer Z (0)	Data rec 60686336 KiB Ser 0	microSD used ISOTS Firmware ver (0) Integrator N (0) Seismometer N (0)	0.1 0 0	Integrator E (0) Seismometer E (0)	0	
microSD status Number of sensors detected Senso	Recording 2 pr0	microSD total Serial number (0) Integrator Z (0) Seismometer Z (0) Serial number (1)	Data rec 60686336 KiB Ser 0 0	microSD used sors Firmware ver (0) Integrator N (0) Seismometer N (0) Firmware ver (1)	0.1 0 0 0.1 -1.878°	Integrator E (0) Seismometer E (0) Temperature (1)	0 0 33.83 °C	
microSD status Number of sensors detected Senso	Recording 2 pr0	microSD total Serial number (0) Integrator Z (0) Seismometer Z (0) Serial number (1) Yaw (1)	Data rec 60686336 KiB Ser 0 0	microSD used ISOTS Firmware ver (0) Integrator N (0) Seismometer N (0) Firmware ver (1) Pitch (1)	0.1 0 0 0.1 -1.878°	Integrator E (0) Seismometer E (0) Temperature (1)	0 0 33.83 °C	

# 7.12.2 **Precision Time Protocol (PTP)**

#### The Certimus system supports timing provided through PTP.

		M	Mmm		— ç	güralp   UN OF PR	iderstand Ptimise Otect		
							Certimu		
	Status Net	twork Setup Trig	ger Data Stre	am Data Record	Storage L	ogin Help			
	s   Host label: NC	) LABEL   Host name: CE	RT-AF5C (10.30.0.	39)   Serial number: 00/	AF5C				
System Status									
		•	General info	ormation					
Host name	CERT-AF5C	Host label	NO LABEL	System type	Certimus	Product type	Certimus		
Serial number	00AF5C	Firmware version	2.1-28	IPv4 address	10.30.0.39 (DHCP)	SEED network and station	DG.0AF5C (No site)		
Digitiser temperature	27.539 °C	Digitiser humidity	30.19%	Input voltage	15.200 V	Power over Etherner voltage	<sup>t</sup> 0.000 V		
System time	11:19:34 AM Fri 14-Feb-2020	Uptime	2d 27m 1s	ETH status	sckt: 10/20 data: 0/6				
		-	GNSS S	tatus					
GNSS connection status	Disconnected	Last timestamp	0000-00-00 00:00:00						
Last lock time	Never	GNSS stability	Disconnected	+					
Lastitude	-59.9	Longitude	92.625						
Altitude	-12.34	Horizontal dilution of precision	Undefined	1 - Q					
GNSS PPS status	Not Trusted No Pulse	GNSS NMEA stream	Bad input	1					
GNSS Lock state	No lock	Number of satellites	Used: 0 In view: 0		Repor	t a problem   © OpenStree	etMap contributo		
			PTP St	atus					
PTP state	Phase Locked	Last PTP timestamp	2020-02-14 11:19:33Z	Last PTP lock time	2020-02-14 06:04:56Z	PTP stability	100%		
Master IPv4 address	10.30.255.35	Master clock class	PRI_REF_PTP	Master clock accuracy	< 100ns (0x21)	Master time source	GPS		
Network path delay	38.3 us	Network jitter estimate	± 511 ns	Network outliers	4%				
			Data recor	d status					
microSD status	Recording	microSD total	60686336 KiB	microSD used	4318916 KiB	microSD free	92%		
			Senso	ors					
Number of sensors detected	2								
Senso	r0	Serial number (0)		Firmware ver (0)	0.1				
		Integrator Z (0)	0	Integrator N (0)	0	Integrator E (0)	0		
		Seismometer Z (0)	0	Seismometer N (0)	0	Seismometer E (0)	0		
Sensor	r1	Serial number (1)		Firmware ver (1)	0.1	Temperature (1)	33.83 °C		
		Yaw (1)	40.343°	Pitch (1)	-1.878°	Roll (1)	-1.987°		
		Orientation (1)		0.9452 -0.02X -0.0	1Y -0.34Z				
		Integrator Z (1)	-2469	Integrator N (1)	20494	Integrator E (1)	542		
		Seismometer Z (1)	-44271	Seismometer N (1)	-18753	Seismometer E (1)	72787		
		Tel: +	44 118 981 9056, F	ns Limited haston, Reading, RG7 8EA, ax: +44 118 981 9943 h. support@guralp.com	UK				

The IEEE 1588 Precision Time Protocol (PTP) is a network protocol which uses modified network hardware to accurately time-stamp each PTP packet on the network at the time of transmission, rather than at the time that the packet was assembled. If you do not have an existing PTP infrastructure, the simplest way to use PTP is to add a "grand-master clock" to the same network segment as the digitisers. A typical such clock is the Omicron OTMC 100, which has an integrated GNSS antenna and receiver which it uses as its own synchronisation source. PTP timing can be extended over up to 100 metres of Ethernet cable or longer distances when fibre-optic cable is used. PTP is significantly more accurate than NTP but generally requires specialised hardware support.

In the "Status" tab of the Certimus web page, a number of reporting parameters are given, including:

- PTP state
- Last PTP time-stamp and last PTP lock date/time
- PTP Stability:
  - Standby  $\Rightarrow$  PTP is running but timing is provided by GNSS;
  - No Master  $\Rightarrow$  PTP not available;
  - 1-100% ⇒ PTP locking process indicator. 100% indicates a time accuracy of better than 200 ns.
- Master IPv4 address
- Master clock class and accuracy
- Master time source
- Network path delay
- · Network jitter estimate: quality indicator
- Network outliers

Under the heading "Network config" are four options:

- **Disabled** ⇒ PTP is never used (default settings).
- **Run if needed Offline backup** ⇒ PTP is automatically enabled whenever the GNSS signal is lost. It is disabled while GNSS is available. This mode is used to minimise network traffic when GNSS is the primary timing source.
- **Run always Online backup** ⇒ PTP is always running but GNSS is used as the primary timing source. This mode is useful for faster fall-back from GNSS to PTP timing and for validation that PTP is available.
- **Run always Override GPS** = PTP is always running and takes priority over GNSS. This mode is useful in a system where PTP is the primary timing source, but GNSS may occasionally be connected for validation purposes.

Netw	ork Timing						
PTP Mode	Run always - Override GPS 🗸	PTP Offset Correction	0 nanoseconds	PTP Transmission Mode	Unicast 🗸	PTP Master IP	0.0.0.0
NTP Se	Run if needed - Offline backup						
Regi	Run always - Online backup						
Regist	Run always - Override GPS	Group ID		Registry Address	52.34.40.123		

PTP can be configured for multicast or unicast mode. In unicast mode, the server I.P. address must be specified. This is available in the "Network" tab of the digitiser's web page.

Network Timing			
	Correction 0 nanoseconds	PTP Transmission Unicast V Mode Multicast	PTP Master IP 0.0.0.0
NTP Server Pool ~		Unicast	

# 7.13 Deploy modes:

The Certimus digitiser offers a number of deployment modes: "Normal" and "Full Power Save", "GPS power-save", "LAN Power Save", "LAN & GPS Power save" mode makes a number of configuration changes in order to reduce the unit's power consumption.

The desired mode can be specified using the "Deploy mode" drop-down menu in the "Setup" tab of Certimus web page. Changes are not applied immediately.

			~~~~~	Mm	····		- •	güralþ	UNDERSTAND OPTIMISE PROTECT
									Certimu
	Status I	Network Se	tup Power	Trigger	Data Stream	Data Record	Storage	Logout F	leip
	Status	Network Se	tup Fower	nigger	Data Stream	Data Record	Storage	Logout	icip
		label: FIXED PL	ATE TEST TIN	Host name:	CERT-4D5C (10.30.0	).15)   Serial numb	er: 004D	5C	
Digitiser Co	ontrols								
Rebo	ot				Reset All Set	tings		The "Reset All Set affect settings on	tings" button will ALS other pages
Digitiser Co	onfig								
Auto Refresh		1	Auto Reboot	Never	<ul> <li>Low Latency Mod</li> </ul>	e Balanced	~	Filter quality	High 💊
Host Label	FIXED PLATE	TEST TIN	Station Code	BOLLO	Network Code	DG		Site Name	No site
SeedLink SOH	Location Code	00	Bluetooth PIN	0000	Bluetooth	Enat	oled 🗸		
Deploy Mode	Normal	~	Deploy		Flush to SD			Stop Recording	
Normal:	Normal Full Power S	21/0	System Rese	t					-
Normal deploy	me GPS Power S	Save							
	LAN Power S GPS & LAN F								
Full Power Sav	e:								
data recording	and related funct	tionalities are							
available - usua	ally used for OBS	ies).	Dip	0	Azimuth	0		Depth	0
GPS Power Sav	/e:								
GPS gets conti	nuously switched	d off for a			Selection				
powered after o	o save power. GF controlled period	of time to re-			Sensor Selector	1		Sensor Selected	1 of 1
adjust to pulse	per second edge				entification				
LAN Power Sav	/e:		Serial Number	61020 (0xee5c)	Firmware	1.2-392		Configuration	unknown
LAN connectio	n gets permanen	tly switched			Response				
off.					Contring				

The final step is to click on the Deploy button and confirm or cancel the operation from the pop-up window that appears.

Digitizer Control	Digitizer Controls								
Reboot			Reset All Settings			The "Reset All Settin ALSO affect settings			
Digitizer Config	_								
Auto Refresh	1	Auto Reboot			~				
Host Label	SPRT-MIN	Station Code	System is about to	be deployed. Are you sure?	DG	Site Name	No site		
Bluetooth PIN	0000	Bluetooth			ligh 🗸				
Deploy Mode	Power Save $\smallsetminus$	Auto Center							
Applied Rotation	1			OK Cancel					
Analogue 0	0 °								
Digital 1	° 0	Digital 2	0 °	Digital 3	0 °	Digital 4	0 °		
Digital 5	0 °	Digital 6	0 °	Digital 7	0 °	Digital 8	0 °		

A thirty-second count-down will start before the system enters power-save mode. The screen changes and a new button is added:

Digitizer Control	ls						
Reboot				Reset All Settin	gs	The "Reset All Setti ALSO affect setting	
Digitizer Config				-			
Auto Refresh	1	Auto Reboot	On Error $\smallsetminus$	Low Latency Mode	Balanced	~	
Host Label	SPRT-MIN	Station Code	TEST	Network Code	DG	Site Name	No site
Bluetooth PIN	0000	Bluetooth	Enabled $\lor$	Filter quality	High	~	
Deploy Mode	Power Save $ \smallsetminus $	Auto Center Disable(I	nr) 12	Deploy		Abort deployment	
You can abort deployment within	28s						

You can cancel the operation before the countdown is complete by clicking the Abort deployment button.

**Caution:** The power-save mode will disable the Ethernet and GNSS modules. You will not be able to continue to use the web interface.

Once in deploy mode, the only way to re-enable the Ethernet module is to connect to the Certimus via a serial connection (see Section 10 on page 147) or to use the GüVü Bluetooth app (see Section Error: Reference source not found on page **Error! Bookmark not defined**.) or to apply power by Power Over Ethernet (PoE)

When a serial or Bluetooth connection is established, type the command **powersave off** in the console to disable the "Full power-save" mode and re-enable Ethernet communication.

### 7.13.1 Full Power Save

This mode achieves the lowest power consumption with some compromises in functionality. The sample rates and channels that are recorded are fixed. 250 sps for the seismic channels and lower rates for other data. There are alternative taps (Fixed rate taps) that perform the decimation and record function which are marked as "..FR" in the record tab.

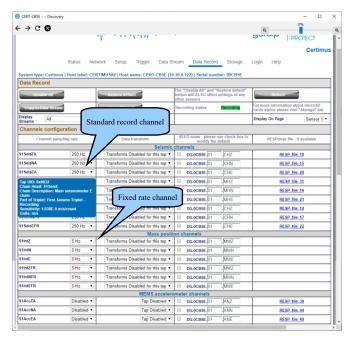
The entire digitiser remains shutdown for the majority of the time so no Ethernet, web page or serial port are available. The system periodically wakes up to copy data to the two SD cards.

The data calendar view function mentioned elsewhere in this manual relies on the streaming sample rate being the same as the record rate. If this function is required the streaming rate must be set to 250 sps for the seismic channels.

The record TAB on the WEB interface shows both FR channels and the standard record channels. The FR channels are written during the wakeup cycles of the Full Power Save mode. The standard record channels are used whenever the system if full running. The two never overlap so enabling both FR and standard channels is normal practice. It is the choice of deployment mode that dictates which is used.

Note: once deployed in Full Power Save mode the full digitiser will not power up other than to offload data periodically. To switch a system out of full power save mode power must be applied over the Ethernet connection (PoE).

The application of PoE causes the system to boot in full mode. Access to the WEB page is possible at this point so the power modes can be reset.



# 7.14 Configuration and control of the seismometer

## 7.14.1 Seismometer

The long period corner of the instrument can be set from the WEB setup page. Choice of 1 second, 10seconds or 120Seconds

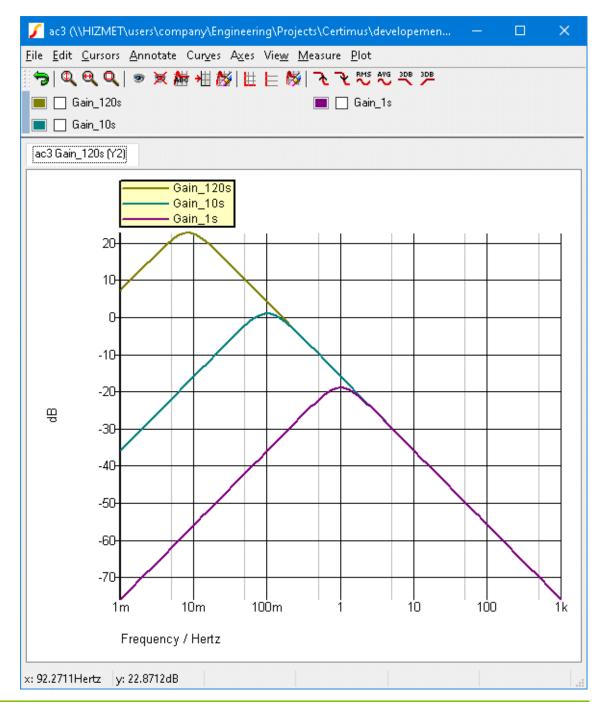
The clip level of the instrument is varies with frequency. The highest gain of the instrument is at the long period corner frequency. The gain of the instrument steadily reduces as the frequency increases. The output is therefore considered to be proportional to the ground Velocity.

Changing the long period corner will have the effect of changing the instruments clip level.

This can be helpful in an environment that is not stable – such as large temperature variations between night and day or soft ground such as volcanic ash or water-logged ground. The instrument may tilt under these conditions. A shorter period corner may help by avoiding repeated centring or clipping.

The graph below, shows the relative gain of the sensor against frequency for the 3 different long period corner settings.

### **Revision History**



### 7.14.2 Sensor centring

The Certimus seismometer automatically centres when it is powered up. To manually re-centre click on "Re-centre" button under the "Digital Sensors" section in the Setup tab.

The Automatic centring function can be disabled – select "Centring Mode" to off. This is NOT normally recommended. The automatic centring operation is performed once the mass has moved beyond normal operating range. Failure to recentre at this point will result in compromised data.

### **Revision History**

### Güralp Certimus

Digital Sensors									
	Selection								
Initialisation	Complete			Sensor Selector	1	Sensor Selected	1 of 1		
			Ider	ntification					
Model	Certimus	Serial Number	61020 (0xee5c)	Firmware	1.2-392	Configuration	unknown		
			Re	esponse					
Response period	120s 🗸								
			С	entring					
Centring Status Z	unknown	Centring Status N	unknown	Centring Status E	unknown	Centring Mode	Auto 🗸		
Re-centre									

# 7.14.3 Output polarity

Direction of ground acceleration	Polarity of Z output	Polarity of N/S output	Polarity of E/W output	
Upwards	positive	zero	zero	
Downwards	negative	zero	zero	
Northwards	zero	positive	zero	
Southwards	zero	negative	zero	
Eastwards	zero	zero	positive	
Westwards	zero	zero	negative	

The polarity of output from each component of the instrument is as follows:

If the ground accelerates northwards, this moves the casing of the instrument northwards and the N-axis inertial mass is left behind. From the instrument's frame of reference, the mass appears to have been deflected southwards. The feedback system then needs to provide a balancing force to accelerate it northwards and this, by design, will result in a positive output signal from the N/S component.

If the instrument is mounted with the 'N' arrow pointing downwards, gravity will try and pull the inertial mass in the direction of the instrument's N-axis. The feedback system then needs to provide a balancing force to accelerate it upwards which, from the instrument's frame of reference, is now southwards. This is the opposite of the situation described above, so the output from the N/S component will now be negative.

The converses are also true: if the ground accelerates southwards, the instrument will produce a negative output signal from the N/S component and if the instrument is orientated with its 'N' arrow pointing upwards, it will produce a positive output signal from the N/S component

## 7.14.4 Instrument Response Verification

Instrument response can be verified by exciting the instrument with a signal and measuring its response. There is a signal generator built in to the system which can

generate a number of different signals. For measuring the frequency response, Güralp recommends the use of white noise. This signal contains equal quantities of all frequencies. By looking at the frequency content of the instruments output, the transfer function of the instrument can be plotted. This plotting function can be performed in Discovery.

Turn on the white noise by enabling "Cal-Mode"

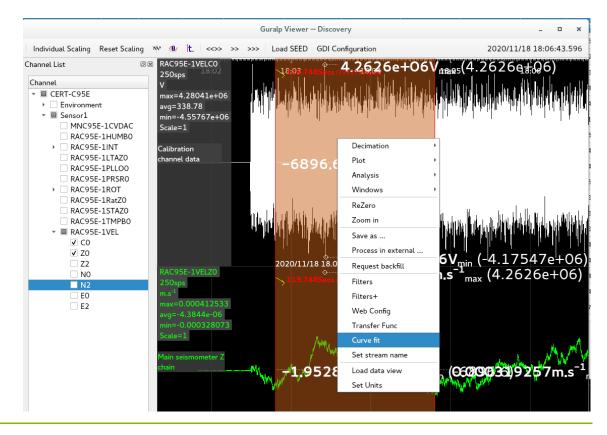
Digital Sensors									
	Selection								
Initialisation	Complete			Sensor Selector	1	Sensor Selected	1 of 1		
			Ider	tification					
Model	Radian Broadband	Serial Number	52058 (0xcb5a)	Firmware	1.2-98	Configuration	unknown		
Response									
Response period	120s 🔻								
			C	entring					
Centring Status Z	Ended (Auto- centring On)	Centring Status I	N Electrical	Centring Status E	Electrical	Centring Mode	Auto 🔻		
Re-centre									
Calibration									
Cal Mode	Off ▼								

While the calibration is in progress, the webpage shows the warning message

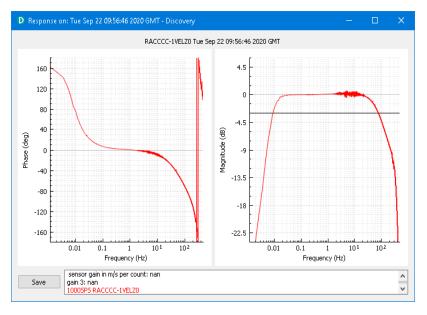
	DEMO 253 Fortimus FMU	S-DA5B	2.0-				
٩	This system is now operating in calibration mo	de	.2-				
٩	System: ACTIVE		.0-				
Ø	Timing: <b>Error</b> (GNSS Error., PTP Error., PPS Error.)						
	Storage: <b>OK</b> (Storage OK., <b>Storage free space is in GREEN zo</b> space: 99.67%, Available space: 60686336KiB, U 199308KiB)		:				

Calibration in progress and Discovery flags the status icon in yellow.

### **Revision History**



## 7.14.5 Instrument response parameters



Calibration is a procedure used to verify or measure the frequency response and sensitivity of a sensor. It establishes the relationship between actual ground motion and the corresponding output voltage. Calibration values, or response parameters, are the results of such procedures.

Response parameters typically consist of a sensitivity or "gain", measured at some specified frequency, and a set of poles and zeroes for the transfer function that

expresses the frequency response of the sensor. A full discussion of poles and zeroes is beyond the scope of this manual.

The gain for a seismometer is traditionally expressed in volts per ms<sup>-1</sup> and, for an accelerometer, in volts per ms<sup>-2</sup>. Other instruments may use different units: an electronic thermometer might characterise its output in mV per °C.

A calibration procedure is also used to establish the relationship between the input voltage that a digitiser sees and the output, in counts, that it produces. The results are traditionally expressed in volts per count. Each Certimus is programmed at the factory so that it knows its own calibration values.

To explore the calibration values of the Certimus' sensor and digitiser, right-click the Certimus in Discovery's main window and select "Calibration"  $\rightarrow$  "Calibration Editor". The resulting screen is shown here shortened:

nsor0 Sensor1					
ettings					
nstrument serial nun	iber:				
Allow values to be	e overwritten by uSoH fitted	analogue sen	sor	Ve	locimeter
Component Z Co	mponent N Component I	E Compor	nent X Mass Z I	Mass N Mass E Calibration cha	annel
Parameters					
🗹 Digitizer Volt	s per count 1.49012e-07	7	V per co	unt	
🗹 Analogue In	strument Gain 526.25		V per p	pico	
ADC Offset	nan		counts		
Coil constant			A/m/s <sup>2</sup>		
Calibration r	esistor nan		Ω		
Response					
Normalizing	factor 9.5551002e+08		V per coun	t	
Poles (Hz)					
Pole 0	-0.0058925599	+ i*	-0.0058925599	Hz	
Pole 1	-0.0058925599	+ i*	0.0058925599	Hz	
Pole 2	-200	+ i*	nan	Hz	
Pole 3	-82	+ i*	210	Hz	
Pole 4	-82	+ i*	-210	Hz	
Pole 5	nan	+ i*	nan	Hz	
Pole 6	nan		nan	Hz	
Pole 7	nan		nan	Hz	
Pole 8	nan		nan	Hz	
✓ Pole 9 Pole 10	-94 nan	+ i* + i*		Hz	
Pole 10	nan	+1-	nan	HZ	
Zeros (Hz)					
Zero 0	0	+ i*	nan	Hz	
Zero 1	0	+ i*		Hz	
Zero 2	nan	+ i*		Hz	
Zero 3	nan	+ i*		Hz	
Zero 4	nan	+ i*		Hz	
Zero 5	nan	+ i*	nan	Hz	
Component configu					
ystem calibration va					
			All	<ul> <li>Export to file Import</li> </ul>	from file
			AII	· Export to me Import	a on ne
				Send instrument calibration t	o device

This form has one tab for each seismic component. The instrument's response values are:

- The **Digitiser Volts per Count (VPC)** the ratio between the input voltage and the digitised output value ("counts"). This field will be populated automatically with the correct value for this input channel of the Certimus.
- Analogue instrument gain this specifies the output voltage of the accelerometer per unit of ground motion in ms<sup>-2</sup>, as measured at 1 Hertz.

- The **ADC offset** is the quiescent output seen when digitiser input is zero. This field will be populated automatically with the correct value for this input channel of the Certimus.
- The **Coil constant** is the coil constant for the component being calibrated, in A/m/s<sup>2</sup>, as given on the analogue sensor calibration sheet.
- The **Calibration resistor is the value of the calibration resistor**, in  $\Omega$ , as given on the sensor calibration sheet. This is common to all sensor components.
- The **Normalising factor** specifies the value that the transfer function (as specified by the poles and zeroes) must be multiplied by in order to provide unity gain at 1 Hz.
- The **Poles** and **Zeros** describe the frequency and phase response of the component. They must be specified in Hertz.

The calibration parameters for one component can be copied to any other component of the same instrument, or other instruments. This is especially useful for poles and zeros, because they are typically identical for all three components of all instruments in a class.

The drop-down menu in the "Component configuration" section allows selection of what to copy: poles and zeros, gains or everything. The destination sensor and component(s) can be selected in the subsequent drop-down menus. Click on the

Copybutton to copy and paste the selected values. Finally click onSend axis Zbutton to send the calibration values to the digitiser and save them permanently.Repeat this last step for the other axis. Note thatSend axis Zonly sends the calibration of the selected axis.

Compor	nent configuration							
Copy:	Poles and Zeros	•	to sensor	0 ≑	to component	ZNE	•	Сору
								Send axis Z

The overall system calibration parameters can be exported and saved in a file for future use by clicking on the Export to file button under "System calibration values".

System calibration values				
	Poles and Zeros	•	Export to file	Import from file
		_		
		Ser	id instrument cali	bration to device

The resulting file-name will have the extension .conf. Values from an existing calibration file can be imported using the Import from file button. The associated drop-down menu allows specification of what to import: poles and zeros, gains or

everything. Click on Send instrument calibration to device to send the calibration values to the digitiser and save them permanently. Note that this action will only send the calibration of the selected sensor. Click on Send to device button to send the complete calibration to the digitiser.

When transmitting MiniSEED data, the responses of the instruments and digitisers are encoded in a message called a "Dataless SEED" volume. The contents of these volumes can be displayed in human-readable form, known as RESP, by clicking on the "RESP file" link of each channel in the "Data flow" and "Data record" tab of the Certimus web page.

		~~~	M	V	güralp   UN OF PR	DERSTAND TIMISE OTECT		
				Fortimus				
Status Network Setup Trigger Data Stream Data Record Storage Logout Help								
System type: Fortin	nus   Host label	: SPI	RT-FMUS   Host name: FMUS-DE5B (10.	10.0.25)   Serial number: 00DE5B				
Data Stream								
Disable All Stream	ms		Restore default	The "Disable All" and "Restore default" button will AL SO affect settings of any other sensors				
Copy to Data Rec	cord		"Copy to Data Record" will apply settings from this page to recording configuration of all of the sensors.					
Display Streams	All	$\sim$	Apply configuration for tap groups		Display On Page Sensor 0			
Channels config	guration							
Channel sa	mpling rate		Data transform	SEED name - please use check-box to modify the default	RESPonse file - if	available		
			Seismic	channels				
0CAL0	200 Hz	$\sim$	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST. 00 .HCA	RESP_file	5		
0ACCZ0	200 Hz	<	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST.00 .HNZ	<u>RESP_file</u>	1		
0ACCN0	200 Hz	~	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST.00 .HNN	<u>RESP_file_</u>	.11		
0ACCE0	200 Hz	~	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST.00 .HNE	<u>RESP_file_</u>	15		

Clicking on a RESP file link produces a page like this:

# #	<< Guralı	SEED re	sponse fil	le b	uilder v1.2-86	515 >>					
÷		CHANNEL	RESPONSE I	ATA							
B050F03	Station:	TEST									
B050F16	Network:	DG									
	Location:										
B052F04	Channel:	HNZ									
B052F22	Start date:	2018,214	,11:26:48								
	End date:										
#											
#	+		+				+				+
#	+		Char	nel	Sensitivity,	TEST ch	HNZ				+
#	+		+				+				+
#											
B058F03	Stage sequend	e number	:		0						
B058F04	Sensitivity:				2.131148E						
B058F05	Frequency of	sensitiv	ity:		1.00000E	C+00 HZ					
B058F06	Number of cal	libration	s:		0						
#											
#	+	+						-+			+
#	+				Poles & Zeros)						+
#	+	+						-+			+
#											
					A [Laplac	e Transfo	orm (Rad	/sec)]			
	Stage sequend				1						
					M/S**2 -		tion in 1	Metres	Per	Second	Squared
					V - Volta						
					3.022955E						
B053F08	Normalization	n frequen	су:		1.00000E	2+00					

Right-click anywhere and select "Back" to return to the Certimus web page.

MAN-CER-0001 202 93 Issue Error! Reference source not found. - June,

D MIN-C45	6 Discovery	
÷	<< Güralp S	EED response file buil
÷ ÷	~~	ANNEL RESPONSE DATA
B050F03	Back	Т
B050F16	Forward	
B052F03 B052F04	Reload	
B052F22	View Page Source	8,045,14:56:59
B052F23	Ena aate: 20	18,046,12:03:06
+		
#	+	+
4		I Channel Se

To save a RESP file, right click on it in the main list and select "Save Link":

ED Location	Display on page	Sensor0 -
	The "Reset All Settings" bu affect settings on other pag	
0K	RESP file	Follow Link
0 <b>K</b>	<u>RESP_fil</u>	Save Link
0L	RESP file	Back
0K	RESP file	Forward
0L	RESP file	Reload View Page Source
0K	RESP file	Copy Link URL
0L	RESP file 10	<u>6</u>

**Note:** RESP files are not available for channels that have a transform enabled. For details about transforms, see Section 7.16 on page 94.

# 7.15 Setting sensor orientation and depth parameters

# 7.15.1 Applied rotation

A Matlab extension for Scream! allows easy determination of the exact orientation of a sensor relative to a surface reference sensor (which can be accurately aligned magnetically or geographically. The procedure is explained at https://www.guralp.com/howtos/determining-sensor-orientation.

The Relative Orientation extension of Scream! provides a correction angle that can be entered into the Sensor Orientation section of the Certimus web page.

### **Revision History**

CERT-EE5C Discovery			- 🗆 X
← → C ⊗			Q 0%
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~	güralp UNDERSTAND OPTIMISE PROTECT
Status Network System type: Certimus   Host label: Engineeri		0	Certimus Logout Help 00EE5C
Digitiser Controls			
Reboot		Reset All Settings	The "Reset All Settings" button will ALSO affect settings on other pages
Digitiser Config			
Auto Refresh 1	Auto Reboot Never V	Low Latency Mode Balanced 🔹	Filter quality High <b>v</b>
Host Label Engineering Developement	Station Code 0EE5C	Network Code DG	Site Name No site
SeedLink SOH Location Code 00	Bluetooth PIN 0000	Bluetooth Enabled V	
Deploy Mode Normal 🔻	Deploy	Flush to SD	Stop Recording
Time Offset 2ms.	System Reset		
Applied Rotation			
Analogue 0 0 °			
Digital 1 0 °			



**Note:** The input rotation is automatically applied to both transmitted and recorded data.

### 7.15.2 Instrument installation parameters

Installation parameters are reflected in the StationXML and the Dataless Seed description of the deployment. They are not used to modify or rotate any data output from the instrument.

The Dip (tilt angle from vertical), Azimuth (tilt direction from North) and Depth of Certimus can be set in the "Setup" tab of the web interface in the section "Instrument Installation Parameters". The instrument to which the displayed parameters apply is selected using the drop-down menu.

#### **Revision History**

		-MM	MMM	·····		güralþ	UNDERSTAND OPTIMISE PROTECT
							Fortimus
	Status Ne	twork Setup	Trigger D	)ata Stream Data R	ecord Storage	Logout Help	
	Status	twork Setup	nigger L	ala Stream Dala N	Storage	Logout Help	
System type: Forti	mus   Host label: S	PRT-FMUS   Host na	me: FMUS-DE	5B (10.10.0.25)   Serial	number: 00DE5B		
Digitizer Contr	ols						
Reboot				Reset All Settings		The "Reset All Sett affect settings on c	ings" button will ALSO
Digitizer Config	1					uncer settings on e	uter pages
Auto Refresh	1	Auto Reboot	On Error V	Low Latency Mode	Balanced ~	1	
Host Label	SPRT-FMUS	Station Code	TEST	Network Code	DG	Site Name	SPRT-FMUS
Bluetooth PIN	0000	Bluetooth	Enabled ~	Filter quality	High ~	Site Marile	SFRI-FM05
Deploy Mode	Normal ~		Eliableu V		High V		
		Deploy					
Applied Rotation						1	
Analogue 0	0 °						
Sensor Installa	tion Parameter	S					
Sensor	Sensor 0 $ \smallsetminus $	Dip	0	Azimuth	0	Depth	0
Fortimus							
		-		Sensor Status			
Initialisation	Complete	Sensor State	ldle				
Model	Fortimus	Serial Number	0 (0x0)	Identification Firmware	0.3	Configuration	1
Model	Torunus	Senar Number	0 (0.0)	Response	0.5	comgutation	
Fortimus Range	-1.0g; +1.0g ~	Fortimus Loop	Normal ~				
				Mass Centring			
Centre Mass							
				Calibration			
Calibration	Off ~	Amplitude	100% ~	Calibration Signal	Disabled $ \sim $		
				Display			
Display settings	Unlocked ~	Display brightness	Auto 🗸	Display switch-off	Never ~	Display flip	Auto ~
Touch sense	Enable ~						
		Mida	s House, Calleva Tel: +44 118 9	uralp Systems Limited Park, Aldermaston, Reading, F 381 9056, Fax: +44 118 981 99 <u>9guralp.com, support@guralp.</u>	943		

**Note:** The orientation and depth are not applied to the data, the parameters are only saved in the Dataless SEED.

# 7.16 Transforms

The Certimus is capable of applying mathematical transforms to the streamed and recorded data. These include low-pass and high-pass filters, integration, differentiation, rotation, STA/LTA trigger etc.

When a specific transform is activated on a particular channel, the resulting streamed (or recorded, accordingly to the chosen configuration) data output is automatically transmitted and/or recorded with the transform applied. The units-of-measure are re-calculated accordingly.

Transform functions are enabled or disabled from the "Data Stream" and "Data Record" tabs for each channel.

### **Revision History**

		~~~	M	V	güralp UNDERSTAND OPTIMISE PROTECT
					Reboot Required · Fortimus
	Status	Netv	vork Setup Trigger Data Str	eam Data Record Storage	Logout Help
System type: Fortin	nus   Host label	: SP	RT-FMUS   Host name: FMUS-DE5B (10.	10.0.25)   Serial number: 00DE5B	
Data Stream					
Disable All Strea	ms		Restore default	The "Disable All" and "Restore default" button will ALSO affect settings of any other sensors	Reboot
Copy to Data Rec	cord		"Copy to Data Record" will apply settings from this page to recording configuration of all of the sensors.		
Display Streams	All	$\sim$	Apply configuration for tap groups		Display On Page Sensor 0 V
Channels confi	guration				
Channel sa	mpling rate		Data transform	SEED name - please use check-box to modify the default	RESPonse file - if available
			Seismic	channels	
0CAL0	200 Hz	$\sim$	Transforms Disabled for this tap $\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!$	DG.TEST.00 .HCA	RESP_file_5
0ACCZ0	200 Hz	$\sim$	Enable Transform (reboot) 🗸 🗸	DG.TEST. 00 .HNZ	<u>RESP_file_7</u>
0ACCN0	200 Hz	$\sim$	Transforms Disabled for this tap	DG.TEST. 00 .HNN	RESP_file_11
0ACCE0	200 Hz	$\sim$	Enable Transform (reboot)	DG.TEST.00 .HNE	RESP_file_15



**Note:** To enable or disable a transform on any channel, it is necessary to reboot the Certimus. Transforms can be applied only on enabled channels.

The available transforms are:

- Pass-through see Section 7.16.1 on page 96.
- 2nd order bi-quadratic filter see Section 7.16.6 on page 99.
- 1st order low-pass filter see Section 7.16.3 on page 97.
- 1st order high-pass filter see Section 7.16.4 on page 97.
- 1st order band/Notch filter see Section 7.16.5 on page 98.
- STA/LTA ratio see Section 7.16.10 on page 103.
- Integration see Section 7.16.7 on page 100.
- Double integration see Section 7.16.8 on page 101.
- Three-dimensional rotation see Section 7.16.11 on page 104.
- EEW parameters Observer see Section 7.16.9 on page 102.
- Differentiation see Section 7.16.2 on page 96.
- QSCDx sender see Section 7.16.12 on page 106.
- MMA logger see Section 7.16.13 on page 107.

Some transforms require parameters such as frequencies or coefficients. For these, the user can either use a fixed, default set, or create their own custom set.

To use customised parameters, visit the "Transform" tab and select the "Saved User Parameters" option in the "Parameter Source" drop-down menu. Type in the required parameters and then click Save Parameters to store them. It is possible to switch between Default and Saved User Parameters without altering the stored custom parameters but clicking Save Parameters while "Default parameters" is selected will overwrite the customised parameters with the default values.

Parameter Source	Default Parameters 🔹	Save Parameters
Select which transform parameters to use: Defaults	Default Parameters Saved User Parameters	
or Recall saved user settings from memory		

The various transforms are each described in the following sections.

**Caution:** The Disable All Streams button at the top of the "Transform" column does not disable *transforms* for all streams. It stops *transmission* of all streams, which may not be what you intend.

# 7.16.1 Pass-through

This null transform simply outputs a copy of the input data, without applying any transform. It has no configuration parameters.

Status	Network	Setup	Power	Trigger	Data Stream	Data Record	Transforms	Storage	Logout	Help
System type: Minir	nus   Host la	bel: Sup	port   Host na	ime: MIN-C5	555 (10.10.0.13)	Serial number: 5	0517			
Data Stream										
Display Streams	All	•	Transform		Trj	to NOT change a	ny SEED Location	Display Or	n Page	Sensor0 🔻
Reboot			Disable All	Streams		Reset All Settin	gs		t All Settings ngs on other	" button will ALSO pages
0XCHN0	200	Hz 🔻	Tra	ansforms Dis	sabled 🔻 🗌	DG.TEST.00	HDF		<u>RESP</u> fi	<u>le 5</u>
0ACCZ0	200	Hz 🔻	Pas	s-through	•	DG.TEST.00	.HHZ		<u>RESP</u> fi	<u>le 7</u>
Status	Network	Setup		Trigger	Data Stream	Data Record		Storage	Logout	Help
System type: Minir	nus   Host la	bel: Sup	port   Host na	me: MIN-C5	555 (10.10.0.13)	Serial number: 5	0517			
Configure Tran	sforms									
					0400	70				

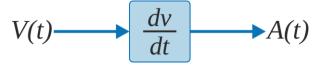
Selected Transform

**Note:** This transform is selected by default when transforms are first enabled or when an invalid transform is selected. Do not use pass-through as a method of disabling transforms: instead, select "Disable transforms" from the drop-down menu next to each stream on the "Data Streams" tab,

Pass-through

# 7.16.2 Differentiation

This transform differentiates the input data, e.g. if the input is a velocity (m/s) channel, the output will be acceleration  $(m/s^2)$ . It has no configuration parameters.

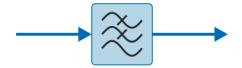


### **Revision History**

Status	Network	Setup	Power	Trigger	Data Stream		Data Record	Transforms	Storage	Logout	Help
System type: Minir	nus   Host labe	el: Suppo	ort   Host na	me: MIN-C5	55 (10.10.0.13)	Ser	rial number: 50	517			
Data Stream											
Display Streams	All	▼ Tra	ansform			ry to	NOT change an	y SEED Location	Display Or	Page	Sensor0 •
Reboot			Disable All	Streams			Reset All Setting	S		t All Settings" ngs on other	' button will ALSO pages
0XCHN0	200 H	z 🔻	Tra	insforms Dis	abled 🔻		DG.TEST.00	HDF		RESP fil	<u>e 5</u>
0ACCZ0	200 H	z 🔻	Diffe	erentiation	•		DG.TEST.00	.HHZ		<u>RESP</u> fil	<u>e 7</u>
Status System type: Minin	Network	Setup	Power	Trigger me: MIN-C5	Data Strean		Data Record	Transforms	Storage	Logout	Help
Configure Trar		on oupp						•			
					0AC	:Z0					
Selected Transform							Diffe	rentiation			

### 7.16.3 1<sup>st</sup> order LPF

This transform applies a first-order low-pass filter to the input data.



The single configurable parameter is "Corner Frequency": this specifies, in Hz, the frequency at which the output power is attenuated by -3 dB. Above this frequency, output power is attenuated by a further 6 dB per octave or 20 dB per decade.

Status No	etwork Setu	p Power	Trigger	Data Stream	Data Recor	d Transforms	Storage	Logout	Help
System type: Minimus	Host label: Sup	oport   Host n	ame: MIN-C5	555 (10.10.0.13)	Serial number:	50517			
Data Stream									
Display Streams	JII T	Transform		T	Try to NOT change	any SEED Location	Display On	Page	Sensor0 V
Reboot		Disable A	ll Streams		Reset All Setti	ngs		All Settings" ngs on other	button will ALSO pages
0XCHN0	200 Hz 🔻	Т	ansforms Dis	sabled 🔻	DG.TEST.00	HDF		<u>RESP fil</u>	<u>e 5</u>
0ACCZ0	200 Hz 🔻	1st	Order LPF	•	DG.TEST.00	.HHZ		<u>RESP fil</u>	<u>e 7</u>
Status No System type: Minimus	etwork Setup   <mark>Host label: Sup</mark>		Trigger ame: MIN-C5	Data Stream			Storage	Logout	Help
Configure Transfo	rms								
				0VEI	_Z0				
Selected Transform	1st Order	LPF P	arameter Sou	ILCE	Det	ault Parameters	✓ Save	e Parameter	5
Corner Frequency (Hz)		10							

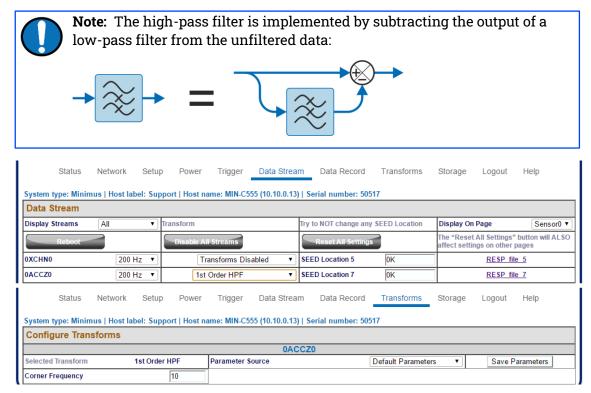
## 7.16.4 1<sup>st</sup> Order HPF

This transform applies a first-order high pass filter to the input data.



The output is the difference between a low-pass filtered copy of the signal and the unfiltered signal.

The single configurable parameter is "Corner Frequency": this specifies, in Hz, the frequency at which the output power is attenuated by -3 dB. Below this frequency, output power is attenuated by a further 6 dB per octave or 20 dB per decade.



# 7.16.5 1<sup>st</sup> Order Band/Notch filter

This transform applies first-order band stop or Notch filter to the input data.



The band-stop filter is implemented as a configurable chain of two components:

- A 1st order high pass filter (implemented using an LPF and a subtractor, as described in Section 7.16.4 on page 97), to gradually attenuate low-frequency integrator drift.
- A 1st order low pass filter (implemented as described in Section 7.16.3 on page 97).

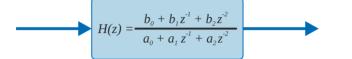
The configurable parameters are the "High Pass Frequency" (HPF corner frequency as defined in Section 7.16.4 on page 97) and the "Low Pass Frequency" (LPF corner frequency as defined in Section 7.16.3 on page 97).

### **Revision History**

Status Network Se	etup Power Trigger Data S	ream Data Record Transforms	Storage Logout Help
System type: Minimus   Host label:	Support   Host name: MIN-C555 (10.10.	.13)   Serial number: 50517	
Data Stream			
Display Streams All	▼ Transform	Try to NOT change any SEED Location	Display On Page Sensor0 V
Reboot	Disable All Streams	Reset All Settings	The "Reset All Settings" button will ALSO affect settings on other pages
0XCHN0 200 Hz	▼ Transforms Disabled	DG.TEST.00 HDF	RESP file 5
0ACCZ0 200 Hz	Band/Notch Filter (1st Orde	DG.TEST.00 .HHZ	RESP file 7
	etup Power Trigger Data S Support   Host name: MIN-C555 (10.10.		Storage Logout Help
Configure Transforms			
		OVELZ0	
Selected Transform	Band/Notch Filter (1st Order)	Parameter Source Default Parameter	eters V Save Parameters
High Pass Frequency (Hz) 0.1	Low Pass Frequency (Hz) 50		

# 7.16.6 2<sup>nd</sup> Order biquad

This transform applies a second-order bi-quadratic filter to the input data.



The biquad filter is a second-order recursive linear filter, containing two poles and two zeros. In the Z-plane, the transfer function is the ratio of two quadratics in z, as shown.

The two configurable parameters are:

- "Corner Frequency": this specifies, in Hertz, the frequency at which the output power is attenuated by -3 dB; and
- "Type":
  - 0: low-pass mode; and
  - 1: high-pass mode.

System type: Mini	mus   Ho	st label:	Sup	oport   Host name: MIN-C555 (10.1	0.0.13)	\$	erial number: 50	517				
Data Stream												
Display Streams	All		۲	Transform		Try	to NOT change an	y SEED	Location	Display Or	n Page	Sensor0 🔻
Reboot				Disable All Streams			- Reset All Setting	s			t All Settings" b ings on other pa	
0XCHN0	[	200 Hz	۲	Transforms Disabled	•		DG.TEST.00	HDF			RESP file	5
0ACCZ0	ſ	200 Hz	۲	2nd Order Biquad	•		DG.TEST.00	.HHZ	1		RESP file	7
Status System type: Mini	Netwo mus   Ho		etup Sup	p Power Trigger Data pport   Host name: MIN-C555 (10.1	Strear 0.0.13)		Data Record		nsforms	Storage	Logout	Help
Configure Tran	nsform	S										
					0AC	cz	0					
Selected Transform	1			2nd Order Biquad	Param	ete	r Source	Defa	ult Paramete	rs v	Save Para	neters
Type (HPF/LPF)	0	Cor	mer	Frequency (Hz) 10		_						
0 = Low Pass Filte	r, 1 = High	Pass Filt	er									

## 7.16.7 Integration

This transform integrates the input data, e.g. if the selected channel unit is velocity (ms-1), the output produced is displacement (m).



The integration transform is implemented as a configurable chain of three components:

- A DC filter (2nd order high-pass bi-quadratic) removes any DC component, which would cause the output to grow without limit;
- The integrator itself; and
- A 1st order high pass filter (implemented using an LPF and a subtractor, as described in Section 7.16.4 on page 97), to gradually attenuate low-frequency integrator drift.

The configurable parameters are:

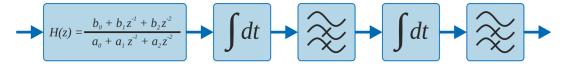
- "DC Cut-off Frequency": this specifies the -3 dB point (in Hertz) for the initial high-pass filter;
- "Output Cut-off Frequency": this specifies the -3 dB point (in Hertz) for the output high-pass filter;
- "Configuration Mode", which configures how many elements of the chain are used. The options are:
  - Apply only the initial DC filter;
  - Apply the DC filter and the integrator; and
  - Apply the DC filter, the integrator and the output HPF.

### **Revision History**

Status Ne	etwork Set	up Power	Trigger	Data Strea	n Data Record	Transforms	Storage	Logout	t Help
System type: Minimus	Host label: St	ipport   Host na	me: MIN-C55	55 (10.10.0.13)	Serial number: 505	517			
Data Stream		1			T- 4- NOT	OFFD Longting	Disates Or	Demo	0.0.0.0
Display Streams A	ll ▼	Transform			Try to NOT change any	SEED Location	Display On	-	Sensor0 •
Reboot		Disable Al	Streams		Reset All Settings	5	The "Reset affect setti		gs" button will ALSO er pages
0XCHN0	200 Hz 🔻	Tra	ansforms Dis	abled 🔻	DG.TE ST. 00	HDF		RESP	file 5
0ACCZ0	200 Hz 🔻	Inte	gration	۲	DG.TEST.00	HHZ		RESP	file 7
System type: Minimus			Trigger	Data Strea		Transforms	Storage	Logout	Help
Configure Transfor	rms								
				0AC	CZ0				
Selected Transform		Integ	ration		Parameter Source	Default	Parameters	•	Save Parameters
DC Cut-off Frequency	0.5	Output Cut-off F	requency	0.003	Configuration Mode		2		
					0 = DC filter output 1 = DC HPF + Integra 2 = DC HPF + Integra				

## 7.16.8 Double Integration

This transform integrates the input data twice so, for example, if the selected channel is acceleration (ms<sup>-2</sup>), the output produced is displacement (m).



Analogously to the single integrator, the double integrator applies an initial DC highpass filter and then two further high-pass filters, one at the output of each integrator. The high-pass filters are implemented using an LPF and a subtractor, as described in Section 7.16.4 on page 97.

The configurable parameters are:

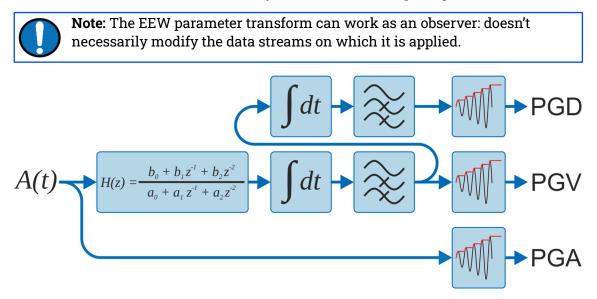
- "DC Cut-off Frequency": this specifies the -3 dB point (in Hertz) for the initial high-pass filter;
- "Interstage Cut-off Frequency": this specifies the -3 dB point (in Hertz) for the first integrator output high-pass filter;
- "Output Cut-off Frequency": this specifies the -3 dB (in Hertz) point for the second integrator output high-pass filter;
- "Configuration Mode", which configures how many elements of the chain are used. The options are:
  - Apply only the initial DC filter;
  - Apply DC filter and first integrator;
  - Apply DC filter, first integrator and interstage HPF;
  - Apply DC filter, first integrator, interstage HPF and second integrator; and

# • Apply DC filter, first integrator, interstage HPF, second integrator and second output HPF.

Data Stream							
Display Streams	All	•	Transform	Try to NOT chang	e any SEED Location	Display On Page	Sensor0 •
Reboot			Disable All Streams	Reset All Se	ettings	The "Reset All Settings affect settings on othe	
0XCHN0	200 Hz	z 🔻	Transforms Disabled	▼ □ DG.TEST.00	) HDF	RESP 1	ile <u>5</u>
0ACCZ0	200 Hz	z v	Double Integration	• DG.TEST.00	) .HHZ	RESP 1	ile 7
2 21		el: Sup					
Configure Trar	nsforms			040070			
Configure Trar Selected Transform			Double Integration	0ACCZ0 Parameter Source	Default Parameters	s ▼ Save I	Parameters

### 7.16.9 EEW Parameter Observer

When an EEW trigger occurs (or is simulated – see below), the peak ground motion values (Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV) and Peak Ground Displacement (PGD)) are calculated and automatically recorded over the selected time-window and subsequently transmitted as a CAP message (see Section 7.17 on page 108 for more details). This transform allows the operator to directly observe the acceleration, velocity and displacement output on the real-time streams. It is available for use with both velocity and acceleration input signals.



The high-pass filters are implemented using an LPF and a subtracter, as described in Section 7.16.4 on page 97.

The configurable parameters are:

- "DC Cut-off Frequency": this specifies the -3 dB point (in Hertz) for the initial high-pass filter;
- "Interstage Cut-off Frequency": this specifies the -3 dB point (in Hertz) for the first integrator output high-pass filter. This is only used when the input signal is acceleration;
- "Output Cut-off Frequency": this specifies the -3 dB (in Hertz) point for the sole (velocity input) or final (acceleration input) integrator output high-pass filter;
- "Window time": this specifies the duration, in seconds, of the time-window over which the peak values are reported; and
  - The values to be shown in the output stream:
    - Peak Ground Acceleration (PGA);
    - Peak Ground Velocity (PGV); or
    - Peak Ground Displacement (PGD).



•

**Note:** Güralp recommend using the integration (Section 7.16.7 on page 100) and double integration (Section 7.16.8 on page 101) transforms to test the filter parameters, because the effect of the parameters will then be clearly visible in the transformed streams. Once suitable parameters have been determined, they can be copied to the EEW Parameter Observer transform.

Status	Network	Setup	Power	Trigger	Data Stre	am	Data Record	Transforms	Storage	Logout	Help
System type: Mini	mus   Host lal	oel: Suppo	rt   Host na	ame: MIN-C5	55 (10.10.0.1	3)   5	erial number: 505'	17			
Data Stream						-					
Display Streams	All	▼ Tra	nsform			Try	to NOT change any	SEED Location	Display Or	n Page	Sensor0
Rebool			Disable Al	I Streams			Reset All Settings			t All Settings' ings on other	' button will ALS pages
0XCHN0	200 H	Hz ▼	Tra	ansforms Dis	abled 🔹	] 🗆	DG.TEST.00	IDF		RESP fi	le <u>5</u>
0ACCZ0	200 H	Hz ▼	EEV	N Parameter	s Observer 🔻	1	DG.TEST.00	HHZ		<u>RESP</u> fi	le 7
Configure Tra	nsforms										
					A0	CCZ	)				_
Selected Transfor	m		EEW Para	imeters - Ob	server Par	ame	ter Source Default	Parameters	✓ Sav	e Paramete	rs
DC Cut-off Freque	ncy 0.5	Interstag	e Cut-off F	requency 0.	003 Ou	put (	Cut-off Frequency	0.0015	5 Windov	v Time (seco	onds) 3
Preview Mode	0										
0 = No preview											
1 = View acceler 2 = View velocit		m									
3 = View displace	ement in stre	am.									

## 7.16.10 STA/LTA Ratio

The Earthquake Early Warning system (EEW) compares the ratio of a short-term average (STA) to a long-term average (LTA) in order to detect "trigger" conditions. For more information see Section 7.17 on page 108.

This transform is included to help determine parameters for configuring the EEW system. It does not affect the operation of the EEW system in any way. The transform calculates the ratio between the result of the Short Term Average filter and

the Long Term Average filter. The input signal is passed through a high-pass filter which removes any DC offset.



The configurable parameters are:

- "DC Frequency (Hz)": this specifies the corner frequency (-3 dB point) in Hertz for the initial high-pass filter;
- "LTA Period (seconds)": this is the Short Term Average filter time period (the reciprocal of the corner frequency);
- "STA Period (seconds)": this is the Long Term Average filter time period (the reciprocal of the corner frequency);
- "Trigger Threshold": this is the STA/LTA ratio threshold value above which a trigger will occur;
- "Event Window (Seconds)": this is the duration of the event after the STA/LTA trigger occurs; any subsequent threshold crossing within this period is treated as belonging to the same event. This can be used to avoid spurious false triggers.
- "Initial Timeout (Seconds)": this specifies an initial period of insensitivity after the trigger function is initialised or changed. This can be used to avoid spurious false triggers.

The high-pass filter is implemented using an LPF and a subtracter, as described in Section 7.16.4 on page 97.

Data Stream	11031110311	abei: 501	PRI-MIN   HO	st name: MIN-C	.555 (10.10.0	).13)	Senai numbe	er: 20217				
Display Streams	All	~	Transform			Try to	NOT change a	ny SEED	Location	Display On	Page	Sensor0 ~
Reboot			Disable A	II Streams			Reset All Setti	ngs			All Settings" but ngs on other pag	
0AUXX0	200	Hz v	Tr	ansforms Disabl	ed ~		DG.TEST.00	HDF	HDF		RESP file 5	1
0ACCZ0	200	Hz 🗸	ST	A/LTA Ratio	~		DG.TEST. 00	.HHZ	HNZ			
Status System type: Mini Configure Trar		Setu abel: SUI		Trigger st name: MIN-C		).13)		_	ansforms	Storage	Logout H	leip
					0A0	CZO						
Selected Transform			STA/LTA Ratio	D	Parameter S	Sourc	e	Defaul	t Parameter	s ~	Save Paramet	ters

## 7.16.11 Three-dimensional rotation

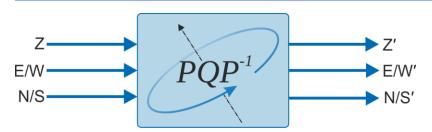
This transform rotates three velocity/acceleration seismic components in space. Rotations are represented by unit quaternions (in preference to the more usual Euler

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```

106 Issue Error! Reference source not found. - June,

angles: yaw, pitch and roll) because they are unambiguous and avoid the problem of gimbal lock.

**Note:** The rotation transform can only be applied if it is enabled in all three velocity/acceleration components of a single instrument at the same sample rate.



Any rotation in three dimensional space can be represented as a combination of a unit three-dimensional vector,  $\vec{u}$ , which specifies the axis (and sense) of the rotation, and a scalar angle,  $\theta$ , which specifies the amount of rotation

Güralp follows a North, East, Up convention when describing sensor orientation. Using this convention, we can represent  $\vec{uas}$  [u,v,w] and use Pauli's extension to Euler's formula:

$$\mathbf{q} = \cos\left(\frac{\theta}{2}\right) + (u\mathbf{i} + v\mathbf{j} + w\mathbf{k})\sin\left(\frac{\theta}{2}\right)$$

to form a quaternion:  $q \equiv [a, b, c, d]$  where:

$$a = \cos\left(\frac{\theta}{2}\right), b = \sin\left(\frac{\theta}{2}\right)u, c = \sin\left(\frac{\theta}{2}\right)v$$
 and  $d = \sin\left(\frac{\theta}{2}\right)w$ 

For example, a perfectly- oriented sensor has a (null) rotation of [1,0,0,0,], where the sensor's Z, N and E axes align with the North, East and Up global axes.

A rotation of

$$\left[\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}},0,0\right]$$

represents a sensor that has been rotated 90° about its *x* axis to align the sensor's Z, N and E axes with global North, Down and East respectively.

**Note:** Clockwise rotations, when looking along an axis, are denoted as positive. This is generally known as the "right-hand rule" because, if you point your right thumb along the (directed) axis, your fingers will curl in a clockwise direction about it.

In the degenerate case of a simple rotation about a vertical axis (commonly used to correct data from a misaligned borehole instrument), the axis of rotation is vertical, so our unit vector is [0,0,1] (following the "North, East, Up" convention). To rotate by  $\theta$  (where positive  $\theta$  is clockwise when looking upwards), our quaternion should be:

$$\mathbf{q} = \cos\left(\frac{\theta}{2}\right) + (0\mathbf{i} + 0\mathbf{j} + 1\mathbf{k})\sin\left(\frac{\theta}{2}\right) \equiv \left[\cos\left(\frac{\theta}{2}\right), 0, 0, \sin\left(\frac{\theta}{2}\right)\right]$$

As a final check, note that

$$a^{2} + b^{2} + c^{2} + d^{2} = \cos^{2}\left(\frac{\theta}{2}\right) + 0^{2} + 0^{2} + \sin^{2}\left(\frac{\theta}{2}\right) = 1$$

which satisfies our requirement for a unit quaternion. The parameters to enter in the Configure Transforms fields are, therefore:

**Scalar** 
$$\Rightarrow \cos\left(\frac{\theta}{2}\right)$$
,  $\mathbf{X} \Rightarrow \mathbf{0}$ ,  $\mathbf{Y} \Rightarrow \mathbf{0}$  and  $\mathbf{Z} \Rightarrow \sin\left(\frac{\theta}{2}\right)$ 

Status Network Setup Power Trigger Data Stream Data Record Transforms Storage Logout Help

System type: Minimus | Host label: Support | Host name: MIN-C555 (10.10.0.13) | Serial number: 50517

Data Stream					
Display Streams	All		Transform	Try to NOT change any SEED Location	Display On Page Sensor0 V
Reboot			Disable All Streams	Reset All Settings	The "Reset All Settings" button will ALSO affect settings on other pages
0AUXX0	200 Hz	•	Transforms Disabled	DG.TEST. 00 .HDF	RESP file 5
0ACCZ0	200 Hz		Rotation (Triplet)	DG.TEST.00 .HDF	RESP file 7
0ACCN0	200 Hz		Rotation (Triplet)	DG.TEST.00 .HDF	RESP file 8
0ACCE0	200 Hz		Rotation (Triplet)	DG.TEST. 00 .HDF	RESP file 11
Status	Network Set	tup	o Power Trigger Data Strea	m Data Record Transforms	Storage Logout Help
System type: Minimu	s   Host label: S	up	port   Host name: MIN-C555 (10.10.0.13)	Serial number: 50517	
Configure Transf	forms				

Configure Tra	nsforms									
0ACCZ0 / 0ACCE0										
Selected Transform Rotation (Triplet)				Parameter Source	Default Parameters •		Save Parameters			
Scalar	1	x	0	Y	0	z	0			

# 7.16.12 **QSCD Sender (triplet)**

The QSCD protocol (Quick Seismic Characteristic Data) transmits values computed from the three triaxial streams of an instrument. One packet is transmitted every second so the number of samples in each packet is equal to the sample rate of the three input streams.

QSCD calculations are implemented using transforms and configured via the Data Stream tab of the Certimus web page. The three input channels must all be configured with the QSCD (triplet) transform. (The transform is disabled if the sample rates of the input streams do not match.)

# **Revision History**

güralp UNDERSTAND OPTIMISE PROTECT											
											Minimus
Status	Network	Setu	p Power	Trigger	Data Strear	Data Record	d Transf	orms s	Storage	Logout	Help
System type: Minim	nus   Host lab	el: SUI	PRT-MIN   Host n	ame: MIN-C5	55 (10.10.0	13)   Serial numb	er: 50517				
Data Stream											
Display Streams	All	~	Transform			Try to NOT change a	iny SEED Loc	ation	Display On	Page	Sensor0 V
Reboot			Disable All S	treams		Reset All Setti	ings			t All Settings' ngs on other	" button will ALSO pages
0AUXX0	200 Hz	~	Trans	forms Disabled	t ~	DG.TEST.00	.HDF			<u>RESP</u> fi	le <u>5</u>
OVELZ0	20 Hz	~	QSCD	sender (Trip	let) 🗸	DG.TEST.00	.BHZ			<u>RESP</u> fi	le 7
OVELNO	20 Hz	~	QSCD	Sender (Trip	let) ~	DG.TEST.00	.BHN			<u>RESP</u> fi	<u>le 8</u>
OVELEO	20 Hz	~	QSCD	Sender (Trip	let) ~	DG.TEST.00	.BHE			<u>RESP</u> fil	e 11

In the Transform tab, the parameter "Period length" configures the number of samples to include in a QSCD packet. For example, QSCD20 requires the sample rate of the streams to be 20 sps so the "Period length" must be set to 20 (samples), in order to send a packet every second.

	~~~~{	hm	www	Mmm		-	gürc		UNDERSTAND OPTIMISE PROTECT
									Minimus
Network	Setup	Power	Trigger	Data Stream	Data Record	Transforms	Storage	Logo	ut Help
nus   Host Ial <mark>sforms</mark>	bel: SUPRT	-MIN   Host				: 50517			
	QSC	Dx Sender (	200			Default Parameter		Save I	Parameters
20	1				L				
	Mar	ual Reset		1					
	Network nus   Host Ial sforms	Network Setup nus   Host label: SUPRT sforms QSC 20	V Network Setup Power nus   Host label: SUPRT-MIN   Host sforms QSCDx Sender	Network Setup Power Trigger nus   Host label: SUPRT-MIN   Host name: MIN sforms QSCDx Sender (Triplet)	Network Setup Power Trigger Data Stream nus   Host label: SUPRT-MIN   Host name: MIN-C555 (10.10.0.13) sforms OACCZ0 / OACCN QSCDx Sender (Triplet) Parameter Source	sforms OACCZ0 / 0ACCN0 / 0ACCE0 QSCDx Sender (Triplet) Parameter Source 20	Network Setup Power Trigger Data Stream Data Record Transforms nus   Host label: SUPRT-MIN   Host name: MIN-C555 (10.10.0.13)   Serial number: 50517 sforms OACC20 / 0ACCN0 / 0ACCE0 QSCDx Sender (Triplet) Parameter Source Default Parameter 20	Network Setup Power Trigger Data Stream Data Record <u>Transforms</u> Storage nus   Host label: SUPRT-MIN   Host name: MIN-C555 (10.10.0.13)   Serial number: 50517 sforms 0ACC20 / 0ACCN0 / 0ACCE0 QSCDx Sender (Triplet) Parameter Source Default Parameters 20	Network Setup Power Trigger Data Stream Data Record <u>Transforms</u> Storage Logo nus   Host label: SUPRT-MIN   Host name: MIN-C555 (10.10.0.13)   Serial number: 50517 sforms OACCZ0 / OACCN0 / OACCE0 QSCDx Sender (Triplet) Parameter Source <u>Default Parameters</u> Save   20

# 7.16.13 MMA Logger

The MMA logger transform [is a function that periodically calculates and logs Maximum Minimum and mean (Average) values over a selected window of data.



**Note:** The EEW parameter transform is an observer: doesn't modify the data streams on which it is applied.

The two configurable parameters are:

- "Short Period Length": this is the length of time between logging events expressed in samples, e.g. 200 samples when applied to a tap configured at 100sps produces an MMA calculation and logging every 2 seconds.
- "Window Length in Short Periods": is the length of window over which the Max, Min and Average values are calculated, in terms of number of short periods.

# **Revision History**

Data Stream											
Display Streams	All	~	Transform		Try to	NOT change a	ny SEED I	ocation	Display On Pag	ge	Sensor0 ~
Reboot			Disable All Stream	s		Reset All Setti	ngs		The "Reset All affect settings		
0AUXX0	200	Hz ~	Transforms	Disabled 🗸 🗸		DG.TEST.00	HDF	HDF		RESP file 5	
	200		MMA Logger			DG.TEST.00	.HHZ	HNZ		RESP file 7	
Status System type: Mini	Network mus   Host la	Setu		er Data Strea	am	Data Record	d Tra	nsforms			elp
	Network mus   Host la	Setu	ip Power Trigg	er Data Strea	am	Data Record	d Tra	nsforms			elp

#### 7.17 Earthquake Early Warning

The "Trigger" tab is dedicated to Earthquake Early Warning settings. These are disabled by default because of the amount of processing resource - and hence, power - consumed by triggering calculations.

The Triggers section of the web page enables the user to configure the triggering system. The trigger Sources should be configured firstly because different configuration options are displayed for different source types. Once the sourcespecific settings are configured, the scores and destinations should be specified. Destinations can be shared between sources, allowing the creation of networks (directed graphs) of systems for distributed event detection.

The heart of the Earthquake Early Warning subsystem are the triggering algorithms: an STA/LTA (Short-Time-Average divided by Long-Time-Average) and level (threshold) algorithms.

The STA/LTA algorithm continuously calculates the average values of the absolute amplitude of a seismic signal in two simultaneous moving-time windows. The short time average (STA) is sensitive to seismic events while the long time average (LTA) provides information about the current amplitude of seismic background noise at the site. When the ratio of STA to LTA exceeds a pre-set threshold value an event is "declared".

The threshold algorithm, instead, declares the presence of an event when the raw data in input passes above or below a pre-set threshold value.

#### 7.17.1 Trigger sources

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The available sources for the trigger are listed below, along with the configurable fields available in each case.

1st/2nd/3rd/4th Remote Source: This setting is used for multiple-source triggering networks. The sources specified here are other Certimus or Minimus based instruments, specified by the I.P. addresses configured in the "Remote Inputs" section: **MAN-CER-0001** 110 Issue Error! Reference source not found. - June,

The configurable fields in these cases are:

Score: this assigns a number of points to this trigger. The points value is used when assessing multiple-source triggers. This value is ignored when a trigger is not configured to use multiple sources.

Destination: this drop-down menu specifies the destination for the trigger. See Section 7.17.2 on page 111 for more information.

Triggers	configuration					
Source	1st Remote Source	Score	100	Destination	Disabled	~

nth Address: is the I.P. address of the remote source, e.g. another Minimus.

Sources	
	Remote Inputs
1st Address	

1st/2nd/3rd/4th I/O Expander Input: Select this value to use inputs from a connected Certimus 8 channel I/O Expander Module.

The configurable fields in these cases are:

Score: this assigns a number of points to this trigger. The points value is used when assessing multiple-source triggers. This value is ignored when a trigger is not configured to use multiple sources.

Destination: this drop-down menu specifies the destination for the trigger. See Section 7.17.2 on page 111 for more information.

Triggers	configuration				
Source	1st I/O Expander Input 🛛 🗸	Score	100	Destination	Disabled $\lor$

Tap Trigger N:: seismic or environmental Certimus channels selectable among any of the active taps in the "Data Stream" and "Data Record" tabs.

The configurable fields in these cases are:

Score: this assigns a number of points to this trigger. The points value is used when assessing multiple-source triggers. This value is ignored when a trigger is not configured to use multiple sources.

Destination: this drop-down menu specifies the destination for the trigger. See Section 7.17.2 on page 111 for more information.

Iriggers	configuration				
Source	Tap Trigger A [0ACCZ0] $ \smallsetminus $	Score	100	Destination	Disabled $\vee$

- Sensor number: this drop-down menu is required to enables the trigger on one of Sensor0, the Certimus.
- Tap: this drop-down menu select the stream to use as input of the trigger algorithm. The choice is between single taps, e.g. 0ACCZ0, or triplets, e.g. First Seismo Triplet.
- Trigger type: this drop-down menu chooses to use either STA/LTA or threshold algorithm.

MAN-CER-0001 202 111 Issue Error! Reference source not found. - June,

The STA/LTA trigger algorithms includes the configuration of the following parameters:

- "DC Frequency": initial AC coupling HPF corner frequency;
- "LTA Period": Long Term Average filter time period (1/corner frequency);
- "STA Period": Short Term Average filter time period (1/corner frequency);
- "Trigger Threshold": STA/LTA ratio level at which trigger occurs;
- "Event Window": After and even has been detected, subsequent crossing of the STA/LTA ratio threshold within the defined event window are treated as part of the same event and, therefore, not considered as new trigger event;
- "Initial Timeout": period of inactivity after the trigger function is initialised in order to avoid false triggers.

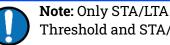
Sources								
			R	emote inputs				
				Tap Triggers				
Tap Trigger	Α	S	ensor 0 🗸 🗸		0ACCZ0	~	STA/LTA	Trigger 🗸
DC Frequency (Hz)	0.04	LTA Period (Seconds)	12	STA Period (Seconds	5)	0.5	Trigger Threshold	12
Event Window (Seconds)	5	Initial Timeout (Seconds)	10	Preview in Stree	am			

The threshold trigger algorithms includes the configuration of the following parameters:

- "Absolute Mode": specifies if the threshold has to act on magnitude with sign (0) or absolute value of the signal (1).
- "Low/High Mode": defines whether the threshold is exceeded when the signal passes below it (0) or above it (1);
- "Threshold": value of the threshold expressed in native signal unit, e.g. m/s2;
- "Timeout": specifies the time to wait (in seconds), after the threshold crossing, before accepting a new event;
- "Hysteresis Percentage": defines the hysteresis point in terms of percentage of threshold value below or above threshold. The hysteresis point is below the threshold for High Mode, above the threshold for Low Mode.

Sources												
Remote Inputs												
			Tap Triggers									
Tap Trigger A		Sensor 0 V		0ACCZ0	~		Threshold Trigger $\smallsetminus$					
Absolute Mode 0	Low/High Mode	1	Threshold		10	Timeout	10					
Hysteresis Percentage 10	Preview in Stre	eam										

The "Preview in Stream" box temporally shows the in the live streams the output calculated by the trigger algorithm, e.g. the STA/LTA ratio. In the STA/LTA ratio trigger, when a single stream is selected as source, the calculated STA/LTA ratio is shown in place of the original data.



**Note:** Only STA/LTA ratio has preview on single streams, both Threshold and STA/LTA ratio have preview of triplets.

When a triplet is selected as source, "3D or Z & NE" parameters is used to choose what type of preview to visualise.

For STA/LTA ratio trigger algorithm:

- 0: shows STA/LTA ratio calculated on 2D resultant vector of N and E components. The 2D STA/LTA ratio is shown in place of original E/W component. Also, shows the STA/LTA ratio calculated on Z component and it is shown in place of original Z component. N/S component shows normal seismic output.
- 1: shows STA/LTA ratio calculated on 3D resultant vector of Z, N and E components. The STA/LTA ratio is shown on E/W component. Z and N/S components show normal seismic output.

Sources							
		Local Ta	p Triggers				
Tap Trigger A			Sensor 0 🗸	~	First Seismo Triplet	~	STA/LTA Trigger 🗸
DC Frequency (Hz)	0.04	LTA Period (Seconds)	12		STA Period (Seconds)	0.5	Trigger Threshold
Event Window (Seconds)	5	Initial Timeout (Seconds)	10		3D or Z & NE	1	Preview in Stream
					1 = Trigger off of the 3D resul E together. 0 = Trigger off of the Z compo the 2D resultant of the horizo components separately.	onent and	

For Threshold trigger algorithm:

- 0: shows the 2D resultant vector of N and E components. The 2D resultant is shown in place of E/W component. Z and N/S components show normal seismic output.
- 1: shows the 3D resultant vector of Z, N and E components. 3D resultant is shown in place of E/W component. Z and N/S components show normal seismic output.

Sources							
		Local Ta	ap Triggers			_	
Tap Trigger A			Sensor 0 🗸	First Seismo Triplet 🗸 🗸		✓ Threshold Trigg	
Absolute Mode	0	Low/High Mode	1	Threshold	10	Timeout	10
Hysteresis Percentage	10	3D or Z & NE	1	Preview in Stream			
		1 = Trigger off of the 3D resu together. 0 = Trigger off of the Z comp resultant of the horizontal N separately.	onent and the 2D			_	

# 7.17.2 Trigger destinations

The options available form the various Destination fields are:

1st/2nd/3rd/4th CAP receiver: When a trigger is declared, the system will issue messages using the Common Alerting Protocol (for the full specification of this protocol, please refer to http://docs.oasis-

open.org/emergency/cap/v1.2/CAP-v1.2-os.html). This field selects to which of the four available CAP receivers the trigger information should be sent to.

Trigger	rs configuration								
Source	1st Remote Source	~	Score	100	Destination		1st CAF	<sup>o</sup> receiver	~
Destinati	ons								
			Со	mmon Alerting Protoco	l Messaging				
1st CAP Add	dress 52.34.40.123	1st CAP P	ort	11789	Total Score	300		1st CAP Threshold	200
1st CAP Ms	g scope Restricted 🗸	1st CAP R	ecipient	eew@guralp.com	1st CAP Inhibit Timeout	1	0	1st CAP Acceptance Window	1

Various parameters control how the CAP message is created:

- *n*<sup>th</sup> CAP Address: the I.P. address or DNS name of the CAP receiver;
- *n*<sup>th</sup> CAP Port: the UDP port on which the CAP receiver is listening;
- Total Score: this is an information field, it displays an automaticallycalculated total of the scores from all of the input sources that specify this destination;
- *n*<sup>th</sup> CAP Threshold: this threshold is used when multiple input sources contribute to this trigger. Otherwise trigger threshold from source configuration is used.
- *n*<sup>th</sup> CAP Msg scope: this value is copied to the "scope" field of the CAP message;
- *n*<sup>th</sup> CAP Recipient: this value is copied to the "addresses" field of the CAP message;
- n<sup>th</sup> CAP Inhibit Timeout: is the time the Certimus waits before sending new CAP message if a new event is detected after a previous CAP message was sent;
- n<sup>th</sup> CAP Acceptance Window: subsequent source triggers for a given destination are counted towards the cumulative score if they arrive within this window;

Common Alerting Protocol						
CAP Msg Expiry 300 seconds	CAP Msg Web URL	CAP Msg HMAC Key secret				

- CAP Msg Expiry: this parameter determines the value used to populate the optional "expires" field in the CAP message. If required, it should be specified in seconds.
- CAP Msg Web URL: this parameter determines the value used to populate the optional "web" field in the CAP message. It should be a full, absolute URI for an HTML page or other text resource with additional or reference information regarding this alert.
- CAP Msg HMAC Key: a shared key used for signing the CAP message. All CAP messages generated by Certimus are signed. The user should set this key to a private value. The HMAC digest can then be used to both authenticate the sender and validate the contents of CAP messages by anyone who is privy to the shared key. This prevents the generation of false, malicious CAP messages by a third party.

EEW parameters (PGA, PGV and PGD values) are sent in the CAP messages body if and only if the "EEW parameter – Observer" transform is enabled on the source taps (see Section 7.16.9 on page 102).

• 1<sup>st</sup>-8<sup>th</sup> I/O Expander Output: Select this value to use outputs from a connected Certimus 8 channel I/O Expander Module. See MAN-MIN-1001 for more details.

Trigger	rs configu	iration						
Source	Tap Trigger	A [OVELZ	)] 🗸 Score		100	Destination	1st I/O Expander	Output 🗸
Destinat	tions							
				Relay Outputs				
1st Hold Tir	me	1			1st Total Score	300	1st Score Threshold	200
1st Inhibit 1	Timeout	10	1st Acceptance Window	1				

Various parameters control how the I/O Expander behaves:

- n<sup>th</sup> Hold Time: is the relay switch timeout in seconds. If configured to O no timeout is used, otherwise relay will be released after specified number of seconds;
- n<sup>th</sup> Total Score: this is an information field, it displays an automaticallycalculated total of the scores from all of the input sources that specify this destination;
- *n*<sup>th</sup> Score Threshold: this threshold is used when multiple input sources contribute to this trigger. Otherwise trigger threshold from source configuration is used;
- *n*<sup>th</sup> Inhibit Timeout: is the time the Certimus waits before sending new command to the I/O Expander if a new event is detected after a previous command was sent;
- n<sup>th</sup> Acceptance Window: subsequent source triggers for a given destination are counted towards the cumulative score if they arrive within this window.

•

1st/2nd/3rd/4th Remote Source: This setting is used for multiple-destination triggering networks. The destinations specified here are other Certimus or Minimus based instruments, specified by the I.P. addresses configured in the "Remote Outputs" section:

Triggers configuration							
Source Tap Trigger A [OVELZ	0] V Score		100	Destination	1st Remote	e receiver	r v
Destinations							
		Remote	Outputs				
1st Address	1st Total Score	300	1st Score Thresh	old	0	t Inhibit neout	10
1st Acceptance Window 1							

- *n*<sup>th</sup> Address: the I.P. address of the remote Certimus;
- *n*<sup>th</sup> Total Score: this is an information field, it displays an automaticallycalculated total of the scores from all of the input sources that specify this destination;
- *n*<sup>th</sup> Score Threshold: this threshold is used when multiple input sources contribute to this trigger. Otherwise trigger threshold from source configuration is used.
- *n*<sup>th</sup> CAP Inhibit Timeout: is the time the Certimus waits before sending new message if a new event is detected after a previous message was sent;
- *n*<sup>th</sup> Acceptance Window: subsequent source triggers for a given destination are counted towards the cumulative score if they arrive within this window.

# 7.17.3 Low Latency Mode

In the "Setup" tab, the "Low Latency Mode" drop-down menu controls the processor workload that affects the power-consumption of the Certimus. This control can be used to prioritise power-consumption at the expense of latency, to balance the two or to optimise latency regardless of the power consumption. Three settings are available:

- Minimum Power ⇒ slow processing / higher latency;
- Balanced  $\Rightarrow$  optimal;
- Minimum latency  $\Rightarrow$  fast processing / lower latency.

#### **Revision History**

		güral	OPTIMISE PROTECT				
Status	Network Set	tup Trigger	Data Stream	Data Record	Transform Parameters	Storage	<b>Minimu</b> Logout Help
Digitizer Con Reboot				Reset All	Settings		t All Settings" button will t settings on other pages
Digitizer Con	fig						
Auto Refresh Host Label	1 SPRT-MIN	Auto Reboot Station Code	On Error TEST	Low Latency Mode Network Cod	Minimum Power	Site Name	No site
Bluetooth PIN Deploy Mode	0000 Normal ~	Bluetooth Deploy	Enabled	✓ Filter quality	Balanced Minimum Latency		

# 7.17.4 CAP receiver

Güralp Discovery includes a CAP (Common Alerting Protocol) receiver. It listens on a specified UDP port for incoming CAP messages. When one arrives, it is displayed and plotted on a map. In addition, the receiver can open a TCP connection to the cloud-based registry server and display CAP messages that have been sent to the registry server. See Section 7.18 on page 119 for information about configuring a registry server.

All CAP messages can be stored in a log-file. The full message is recorded so that it can be re-loaded later, if required.

The CAP receiver functionality is accessed using the context (right-click) menu in Discovery or clicking on "Edit" in the menu bar:

Gür	alp Systems	- Discovery										-		×
ile E	dit View	Help												
	CAP Re Add De miniSEE		lystem inimus	Name MIN-C456	Firmware Ver 1.2-8580	WAN Address 0.0.0.0	LAN Address 10.10.0.36	Netmask 255.255.0.0	Uptime 3 days 20 Hrs	Last Contact Just Now	Latitude 0.0000	Longitude 0.0000	Altitude 0.00	т 0
Active		FishAffinity	Affinity	SUPRT-AFFT	1.0-15757	0.0.00	10.10.0.22	255.255.0.0	56 days 1 Hrs	Just Now	0.0000	0.0000	0.00	0
0	0	SUPRT-MIN	Minimus	MIN-C555	1.2-8572	0.0.0.0	10.10.0.13	255.255.0.0	00:09:05	Just Now	51.3606	-1.1630	106.80	0
Active		fishyNAM	NAM2	SUPRT-NAM2	1.0-15757	0.0.0.0	10.10.0.1	255.255.0.0	34 days 19 Hrs	Just Now	0.0000	0.0000	0.00	0
Active		IISHYNAM	INAM2	JULKI NAMZ	1.0 13/3/	0.0.0.0	10.10.0.1	233.233.0.0	34 ddys 13 11 3	Just Now	0.0000	0.0000	0.00	0
<	1		1											2
	n Locally Systems	Registry	5	2.34.40.123								gü	ıralp	-

The CAP receiver window allows specification of the listening port. Each Certimus from which messages should be received must have this value specified as the "CAP Port" in its triggering settings (see Section 7.17.2 on page 111). The value should be between 1025 and 65535. You should avoid numbers in the list at

https://en.wikipedia.org/wiki/List\_of\_TCP\_and\_UDP\_port\_numbers.

# **Revision History**

Browse

CAP Receiver - Discovery		– 🗆 X
Port 11789		Start
Log events	Browse	Load from logfile
Use form	arding server	
Esland	United Kingdom Deutschland France España Copen Street Map ropatjabutors	
Clear events		Close

The reception of CAP messages can be enabled or disabled clicking on the Start button at the top, right-hand side of the window.

If you wish to forward the CAP messages to a server, type its IP address into the field and tick the check-box named "Use forwarding server". An error message is displayed if the entered IP address is not valid.

D CAP Receiver - Discovery		– 🗆 X
Port 11789		Start
Log events	Browse	Load from logfile
52.34.40.123 Vise forwarding server		
E osc forwarding server		

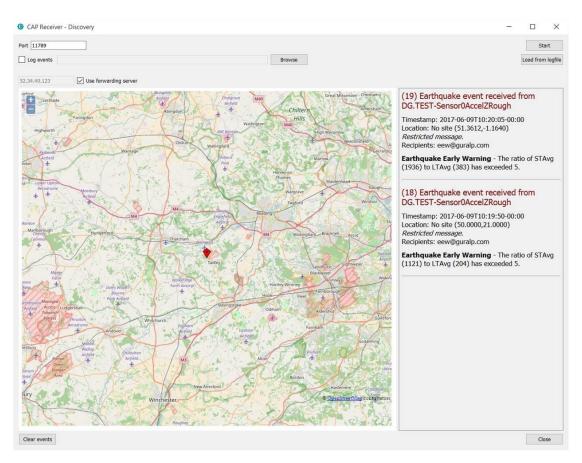
To log CAP messages to a file, tick the "Log events" check-box and use the button to select an appropriate location for the database file.

CAP Receiver - Discovery	_		×
Port 11789		Star	't
Log events     Browse	L	oad from	logfile
Use forwarding server			

To import an existing database of events, first enable logging, then browse to the file

using the Browse button and, finally, click the Load from logfile button to load the file. If no file is specified, the logging is automatically switched off and a pop-up message is displayed.

#### **Revision History**



When an event is detected and a CAP message is received, the location of the Certimus that generated the trigger is identified by a pointer displayed on the map. The events and the information contained in the CAP message are displayed at the right-hand side of the window. This includes the SEED identifiers, network, station, channel and location, along with the time, the recipients and the threshold value which was exceeded.

If the EEW parameters are enabled in a particular source, after the first CAP message containing the event information, three other messages with the PGA/PGV/PGD details are sent, one for each component.

Click on the Clear events button to clear markers from the map and descriptions from the right-hand-side list. This action does not affect the contents of the log-file.

#### Seismic Event Table

The Certimus can generate a "Seismic Event Table". This is list of events detected by the STA/LTA or threshold trigger enabled on taps. It contains information about the time when the event occurred, its duration, the channel that generated the trigger and the peak magnitude of the event. The seismic data before, during and after the event are saved in miniSEED format and can be downloaded using links in the table.

The table is located at the bottom of the "Trigger" tab in the Certimus web page.

# **Revision History**

### Güralp Certimus

Seismic Events Table				
Download Settings:	Seconds Pre 10	Seconds Post	0	Download Z,N,E Triplet
Time of Event Duration	Trigger Function (Tap) Peak Magnitude (Time)	Download Source Tap	,	Download
Thu Aug 2 12:21:17 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.50187 m.s	SOA	AccZA ∨	Request Event Data
Thu Aug 2 12:21:17 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.58626 m.s	SOA	AccZA ∨	Request Event Data
Thu Aug 2 12:21:17 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.27047 m.s	SOA	ccZA 🗸	Request Event Data
Thu Aug 2 12:20:46 2018 < 1 second	STA/LTA Trigger (0AXL20) 0.08352 m.s	SOA	ccNA 🗸	Request Event Data
Thu Aug 2 12:20:46 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.74786 m.s	SOA	xccZA ∨	<u>Request Event Data</u>
Thu Aug 2 12:20:46 2018 < 1 second	STA/LTA Trigger (0AXL20) 0.14463 m.s	SOA	ccNA 🗸	Request Event Data
Wed Aug 1 09:27:20 2018 < 1 second	STA/LTA Trigger (0AXL20) 0.2666 m.s	SOA	ccNA 🗸	Request Event Data

The Certimus allows the download of event data in miniSEED format in a time range that is user selectable. The user can select how many seconds before and after the event detection to include in the miniSEED file.

Download Set	tings:	Seconds Pre	10	Seconds Post	10	Download Z,N,E Triplet
	Jse the to the r	Flush data			-	copy most recent

The event table shows which of the components has caused the trigger and the user can chose to either download data related to that single component by deselecting the option "Download Z, N, E Triplet" or download data for all three components by leaving the option enabled.

Download Settings:	Seconds Pre	10	Seconds Post	10	Download Z,N,E Triplet
					and the second strate subject

The last column of the table contains links to downloaded and saved miniSEED files related to each event.

Time of Event Duration	Trigger Function (Tap) Peak Magnitude (Time)	Download Source Tap	Download
Thu Aug 2 12:21:17 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.50187 m.s	S0AccZA 🗸	Request Event Data
Thu Aug 2 12:21:17 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.58626 m.s	S0AccZA ~	Request Event Data
Thu Aug 2 12:21:17 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.27047 m.s	S0AccZA 🗸	Request Event Data
Thu Aug 2 12:20:46 2018 < 1 second	STA/LTA Trigger (0AXL20) 0.08352 m.s	S0AccNA 🗸	Request Event Data
Thu Aug 2 12:20:46 2018 < 1 second	STA/LTA Trigger (0AXL10) 0.74786 m.s	S0AccZA 🗸	Request Event Data
Thu Aug 2 12:20:46 2018 < 1 second	STA/LTA Trigger (0AXL20) 0.14463 m.s	S0AccNA 🗸	Request Event Data
Wed Aug 1 09:27:20 2018 <1 second	STA/LTA Trigger (0AXL20) 0.2666 m.s	S0AccNA 🗸	Request Event Data

**Note:** The links produce downloadable miniSEED files if and only if the requested data is available in the microSD card. This depends on last flushing time and selected post event time.

# 7.18 Using a registry

Discovery can maintain a list of all Minimus and Certimus units in a local <u>or</u> cloudbased registry, simplifying management of medium to large networks and removing the need for static IP addresses at telemetered stations. Registered digitisers appear in the selection list in the main screen, regardless of whether they are on the local network or not.

Note: Locally connected systems on the same physical network as the Discovery can be 'discovered' directly by Discovery by selecting 'Scan Locally'. This yields much the same information as using the registry but bypasses the need for the 'man in the middle' registry.

Each system simply send a status packet directly to the cloud server. The server remembers the contents of the packet which includes the serial number of the device. The Discovery application interrogates the registry server and displays a list of systems that belong to the requested Group ID.

A wide range of status parameters are displayed on the Discovery front page. These include:

# 7.18.1 Registry/Discovery State of Health

settable description of the remote instrument - set in the Network Tab

**System**: Text description of the product type as this idea is support by a wide range of Guralp systems.

**Name**: System name based on unique serial number eg. CERT-5A1D. The hexadecimal digits represent the last two bytes of the systems network MAC address.

Serial#: Decimal representation of the serial number.

**Firmware** Ver: eg 2.1.1234. This has 3 parts: Major.Minor:Build. Typically a build number variation implies bug fixes without significant manual or operational changes. A minor version number change implies new features or significant operational changes.

**WAN address**: Source IP address of the status packet that arrives at the registry server. This is usually the public IP of the internet connection to which the instrument is connected. Historically, this has often been required to be a static address. This is not the case as this is updated dynamically every time the system communicates.

LAN address: The local IP address of the instrument's LAN connection.

**Uptime**:Hours:minutes:seconds of the instruments uptime.

**Last Contact:** Time since the last status packet was received at the registry server. Losst of instrument power OR loss of internet connection cause this to start counting up...

**Latitude/Longitude/Altitude**: Location of the GPS antenna connected to the instrument.

**Timing Quality**: A measure in % of the quality of the time source and lock to it. This is derived from the measured drift between internal clock and the external GPS or PTP derived time. 0% implies NO connection to the time source (eg GPS not connected). 1% implies that some time communication exists. This may not be enough for a good time as the GPS may not be able to see the sky. The numbers should gradually increase to settle close to 100%. Mor GPS information is available on the WEB page status – eg No of satellites etc.

**Voltage**: The power voltage connected to the instrument.

**Humidity**: Internal humidity within the instrument. Typically this will remain at 20-50% If this climbs steadily it may indicate a leak in the instrument enclosure.

**Temperature**: Temperature within the instrument's electronics enclosure. Always above ambient due to dissipation of the electronics.

Free Storage: Percentage of available space on the SD card.

# 7.18.2 Registry management

Administrators can create their own registry servers by installing a simple program on a server. The server itself must have a static IP address and be accessible to all connected Minimus/Certimus units, as well as the PCs running discovery. Registry servers programs are currently available for Linux and Windows. Please contact Güralp technical support for details.

For administrators not wishing to install their own registry, Güralp provide a shared registry server in the cloud at 52.34.40.123 which customers are welcome to use.

Registered digitisers must be assigned to groups, each of which has a **Group Identifier**. Instances of Discovery must also be configured with a Group ID and can only display registered digitisers from the matching group. This allows partitioning of large networks into smaller administrative domains. It also makes possible the simultaneous use of the Güralp shared registry server by multiple organisations.

To use a registry:

- Choose whether to use the Güralp shared registry or to deploy your own. If deploying your own, install the software on your chosen server and note its public IP address.
- 2. Choose one or more Group IDs for your digitisers
- 3. Set the Registry server address and Group ID in each Minimus/Certimus

4. Set the Registry server address and Group ID in each instance of Discovery.

# 7.18.3 Configuring a Certimus for use with a registry

The address of the registry server and the chosen Group ID must be set individually for each participating Certimus.

To do this, first connect the Certimus to the same network as a PC running Discovery and click the Scan Locally button, so that the Certimus appears in the main Discovery

list. Right-click () on the digitiser's entry and select "View Web Page" from the context menu:

	Status	Label	System	Name	Serial#	Firmwa	are Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude		
1		NO LABEL	Minimus		4438	1.1-102		0.0.0.0	10.10.0.45	00:04:49	51.3607	-1.1630		
2		DEMO	Control Ce Live View	ntre		۰, <sup>2</sup>	22	0.0.0.0	10.10.0.36	19:49:55	0.0000	0.0000		
3	$\bigcirc \bigcirc \blacksquare$	Suppc	Firmware l	Jpdate			81	0.0.0.0	10.10.0.13	19:24:21	51.3608	-1.1628		
1	Active	FishAf		, nfiguration		6	528	0.0.0	10.10.0.22	22 days 20	0.0000	0.0000		
5	Active	fishyN	GDI Config File Exchar Edit Netwo			6	67	0.0.0.0	10.10.0.1	8 days 23 Hrs	0.0000	0.0000		
			Show On M	Лар										
S	Scan Locally	Registr	View Web	Page										
00	cal Systems		View Web	Page (in sy	tem brow:								gui	a
	,		Calibration			- +								
of	f 5 systems respo	nding	CAP Recei Add device											

In the resulting web page, select the "Network" tab. The Registry parameters can be found near the bottom of the resulting screen:

Registry					
Registry Update	Every 10Secs $ \smallsetminus $	Group ID	NothernArray	Registry Address	52.34.40.123

These are:

- **Registry Update**: the frequency at which the registry is updated with details of this digitiser can be specified here, using the drop-down menu;
- Group ID: the chosen Group Identifier should be entered here;
- **Registry Address**: the I.P. address of the registry should be entered here. To use the Güralp shared cloud server, enter **52.34.40.123**.

Once you have set the correct values, the digitiser must be rebooted before they will take effect. To do this, click the Reboot button.

# 7.18.4 Configuring Discovery for use with a registry

To specify a registry server for an instance of discovery, type its address into the field at the bottom left of the main screen:

NO LABEL         Minimus         MIN-1156         4438         1.1-1022         0.0.0.0         10.10.0.455         00:04:49         51.3607         -1.1630           DEMO 83         Minimus         MIN-C456         50262         1.1-1022         0.0.0.0         10.10.0.366         21:18:15         0.0000         0.0000           Support         Minimus         MIN-C555         50517         1.1-1031         0.0.0.0         10.10.0.133         20:52:41         51.3607         -1.1629	_	Status	Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude	
			NO LABEL	Minimus	MIN-1156	4438	1.1-1022	0.0.0.0	10.10.0.45	00:04:49	51.3607	-1.1630	
Support         Minimus         MIN-C555         50517         1.1-1031         0.0.0.0         10.10.0.13         20:52:41         51.3607         -1.1629			DEMO 83	Minimus	MIN-C456	50262	1.1-1022	0.0.0.0	10.10.0.36	21:18:15	0.0000	0.0000	
			Support	Minimus	MIN-C555	50517	1.1-1031	0.0.0	10.10.0.13	20:52:41	51.3607	-1.1629	

To set the Group ID in Discovery:

1. Select "Settings " from the "File" menu:

Güralp Syster	ms - Di	scovery						
<u>File Edit V</u> ie	w <u>H</u>	elp						
Settings		Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Ad
Exit		NO LABEL	Minimus	MIN-1156	4438	1.1-1022	0.0.0.0	10.10.0.4
2 🕑 🕓		DEMO 83	Minimus	MIN-C456	50262	1.1-1022	0.0.0.0	10.10.0.
3 🕑 🕓		Support	Minimus	MIN-C555	50517	1.1-1031	0.0.0	10.10.0.

2. Type the chosen Group ID in the "Cloud registry group identifier" field and click Apply

D Application configuration	Discovery		_		×
General					
Cloud registry group identifier	NorthernArray				
Default HTTP connection port	80				
Restore defaults		Cance	1	Appl	у

Return to the main windows and test the configuration by clicking the

Registry button. All Certimus using the same Registry server and Group ID should appear in the main list.

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# 7.18.5 Registry mode: using WAN or LAN addresses

When Discovery displays a list of devices found from a local scan, all access to those systems is initiated via the LAN address. When displaying a list of registered devices, you have the option of using either the LAN address or the WAN address. This can be useful when the WAN address has been configured but is not yet available or when a registered device is installed remotely and not available on the LAN. The feature is controlled by exactly where you right-click in the list of devices.

If you right-click anywhere other than in the LAN address column, the WAN address is used and the behaviour is otherwise exactly as previously documented. To access the digitiser via its LAN address, right-click in the LAN address column, as shown below:

		Statu	S	Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longi ′
5 (	0	0		NO LABEL	Minimus	MIN-FD57	64855	1.2-8572	192.0.2.157	10.0.1.64	30 days 4 Hrs	35.4279	-98.02
68	0	0		NO LABEL	Minimus Plus	MINP-6158	24920	1.3-2713	192.0.2.35	10.0.1.67	21 days 22 Hrs	51.3612	-1.164
67	0	0		bktest65	Minimus Plus	MINP-DC58	56408	1.2-8572	192.0.2.201	10.0.1.68	30 days 16 Hrs	37.8761	-122.2
65	0	0		bktest66	Minimus Plus	MINP-DD58	56664	1.2-8572	192.0.2.201	10.0.1.66	9 days 18 Hrs	37.8761	-122.2
63	0	0		bktest68	Minimus Plus	MINP-DE58	56920	1.2-8572	192.0.2.201	10.0.1.65	9 days 18 Hrs	37.8761	-122.2
66	0	0		bktest67	Minimus Plus	MINP-DF58	57176	1.2-8572	192.0.2.201	10.0.1.14	30 days 16 Hrs	37.8761	-122.2
64 ( <	0	0		bktest64	Minimus Plus	MINP-E058	57432	1.2-8572	192.0.2.201	10.0.1.186	30 days 16 Hrs	37.8761	-122.2
		cally		Registry 52	2.34.40.123	1							_

When you click on the LAN address of an entry, the context menu changes:

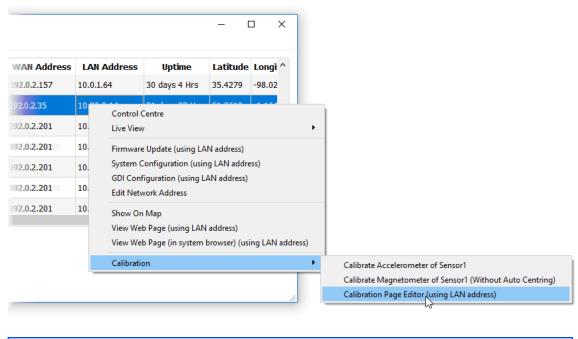
	System	Name	Serial#	Firmware Ver	WAN Address	LAN Ad	dress	Uptime	Latitude	Longi ^				
	Minimus	MIN-FD57	64855	1.2-8572	192.0.2.157	10.0.1.64		30 days 4 Hrs	35.4279	-98.02				
	Minimus Plus	MINP-6158	24920	1.3-2713	192.0.2.35	10	Control (	Centre	54.0640					
	Minimus Plus	MINP-DC58	56408	1.2-8572	192.0.2.201		Live View							
	Minimus Plus	MINP-DD58	56664	1.2-8572	192.0.2.201	10. j	Firmware	Update (using LA	N address)					
	Minimus Plus	MINP-DE58	56920	1.2-8572	192.0.2.201	10.	System C	ss)						
	Minimus Plus	MINP-DF58	57176	1.2-8572	192.0.2.201	10		DI Configuration (using LAN address) lit Network Address						
	Minimus Plus	MINP-E058	57432	1.2-8572	192.0.2.201	10.	Show On	Мар						
						1	View Wel	b Page (using LAN	address)					
52.	34.40.123					١	View Wel	b Page (in system	browser) (usi	ng LAN addre				
						(	Calibratio	n						

Entries for firmware updates, system and GDI configuration and web page access all now use the LAN address rather than the WAN address.

In addition, all options on the Live View sub-menu use the LAN address:

rial#	Firmware Ver	WAN Address	LAN	Address	Uptime	Latitude	Longi ^		
55	1.2-8572	192.0.2.157	10.0.1	.64	30 days 4 Hrs	35.4279	-98.02		
	1.3-2713	192.0.2.35	10,00	Control	Centre	C1 0(10			1
40 <b>8</b>	1.2-8572	192.0.2.201	10.	Live Viev	K			•	GDI (using LAN address)
6 <b>64</b>	1.2-8572	192.0.2.201	10.		े e Update (using LA	N address)			GCF (using LAN address)
9 <b>20</b>	1.2-8572	192.0.2.201	10.	-	Configuration (usir	-		L	GDI and GCF (using LAN addres
176	1.2-8572	192.0.2.201	10.		figuration (using L vork Address	AN address)			
432	1.2-8572	192.0.2.201	10.		n Map b Page (using LAN b Page (in system		ng LAN add	ress)	
				Calibrati	on			+	

and the calibration page editor is also invoked using the LAN address:



No to t

**Note:** For these techniques to work, the digitiser and PC must be connected to the same LAN.

# 7.19 Updating Certimus firmware

The firmware of the Certimus is upgradeable. New releases appear regularly – mostly to add new features but, occasionally, to fix problems. Güralp recommends that the Certimus is regularly checked for availability of firmware updates and, when convenient, these updates should be installed.

The procedure below guarantees a straightforward upgrade and prevents any data loss or misconfiguration.



**Note:** The latest version of Discovery software must be used to perform the firmware update of any Certimus digitiser. See Section 14.5 on page 173 for more details.

If you have any recorded data that you value, backup all files from the Certimus microSD card:

- 1. Unplug the external microSD card from your Certimus.
- 2. Plug the external microSD card into your PC.
- 3. Copy all files from the external microSD card into your PC.
- 4. Unplug the external microSD card from your PC.
- 5. Plug the external microSD card back into your Certimus.

Once this is complete, to upgrade the Certimus:

- 1. Run Discovery.
- 2. Right-click on the Certimus in Discovery main window and select "Firmware Update".

3. In the "Firmware Update" tab, select "Güralp server – stable (online version: 2.0-\*\*\*\*)" to obtain the new firmware from the Internet via a local Ethernet

FMUS-DA5B - Firmware Update - Discovery		-		×
Host name: FMUS-DA58 IP address: 10.10.0.11 MAC address: 00:50:C2:40:58:DA				
Configuration				
Automatically download/upload configuration				
O Reset configuration				
O Apply configuration from file			Browse	
Firmware				
Current firmware date: 14-Nov-2019 Current firmware version: 2.0-7886				
Güralp server - stable (online version: 2.0-7856) <u>Release notes</u>	Get from serve	r and up	date	
○ Güralp server - experimental (online version: 2.0-7856)	Get from serve	r and up	date	
O Local file	Browse	L	Jpdate	
				0%
			Close	•

connection. Click Get from server and update

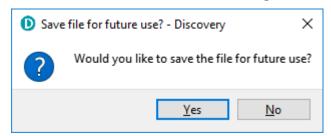
### **Revision History**

#### **Güralp Certimus**

**Caution:** If updating from any release of v1.2 to v2.0, select the option "Güralp server – version 2.0-\*\*\*\* (online)" only. Do not use "Local file" option unless agreed case-by-case with support@guralp.com.

Configuration	2:40:5B:DA	
Automatically dow	nload/upload configuration	
Reset configuration	on	
Apply configuratio	n from file	Brow
Firmware		
Current firmware date		
Current firmware vers		
<ul> <li>Güralp server - sta</li> </ul>	able (online version: 1.2-8713) <u>Release notes</u>	Get from server and update
🔘 Güralp server - ex	perimental (online version: 1.2-8713)	Get from server and update
O Local file		Browse Update
Güralp server -	version 2.0-7856 (online)	Get from server and update
		c

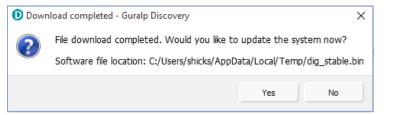
Discovery will ask you if you want to save the Firmware binary file for future use – click Yes for future use, e.g. update other systems offline using same firmware file. Otherwise, proceed with No



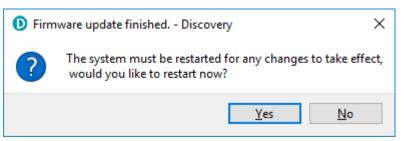
Discovery may ask to overwrite a temporary file on your PC – click
 Yes to allow it to do so.

File download - Guralp Discove	iry	_	×
	D File already exists Guralp Discovery       X         Image: C:/Users/shicks/AppData/Local/Temp/dig_stable.bin		
Close this window automatically v	Yes No Inen Tinisned.		

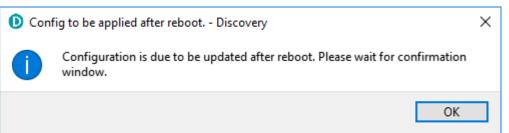
 Discovery will confirm through another dialogue box that the file download is complete. Click Yes to begin the firmware upload to the Certimus.



 At the end of the uploading process, the dialogue box will ask to restart the Certimus. Click Yes to finalise the process.

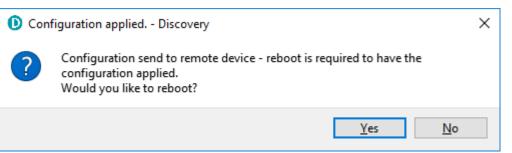


 A dialogue box will ask you if you want to upload the previous configuration. Click Yes to finalise the process.



9. When the configuration is uploaded, the Certimus needs to be restarted again.

Confirm with Yes to the dialogue box.



- 10. The Certimus will re-boot and, during this process, the displays will show a white screen with the Güralp logo in the middle and a progress-bar at the bottom.
- 11. Go to the "Storage" of the Certimus web page and Quick-format the microSD cards of your Certimus (for details, see Section 7.10.2.1 on page 60).
- 12. Check that all indicators are green (i.e. nothing in red nor in yellow) in Discovery.
- 13. Go to the "Status" tab of the Certimus web page.
- 14. Check that your Certimus firmware version is as expected.
- 15. Check that nothing red or yellow shows up in the "Status" tab of the Certimus web page.

# 7.20 Import / Export an existing configuration

Updating the Certimus' firmware can, occasionally, cause loss of configuration. We recommend that you export and save the current configuration before proceeding with an upgrade. This operation can be done through Discovery by right-clicking on the digitiser in the list and selecting "System Configuration" from the context menu:

	Status	Label	System	Name	Serial#	Firmware	Ver	WAN Address	LAN Address	l	Jptime	Latitude	Longitude		
	0	NO LABEL	Minimus	MIN-1156	4438	1.1-1022		0.0.0.0	10.10.0.45	00:	04:49	51.3607	-1.1630		
2		DEMO 83	Minimus	MIN-C456	50262	1.1-1022		Control Centre			7:55	0.0000	0.0000		
Ø		Support	Minimus	MIN-C555	50517	1.1-1031		Live View		۲	2:21	51.3607	-1.1630		
							Firmware Update								
								System Configura	1						
Scan	Locally	Registry	52	34.40.123				GDI Configuration	1						
Juan	Locally	Registry	JJ <b></b>	54.40.125				File Exchange							
cal S	ystems							Edit Network Address					gu	u	
								Show On Map							
of 5 s	ystems res	oonding						View Web Page							
								View Web Page (i	n system browser	)					
								,							
								Calibration •							
								CAP Receiver							
								Add device							

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Select "Use configuration from one of the devices". If more than one device is available, select the one from which the configuration should be downloaded. Click

the Download configuration button and browse to a suitable location (on your PC) into which to save the configuration file.

System Configuration Import/Export Tool ·	- Discovery	_		×
Configuration source				
$\textcircled{\ensuremath{ \odot}}$ Use configuration from one of the devices:	MIN-9555 (10.10.0.18)	Download	configura	tion
○ Use configuration from file:		Br	owse	
Devices Select devices for configuration upload				
select devices for configuration upload				
MIN-9555 (10.10.0.18)				
Select All				
Upload				
		Upload	configura	tion
		Rel	boot selec	:ted
			OK	

After the firmware update is successfully completed, the previous configuration can be imported, if required, by following the instructions below.

Right-click on the digitiser's entry in the Discovery list and select "System Configuration" from the context menu. Select the "Use configuration from file" option.

System Configuration Import/Export Tool	- Discovery	_		×
Configuration source				
$\bigcirc$ Use configuration from one of the devices:	MIN-9555 (10.10.0.18) 👻	Download	configurat	ion
Ose configuration from file:		Br	owse	
Devices				
Select devices for configuration upload				
MIN-9555 (10.10.0.18)				
Select All				
Upload				
		Upload	configurat	ion
		Re	boot selec	ted
			OK	

Select the configuration file from where it was saved in the File Explorer and confirm. Use the check-boxes to select the devices to which the configuration should be

uploaded and click on the Upload configuration button.

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Wait until the process finishes. To apply the new configuration, the unit has to be rebooted: the Reboot selected button can be used to perform the required system restarts.



**Note:** The configuration export and upload doesn't preserve the settings related to the applied transforms.

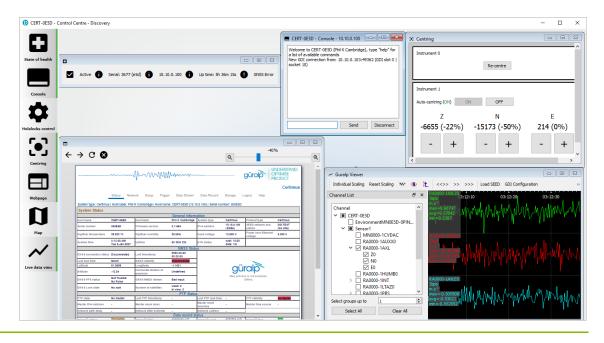
# 7.21 Control Centre

Several actions can be taken from within Discovery to control your Certimus digital accelerometer.

These operations can be performed by right-clicking on the digitiser's entry in the list and select "Control Centre" from the context menu. The meanings of the icons are given in the table below:

Icon	Function
State of health	This tab provides information about the general state of the instrument, its serial number and I.P. address, its up-time (time since last boot) and GNSS status.
Console	This button launches a console that allows interactions with the command line of the Certimus. The list of available commands and their respective descriptions can be displayed by entering the command "help". This should generally only be done on the advice of the Güralp technical support team.
Webpage	This button is equivalent to the "View Web Page" entry in the context (right-click) menu of the Certimus in the Discovery main window.
П	This button is equivalent to the "Show on Map" entry in the context (right-click) menu of the Certimus in the Discovery main window.
Live data view	This button is equivalent to the "Live View" entry in the context (right- click) menu of the Certimus in the Discovery main window.
Centring	This tab allows manual centring of the Certimus accelerometer.

# **Revision History**



# 7.21.1 Mass Centring

By default, the Certimus automatically keeps its masses centred. The Certimus's unique motorised mass centring system allows the masses to centre when the instrument is installed at any angle within ±90°.

To perform a manual centring of the masses, launch the Control Centre by rightclicking on the device in the Discovery main window. The Certimus is identified with the title "Instrument 1".

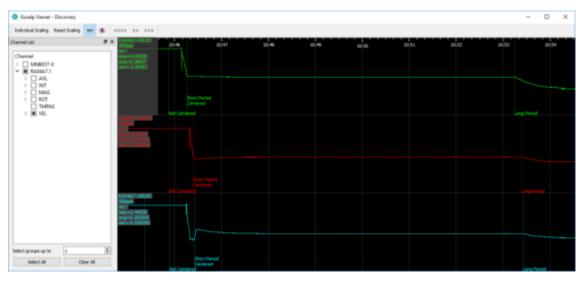
3	Centring
	Instrument 0
	Re-centre
	Instrument 1
	Auto-centring (ON) ON OFF
	Z N E
	727 (2%) -3801 (-12%) -15 (0%)
	- + - + - +

The mass position values in counts of the three components are showed in real-time under the corresponding component indicators (Z, N, E).

The mass positions can be adjusted manually:

- click the button to decrease the mass position value (i.e. make it less positive or more negative).
- click the <sup>+</sup> button to increase the mass position value (i.e. make it more positive or less negative).

In action starts the auto-centring procedure. The first stage consists in a rough mechanical centring which it is followed by a more accurate electrical centring sequence that lasts 7 minutes.



When the auto-centring is enabled, the centring procedure is activated as soon as the percentage reaches ±100%. To turn off Automatic Mass Centring, select the

OFF button in the Auto Centring option (not recommended). To restore the

default setting, click on the ON button.

# 7.22 Discovery Tunnel

To simplify the network configuration required to connect to a remotely deployed Certimus, it is possible to transmit and receive data via a Güralp Discovery Tunnel. Much like a VPN, this removes the need for setting inbound traffic firewall rules and requiring a known static public IP address for each device in the field.

This feature is built into the latest versions of Discovery, Certimus firmware (Dig) and the Registry server.

# 7.22.1 Tunnel Configuration

#### Certimus

In the network tab of the web page, ensure that the (or the first slot, if more than one) "Registry Address" is set to the tunnel enabled Registry server you wish to use.

Registry	-												
Registry Update Every 10Secs V	Group ID ben	Registry Address	.168.216.36 Registry Addr	ress 52.34.40.123									
Registry Address 0.0.0.0	Registry Address 0.0.0.0												
Discovery Tunnel													
Tunnel Auto Connect	Tunnel Status Connected												

Once the Registry server to be used as the tunnel relay is set, tick the "Tunnel Auto Connect" check box to connect.

#### **Registry Server**

The latest version of the Güralp Registry Server software will operate as a tunnel relay if enabled. To enable this feature, set the "-t" argument when starting the server software.

The console output will contain *"[TUNNEL] Initialising Tunnel Relay Server"* if the tunnel relay feature has been enabled successfully.

Alternatively, Güralp maintain a public tunnel enabled Registry server for convenience and testing purposes, located at *18.168.216.36* Please note that we recommend operating your own Registry server, especially when making use of the Discovery tunnel.

#### Discovery

Set the Registry server to the same tunnel enabled Registry server that your devices are connected to. Set Discovery to "Registry" mode and confirm that all devices appear as expected.

# **Revision History**

#### **Güralp Certimus**

Güralp Systems - Discovery		- 🗆 X
File Edit Tools Window Help		
Status L Status BE Scan Locally Ctrl+L Registry Ctrl+R	erial# Firmware Ver WAN Address LAN	Address Uptime Latitude Longitude Tunnel Available 0.47 06:44:56 51.3615 -1.1639 Available
Show ,	Status	0.47 00:44:30 51:3015 -1:1039 Available
L	✓ Label	
	✓ System	
	V Name	
	✓ Serial#	
	<ul> <li>Firmware Ver</li> </ul>	
	Connection Type	
	VWAN Address	
	LAN Address	
	Netmask	
	✓ Uptime	
	Last Contact	
	✓ Latitude	
	Longitude	
	Altitude	
	Timing quality	
	Voltage	
	Humidity	
	Temperature	
	Free storage	
	Last EEW Timestamp	
	Last EEW PGA Peak	
Scan Locally Registry Cloud server config	<ul> <li>Tunnel Available</li> </ul>	ou''irolo
Registered Systems		guiap

Via "Window"  $\rightarrow$  "Show"  $\rightarrow$  "Tunnel Available", ensure the "Tunnel Available" column is visible in the Discovery window.

All devices that are configured to instantiate a Discovery Tunnel connection to this Registry will display as "Available" in the "Tunnel Available" column.

tus La	bel System Name Serial	# Firn	ware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude	Tunnel /
BEN	MIN-2B57 127.0.43.87	214	1039	89.213.16.113	10.30.0.47	06:50:26	51.3615	-1.1639	Available
	Control Centre								
	Live View	•	GDI	L					
	Firmware Update System Configuration Device Port Configuration GDI Configuration Edit Network Address File Exchange Tunnel Status	U	GCF GDI and	d GCF					
	Show On Map View Web Page View Web Page (in system brows Calibration	W er)							

Right clicking on any column other than "LAN Address" or "WAN Address" will now cause Discovery to connect via the tunnel for the given service or feature. This can be confirmed by observing that the displayed IP address is a local loopback address, not a LAN or WAN address, indicating utilisation of the tunnel.

# **Revision History**

-	Label	System	n Name	Serial#	Firmware	Ver	WAN Address	s LAN Address	Uptime	Latitude	Longitude	Tunn	el A
	BEN-MIN	Minimus	MIN-2B57	11095	2.1-11039	8	89.213.16.113	10.30.0.47	06:54:56	51.3615	-1.1639	Availa	ble
	D (MIN	-2B57) Tur	nnel - Discove	ery								?	×
	Tunne	l Relay 🕻	Connected	нттр	Web	127.0	.43.87:22080						
	Devic	e C	Connected	GDI		127.0	.43.87:1565						
				GCF		127.0	.43.87:1567						=
					xchange		.43.87:4242						=
													=
				Remo	te Console	127.0	.43.87:4244						
				RPC		127.0	.43.87:11788						
				SeedL	ink	127.0	.43.87:18000						
	16/06/	21 16:35	:41: Incomn	ning head	er 🛛 "010100	024061	d717d00002b5	759d51071675b" 759d51071675b"	] src: 156	55 dst: 290	53 prot: 1 ler	n: 36	^
								759d51071675b" 759d51071675b"					
								759d51071675b"					
								759d51071675b"					
								759d51071675b" 759d51071675b"					
								759d51071675b"					
								759d51071675b"					
		21 16.35	:41: Incomn	ning head				759d51071675b"					
	16/06/							759d51071675b"					

Further details regarding the current status of each device's tunnel connection and the service available via the tunnel can be accessed by opening the "Tunnel Status" feature from the right click context menu for a given device.

# 8 Instrument State of Health (SoH)

There are multiple ways of reporting and viewing the SOH of an instrument.

Many of these are based on the network connection an can be scripted, fetched by HTTP or Discovery or the users application code.

There are also files written to the SD card at intervals.

The debug/Serial port has commands that will return various status's.

The GüVü App reports SoH via Bluetooth. The LED flash sequences report certain errors.

# 8.1 Commands on the debug RS232 serial port

The web page interface consists of named parameters with their respective values.

There Name/Value pairs can the read and written from the serial debug port. This feature is offered specifically for the rarer applications where connectivity can only be provided by RS232 connection and not the LAN Ethernet.

A group of commands are available under the name "var"

var ? - lists available commands

var get "Digitiser humidity" - read contents of the named variable "Digitiser Humidity"

var set "DHCP" 1 - enable DHCP mode (as seen on the Network TAB of the web interface)

var get "Integrator Z (1)" - mass position of first sensor's vertical mass

var get "Temperature (1)" - temperature

# 8.2 HTTP and web page access

Several files containing data can be downloaded from the in-built WEB server.

# 8.2.1 ASCII Text status

http://1.2.3.4/status.txt

#### **Revision History**

#### **Güralp Certimus**

\*\*\*\*\* 2020-11-19 15:05:35 \*\*\*\*\* Digitizer er Host name: CERT-CB5E Host label: CERTINUS#2 System type: Certimus SEED network: DG SEED station: 0CB5E Site name: No Site Firmware version: 2.1-240 System bot time: 19.11.2020 12:21:42 System uptime: 2h 43m 50s Environment Environment Temperature: 34.639 °C Relative humidity: 30.35% Relative numbarry: 50.55% Power supply Input voltage: 12.700 V Power over Ethernet voltage: 0.010 V Network configuration IPv4 address: 10.30.0.122 Subnet mask: 255.255.0.0 Gateway: 10.30.255.1 Gateway: 10.30.255.1 Mode: DHCP MAC address: 00:50:C2:40:5E:CB IPv4 sockets used: 12 out of 20 IPV4 sockets used: 12 out of 20 GNSS status Latitude: -59.9000 Longitude: 94.7090 Altitude: -12.34 m Horizontal dilution of precision: Last timestamp: 0000-00-00 00:00:00 Last lock time: 1970-01-01 00:00:00 Stability: 0% Stability: 0%
tus
PTP state: Phase Locked
Last PTP timestamp: 2020-11-19 15:05:352
Last PTP lock time: 2020-11-19 12:22:482
PTP stability: 100%
Master IPv4 address: 10.30.255.56
Master clock class: PRI\_REF\_PTP
Master clock accuracy: <2.5us(0x24)
Master time source: GPS
Network path delay: 18.1 us
Network jitter estimate: +/- 434 ns
Network outliers: 4%
O cards</pre> PTP status microSD cards External slot: Card detected / Card usable / Primary card Internal slot: Card usable / Backup card Internal Slot; Canada Primary card Status: Recording Capacity: 122814464 KiB Used: 752136 KiB Backup card Status: Recording Number of sensors detected: 2 Sensor@ Serial number: Firmware version: 1.4 Sensor1 Serial number: Firmware version: 1.4 Temperature: 40.36 °C Rotation: yaw = 0.000°, pitch = 0.000°, roll = 0.000°

# 8.2.2 Station XML

http://1.2.3.4/station.xml



### 8.2.3 Dataless Seed

This can be extracted by downloading the DG.dataless file from the Storage TAB of the WEB interface. The same file is available by direct URL

http://1.2.3.4./DG.dataless

MAN-CER-0001 202 141 Issue Error! Reference source not found. - June,

# 8.2.4 System Configuration

http://1.2.3.4/config.txt

returns name/value pairs of WEB interface parameters

# 8.2.5 Instrument response

http://1.2.3.4/calib.txt

Returns pole/zero/gain values

Hexadecimal values are IEE754 32 Bit single precision floats – little endian

# 9 GüVü app

The GüVü app provides monitoring and control of near-by Certimus digital seismometer using the Bluetooth protocol. It is available for both Android and Apple devices.

GüVü can be downloaded from the Google Play store at:

https://play.google.com/store/apps/details?id=com.guralp.whisper

or from the Apple store at:

https://itunes.apple.com/us/app/id1208418113

# 9.1 Getting started

(

To launch GüVü, follow the steps shown in the figure below:

1	0 н н П л лиз но								*	3	güralp Ø		Disconnected		güralþ	0	Disconne	
	- × +	31 Cuinta	Canes	Chopme	Cook						guidip -			De	vice list: +6855 :16-1F:75:50:0C)			
	Contacto	Decs	Downloads	Dive	ES File Explorer													
		CCP viewer	Grad	Geogre	G+ Coogle+		gù	iro	lp									
	güvü g.v.	Hargoute	Keep	Mage	Potes		GüV				Tap on bluetooth	i icon to scan and co	nnect to device.			*		
	Pier Books	Pay Games	Play Movies & TV	Pay Music	Pity Newsstand													
	Pag Store		Steets	Sides	hett													Scanning
							Þ	0	0		⊲	0			0	0		

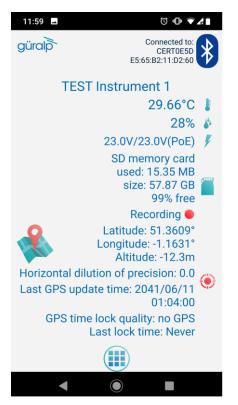
Steps for launching the GüVü App:

- 1. Launch by clicking on the GüVü icon from either the Apps menu or from the Home Screen.
- 2. Wait a few seconds for the app splash screen.
- 3. Press the Bluetooth icon (<sup>35</sup>) to enable Bluetooth connectivity (if not already enabled) and to search for available devices with which to pair.
- 4. Select the appropriate Certimus device from the list of available devices. Wait a few seconds for the main viewer screen to show.

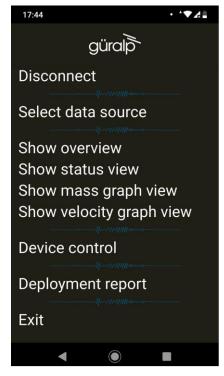
The instrument connection screen can also be accessed by pressing the menu icon

(I) on the main instrument status window, and selecting the "Connect" option.

If you experience problems connecting, try forcing GüVü to quit and then relaunching the app. Once the device is connected, the main view of the app will be displayed. This screen displays a number of status indicators associated with both the digitiser and accelerometer. These features are summarised in the figure below:



Access the menu by pressing the menu icon (IIII) on the main instrument status window:



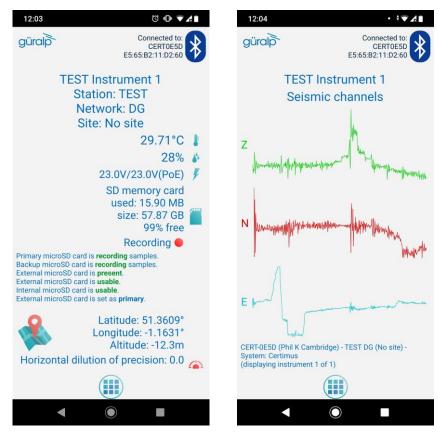
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## 9.2 View settings

The user can customise the view of the main instrument status window. Four

different view options can be cycled through by tapping the menu icon (()) on the main instrument status window:

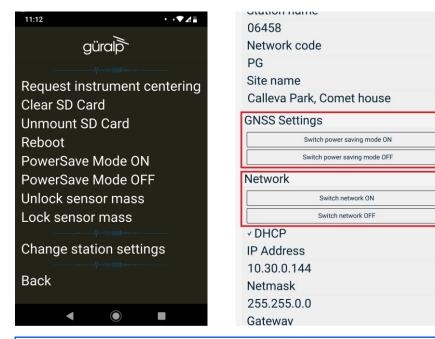
- .View settings
- The user can customise the view of the main instrument status window. Four different view options can be cycled through by tapping the menu icon (III) on the main instrument status window:
- **Show overview** the default view setting; show state-of-health status, mass positions, and sensor traces on a single screen;
- Show status view show state-of-health on the main screen only;
- Show mass graph view show mass position traces on the main screen only; and
- Show velocity graph view show sensor traces on the main screen only.



## 9.3 Instrument control

Several features of the Certimus can be controlled and configured remotely over Bluetooth using GüVü:

- Mass centring
- Clearing and un-mounting SD card
- Rebooting the Certimus
- Station meta-data (User Label, Station Name, Network Code, Site Name)
- Enable/disable GNSS.
- Enable/disable Ethernet.
- Network setting (I.P., Netmask, Gateway)
- Changing main channels' sampling rates
- In each case, GüVü will report whether the selected command has been successfully sent to the device.



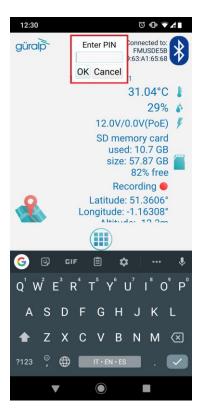
**Note:** After any modification to station settings, the Certimus must be rebooted before the changes will take effect.

These options can be accessed by tapping the menu icon (()) and choosing the "Device control" option. To access the instrument control and configuration sub-

menu, a PIN code has to be entered by selecting the text entry box and tapping OK

#### **Revision History**

#### Güralp Certimus



The default PIN code used to access the Instrument Control menu is "0000".

**Caution:** Güralp recommends changing the PIN code from the default, as described in the following section, in order to maintain station security.

#### 9.3.1 Setting the PIN code

The PIN code for accessing the instrument control menu of GüVü can be changed from the "Setup" menu of Güralp Discovery. The new four-digit PIN code should be entered into the "Bluetooth PIN" field. The new value is applied by keying ENTER

); or clicking the left mouse button in any other setting box.

Digitizer Config								
Auto Refresh	1	Auto Reboot		Low Latency Mode	Balanced $\lor$			
Host Label	SPRT-MIN	Station Code	TEST	Network Code	DG	Site Name	No site	
Bluetooth PIN	0000	Bluetooth	Enabled 🗸	Filter quality	High 🗸			
Deploy Mode	Normal ~	Deploy				-		

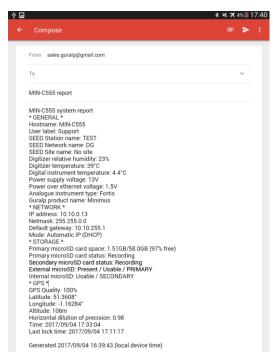
#### 9.3.2 Emailing a deployment report

The GüVü app has a feature that allows the user to generate an automatic deployment report that can then be filed via email.

- The deployment report includes the following details:
- System name

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- Station name
- Network code
- Instrument user label
- Memory card storage size and recording status
- Location of site (GNSS latitude, longitude, elevation)
- Time of deployment
- GNSS lock quality
- Power supply status
- · Instrument temperature and humidity recordings
- To send a deployment report, tap the menu icon (I) and choose the "Deployment report" option. GüVü will then open the default email application on the device, showing a draft email which will include the parameters described above.



# 10 Advanced troubleshooting

In the unlikely event of the user experiencing problems with the operation of the Certimus, a diagnostics tool is available via the GNSS connector, which also acts as a terminal communications device via a Serial connection.

The user should first plug in the serial adapter to the GNSS connector, which is then attached to a 9-pin COM port on your PC/laptop (if a 9-pin COM port is not available, a serial-to-USB converter should be used instead and connected to an available USB port. Güralp recommend converters based on the FTDI chip-set.)

A connection is then made using a terminal emulator, such as minicom under Linux or PuTTY under Windows. The appropriate COM port should be entered in the "Serial line" box and the Speed should be set to 115,200.

🕵 PuTTY Configuration		?	×
Pulliy Configuration         Category:         □- Session         □- Terminal         □- Terminal         □- Terminal         □- Terminal         □- Features         □- Window         □- Window         □- Window         □- Selection         □- Colours         □- Colours         □- Connection         □- Data         □- Proxy         □- Tenet         □- Rlogin         ⊡- SSH         □- Serial	Basic options for your PuTTY set         Specify the destination you want to connect         Serial line         COM1         Connection type:         O Raw       Telnet         O Raw       Telnet         Nave or delete a stored session         Saved Sessions         Default Settings         Web Mirror         Close window on exit:         O Always       Never         O Only on close	ssion ct to Speed 115200 I  Se Load Save	ejal
<u>A</u> bout <u>H</u> elp	<u>O</u> pen	<u>C</u> ance	el

Finally click the Open button and a terminal window will open, connected to the console of the Certimus.

In the event of any operational issues, the Güralp Support Team may request you to interact with the console in order to diagnose and fix problems.

### **10.1** Reset all settings during boot phase

The Certimus can be reset to its factory settings during its boot-up stage. This is useful in cases where:

- the user is not able to communicate with the Certimus via the LCD;
- the user is not able to communicate with the Certimus via a network connection;
- the unit is not responsive; or
- the unit does not appear in the Discovery software's scan results.

To carry out a full system reset, connect to the terminal port via a serial connection (as described in Section 10 on page 147). During the middle part of the boot phase, when the text @GURALP SYSTEMS and the firmware version number is displayed, key

Ctrl + R. This causes all settings (except Username, Password and Bluetooth PIN) to revert to their factory default values, and the Certimus will re-boot. It may be necessary to enter this key combination several times.

A typical boot log is shown below, identifying the stages where Ctrl + R will cause the Certimus to reset and re-boot.

Do not press any buttons during the first phase of boot-up:

RomBOOT SCKC\_CR = 0xA, CKGR\_MOR = 0x100FF0A, CKGR\_PLLAR = 0x20FDD101, PMC\_MCKR = 0x1122, PIO\_PDSR = 0xF2357EB5 SCKC\_CR = 0xA, CKGR\_MOR = 0x100FF0A, CKGR\_PLLAR = 0x20AC3F01, PMC\_MCKR = 0x0202, PIO\_PDSR = 0xF2357C25 AT91Bootstrap v3.8.10-1.guralp NAND: ONFI flash detected NAND: Manufacturer ID: 0x2C Chip ID: 0xDA NAND: Page Bytes: 2048, Spare Bytes: 64 NAND: ECC Correctability Bits: 4, ECC Sector Bytes: 512 NAND: Disable On-Die ECC NAND: Initialize PMECC params, cap: 4, sector: 512 NAND: Image: Copy 0x92000 bytes from 0xE000 to 0x2FA0E000

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#### **Revision History**

#### **Güralp Certimus**

```
NAND: Done to load image
SCKC CR = 0xA, CKGR MOR = 0x100FF02, CKGR PLLAR = 0x20AC3F01,
PMC \overline{M}CKR = 0 \times 0202, \overline{P}IO PDSR = 0 \times F2357C25
U-Boot v2019.10-1.guralp
CPU: SAMA5D36
External clock: 12.000 MHz
CPU clock: 528.000 MHz
Master clock: 132.000 MHz
DRAM: 512 MiB
NAND: 256 MiB
MMC: Atmel mci: 0, Atmel mci: 1
Loading Environment from NAND... OK
     serial
In:
Out: serial
Err: serial
Net: eth0: ethernet@f0028000
Total of 1 word(s) were the same
PHY 0x07: OUI = 0x0885, Model = 0x22, Rev = 0x02, 10baseT, HDX
Hit any key to stop autoboot: 0
NAND read: device 0 offset 0x5C0000, size 0x360000
 3538944 bytes read: OK
Uncompressed size: 5009436 = 0x4C701C
crc32 for 21000000 ... 214c701b ==> b6ae61d4
Total of 2 word(s) were the same
Total of 1 word(s) were the same
## Starting application at 0x00300000 ...
(boot)Crash Info###
Number of crash left=0
(boot)Last crash time:1970-01-01T00:00:00.000
```

```
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```

151 Issue Error! Reference source not found. - June,

```
Board type set to: Certimus
Recognised external clock: 12000000 Hz
SCKC_CR = 0xA, CKGR_MOR = 0x100FF02, CKGR_PLLAR = 0x20AC3F01,
PMC_MCKR = 0x0202, MCK = 132000000 Hz
```

@GURALP SYSTEMS

Once the "@GURALP SYSTEMS" banner has been printed, keying Ctrl + R (at least once) will cause all settings (except Username, Password and Bluetooth PIN) to revert to their default values and cause the Certimus to reboot.

```
v2.0-7642 by teamcity on 10:41:19 12-Nov-2019
Vecbase: 300000 CPUid: 410fc051 Cache: c5187d
PMT init
Unsafe to change DBGU clock while running
mux start SP 300fb4
FPU start
VFP Id=41023051
    0.00 | -> init dbgprint
    0.00 | -> init cmdutils
    0.00 | -> init pmt dlg
    0.00 | -> init memdlg
    0.00 | -> malloc debug
    0.00 | -> start timer interrupts
    0.01 | -> rtc init
RTC Time: 2019-11-13T10:05:37 UTC
    0.01 | -> uart start_ints
    0.01 | -> init arm parse
    0.01 | -> t init task utils
    0.01 | -> gpio init
##### NORMAL INITIALISATION MODE #####
    0.01 | -> unit test init
    0.01 | -> init devio
    0.01 | -> init usart
    0.01 | -> init devio cmds
    0.02 | -> rpc init
                       152 Issue Error! Reference source not found. - June,
```

```
MAN-CER-0001
202
```

202

```
0.02 | -> ram_init
0.02 | -> ram exchange init
0.03 | -> system update init
```

If your key-strokes have been recognised, Ctrl+R will be printed in the boot log, as shown below - once for each time your keystrokes were logged:

```
0.03 | -> i2c init
              i2c configure( 0, 100000Hz )
              Using pclk 33000000, cdiv 161, shift 0 => 100000
              i2c configure( 1, 100000Hz )
              Using pclk 33000000, cdiv 161, shift 0 => 100000
              i2c configure( 2, 100000Hz )
              Using pclk 33000000, cdiv 161, shift 0 => 100000
                   0.06 | -> i2c dac init
              Ctrl+R
              Ctrl+R
              <mark>Ctrl+R</mark>
              Ctrl+R
              Ctrl+R
              Ctrl+R
              Ctrl+R
                   0.06 | -> i2c humid init
              Humidity sensor test SUCCESS
                   0.07 | -> fram init
              Installing NVR device. size 12640
                   0.10 | -> net sockets init
                   0.14 | -> newtask init
              USE ADC Certimus
                   0.14 | -> display init
              i2c rd S FAILED [bus: 2 | slave: 0x38]
              i2c rd S FAILED [bus: 2 | slave: 0x38]
              i2c rd S FAILED [bus: 2 | slave: 0x38]
              ###FAIL OF i2c write( 2, 38, 1[000000], 1, 0x22a4ff7b )
                after 3 attemptsi2c configure( 2, 100000Hz )
MAN-CER-0001
                                      153 Issue Error! Reference source not found. - June,
```

Using pclk 33000000, cdiv 161, shift 0 => 100000 If you saw the previous i2c operations failing, do not panic, it was an attempt to detect FT6x36 touchscreen... GT911 PIN CONFIGURATION... GT911 SETTING PINS TO 0... GT911 SETTING PINS TO 0... GT911 SETTING RESET TO 1... GT911 SETTING GT911 PIN IRQ TO INPUT... GT911 Config checksum: 9a GT911 Product ID: 00 31 31 39 GT911 Firmware Version: 1060 GT911 Vendor Id: 00 GT911 Config Version: 00 GT911 Written Resolution of X/Y Axis: 0000-0000 GT911 resolution X (0x8146) / resolution Y (0x8146) / Touch number: 0000 / 0000 / ff gt911 has been detected 2.69 | -> aux ioexp init 2.70 | -> init whalesong 2.70 | -> analog232 init 2.73 | -> start timers 2.76 | -> spi datalink init semaphores 2.79 | -> chain init Using 251 coefficients.

2.87 | -> var user init 3.20 | -> calibration\_init 4.86 | -> gcftx init 4.89 | -> spi datalink chains init Sensor0 is accelerometer 5.15 | -> init nand 6.18 | -> adc12 init  $6.20 \mid -> init random$ 6.24 | -> ltc4151 vc monitor init

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```
6.27 | -> voltage_sniffer_init
    6.31 | -> init lut
    6.42 | -> i2c humid init ui
    6.45 | -> sd init
    6.48 | -> sd file init
    6.51 | -> sd log init
    6.54 | -> streaming client init
2019-11-13T10:05:43.000Z Retime Request Waiting (35s/3600s/Boot
delay)
    6.59 | -> xtaltable init
No XTAL table found.
    6.71 | -> gps pps init
Chain 54 already set.
FMUS-DA5B->
              6.82 | -> init var debug
    6.85 | -> tcpdump init
    6.88 | -> var html init
    6.91 | -> init http server
    6.94 | -> sd init var
    6.96 | -> gps_pps_ui_init
    6.99 | -> xtaltable ui init
checking for xtaltable.txt
    7.03 | -> init_fpga_datalink
    7.06 | -> init auto center
    7.09 | \rightarrow init embedded fs
    7.12 | -> status txt init
    7.18 | -> lan init web
```

```
#####tx_lock:
majic:f710f7f7
 Call lock value:-1
                     7.19 | -> init responder ui
1969-12-31T23:59:59.459Z User variable "Group ID" modified (called
from init responder ui)
    7.20 | -> init tunnel ui
    7.24 | -> quasar init
Quasar Serial Isolated Input/Output Module support is disabled.
    7.31 | -> quasar init ui
    7.31 | -> applied rot init web
    7.31 | -> installation parameters init web
    7.35 | -> init Certimus web
    7.39 | -> analog232 init web
    7.46 | -> init transforms
    7.49 | -> triggers init ui
    7.66 | -> chain init web
    7.95 | -> transform init web
    9.11 | -> storage_init_web
    9.16 | -> spi datalink ui init
    9.20 | -> gps init ui
    9.23 | -> gps init
```

Once the boot-up reaches this stage, pressing Ctrl + R will no longer have any effect.

If Ctrl + R was recognised during the second stage of boot-up, then the Certimus will reset and re-boot:

```
Ctrl+R NVR load, resetting all vars to their default values and
then rebooting
Forcing all vars to default values (including non-default-able)
PPS clock sources ACTIVE: 0x00000001 [GPS:0 PTP:0 RTC:0 TABLE:1]
PPS clock sources ACTIVE: 0x01000001 [GPS:1 PTP:0 RTC:0 TABLE:1]
PPS clock sources ACTIVE: 0x01010001 [GPS:1 PTP:1 RTC:0 TABLE:1]
PPS clock sources ACTIVE: 0x01010001 [GPS:1 PTP:1 RTC:1 TABLE:1]
Ctrl+R
Ctrl+R
```

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#### <mark>Ctrl+R</mark>

sd manager: probed both microSD card slots 11.58 {calibration.c;1142} calibration write to fram: successfully wrote calib to FRAM 11.60 {var nvr.c;773} 'sd format time' \$20301021 --> \$00000000 11.61 {var\_nvr.c;773} 'sd\_unmount\_time' \$22647008 --> \$0000000 11.62 {var nvr.c;773} 'pps src table' 168 --> 1 11.63 {var nvr.c;773} 'pps src gps' 0 --> 1 'pps src ptp' 69 --> 1 11.63 {var nvr.c;773} 11.64 {var nvr.c;773} 'pps src rtc' 132 --> 1 11.64 {var nvr.c;773} 'rtcSavedOffsetSecs nv' -1737983855 --> 0 11.65 {var nvr.c;773} 'rtcSavedOffsetNano nv' 402788896 --> 0 11.66 {var nvr.c;773} 'rtcSavedFreqErrorPPB nv' -2129883872 --> 1000000 11.67 {var nvr.c;773} 'rtcSavedOffsetTime nv' \$52080158 --> \$00000000 11.68 {var\_nvr.c;773} 'xtaltable\_offset' 610275339 --> 0 ÷

# 11 Appendix 1 – Instrument/channel names

The tables in this section show the names and codes of the streamed channels along with the record names and channel codes for recorded data. The first character "x" in miniSEED channel code represents the sample rate. The possible values are shown in the table below:

F	≥ 1000 Hz to < 5000 Hz
С	≥ 250 Hz to < 1000 Hz
н	≥ 80 Hz to < 250 Hz
В	≥ 10 Hz to < 80 Hz
М	> 1 to < 10
L	≈1
v	≈ 0.1 Hz
U	≈ 0.01 Hz
R	≥ 0.0001 Hz to < 0.001

The "Data record names" of the seismic channels and MEMS accelerometer channels are postfixed with "A" or "B". This notation distinguishes between the two different sample rates that is possible to select for each recorded channel. For example, the recorded streams SOAccZA and SOAccZB carry digitisations of the same signal, differing only in the sample rate.

## **11.1 Environmental channels**

	Comp.		Data streaming		Data recording	
Sensor		Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code
		Acausal	S0AccZ	0AXL10	S0AccZA	xN1
	1	Acausai			SOAccZB	xN1
		Causal	S0AccelZLowLat	0AXL1C		xN1
	2	Acausal	SOAccN	0AXL20	SOAccNA	xN2
MEMS accelerometer					SOAccNB	xN2
		Causal	S0AccelNLowLat	0AXL2C		xN2
	3	Acausal	SOAccE	0AXL30	SOAccEA	xN3
					SOAccEB	xN3
		Causal	S0AccelELowLat	0AXL3C		xN3
Magnatamatar	1	Acausal	S0MagZ	0MAG10	S0MagZ	xF1
Magnetometer	2	Acausal	S0MagN	0MAG20	S0MagN	xF2

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#### **Revision History**

#### Güralp Certimus

		Data streaming			Data recording	
Sensor	Comp.	Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code
	3	Acausal	S0MagE	0MAG30	S0MagE	xF3
Input voltage		Acausal	S0Voltage	0VINP0	S0Voltage	xYV
Digitiser power usage		Acausal	S0Power	0PINP0	S0Power	хҮР
Humidity	Relative within Minimus	Acausal	S0HumidA	0HUMA0	S0HumidA	xIO
Humany	Within sensor enclosure	Acausal	S0HumidB	0HUMB0	S0HumidB	xIO
Pressure	Within sensor enclosure	Acausal	S <i>n</i> Pressure	<b>n</b> PRSR0	S <i>n</i> Pressure	xDI
	External	Acausal	S <b>n</b> ExtPressure	<b>n</b> PRSR1	S <i>n</i> ExtPressure	xDO
<b>T</b>	Precision temperature	Acausal	S0TemprA	0TMPA0	S0TemprA	хKO
Temperature	First derivative of temperature	Acausal	S0TemprD	0TMPD0		xKD
	Internal clock offset from GNSS	Acausal	ClkGpsOffset	0CGPSO	ClkGpsOffset	BEO
	Internal clock period difference from GNSS	Acausal	ClkGpsPeriod	0CGPSP	ClkGpsPeriod	BEF
Internal Clock	Internal clock DAC frequency pulling	Acausal	ClkDacFreqPull	0CVDAC	ClkDacFreqPull	BED
	Test internal clock drift	Acausal	ClkTestPbpS	0CTSTB	ClkTestPpbS	BEB
	Internal clock offset from PTP	Acausal	ClkPtpOffset	0CPTPO	ClkPtpOffset	BEP
	Delay MS	Acausal	ClkPtpDelayMS	0CPDMS	ClkPtpDelayMS	BEA
	Delay SM	Acausal	ClkPtpDelaySM	0CPDSM	ClkPtpDelaySM	BEB
	Mean path delay	Acausal	ClkPtpMeanPathDelay	0CPMPD	ClkPtpMeanPathDelay	BEC
PLL clock offset		Acausal	S <b>n</b> PLLOffset	0PLLO0	S <b>n</b> PLLOffset	хYО

# **11.2 Broadband accelerometer channels**

	Comp.		Data streaming		Data recording	
Sensor		Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code
		٨٥٥١١٥٥١	S0SeisZ	0ACCZ0	S0SeisZA	xNZ
	Vertical	Acausal	S0SeisZ	0ACCZ2	S0SeisZB	xNZ
		Causal	Se0SeisZLowLat	0ACCZC	Se0SeisZLowLat	xNZ
	North	Acausal	S0SeisN	0ACCN0	S0SeisNA	xNN
Analogue accelerometer			S0SeisN	0ACCN2	S0SeisNB	xNN
		Causal	Se0SeisNLowLat	0ACCNC	Se0SeisNLowLat	xNN
	East	Acausal	S0SeisE	0ACCE0	S0SeisEA	xNE
			S0SeisE	0ACCE2	S0SeisEB	xNE
		Causal	Se0SeisELowLat	0ACCEC	Se0SeisELowLat	xNE
Calibration channel		Acausal	S0Calib	0ACCC0		xCA

# **12** Appendix 2 – Certimus network ports

The following network ports are used by the Certimus:

Port	Layer 4 Protocol	Description
80	TCP	HTTP server
1565	TCP	GDI transmission protocol
1567	TCP/UDP	GCF transmission protocol
4242	TCP	File exchange protocol
4244	TCP	Remote console
11788	UDP	Remote procedure calls
18000	TCP	SEED-link transmission protocol

# **13** Appendix 3 – Connector pin-outs

### 13.1 Ethernet

This is an Amphenol RJField-series 8P8C connector. It consists of a standard ISO 8877 8P8C modular socket (often called RJ45) in a bayonet mounting compatible with MIL-DTL-26482 (formerly MIL-C-26482).



	-	
Pin	10BASE-T & 100BASE-TX	1000BASE-T
1	Transmit Data +	BI_DA+
2	Transmit Data -	BI_DA-
3	Receive Data +	BI_DB+
4	not connected	BI_DC+
5	not connected	BI_DC-
6	Receive Data -	BI_DB-
7	not connected	BI_DD+
8	not connected	BI_DD-



This connector accepts unmodified ISO 8877 8P8C modular connectors (often called RJ45 connectors or Ethernet "Cat 5/6" connectors).





When used in hostile environments, a standard Ethernet cable can have a mating environmental shield (Amphenol part number RJF6MN) fitted.

## 13.2 Power

This is a standard 4-pin military-specification bayonet plug, conforming to MIL-DTL-26482 (formerly MIL-C-26482).



Pin	Function
Α	Ground
В	10-36 V DC input
С	not connected
D	not connected
	A D B C Wiring details for the compatible socket as seen from the cable end (i.e. when assembling).
<u>(</u>	<b>Caution:</b> Observe the correct polarity when connecting the power supply. The red lead (from pin B) must be connected to the positive terminal, typically labelled '+', and the <b>black</b> lead (from pin A) must be connected to the <b>negative terminal</b> , typically labelled '-'. An incorrect connection risks

destroying the digitiser, the power supply and any connected instruments.

# 13.3 GNSS/serial

This is a 14-pin LEMO EEG.1K socket. Suitable mating connectors can be found in the LEMO FGG.1K.314 range.

- To engage the mating connector, line up the red marks and push firmly home.
- To disengage, hold the mating connector by the gnurled outer sleeve and pull steadily.



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Pin

#### **Revision History**

- 1 Ground
- **2** not connected
- **3** Ground
- 4 Debug (serial) receive
- **5** Debug (serial) transmit
- 6 not connected
- 7 GNSS power
- 8 GNSS pulse-per-second signal RS-422 positive
- 9 GNSS receive RS-422 positive
- 10 GNSS transmit RS-422 positive
- 11 GNSS transmit RS-422 negative
- **12** *not connected*
- **13** GNSS pulse-per-second signal RS-422 negative
- 14 GNSS receive RS-422 negative



Wiring details for the compatible plug, FGG.1K.314.\*, as seen from the cable end (*i.e.* when assembling).

# 14 Appendix 4 – Güralp Discovery installation

Güralp Discovery is a software package for Microsoft Windows, MAC and Linux, which facilitates the identification, configuration and management of Güralp digitisers and instruments.

Güralp Discovery has a conventional .msi -based installer. Once installed, the software can check whether it is the current version and can update itself using a button on the Help $\rightarrow$ About menu.

## 14.1 Installation in Linux

The Linux version of Discovery 64-bit is delivered in a self-contained package.

To install Güralp Discovery:

- 1. Open the terminal
- 2. Visit www.guralp.com/sw/download-discovery.shtml to download the appropriate installation script or use the command

wget http://www.guralp.com/download/discovery/Discovery.run

3. Make the downloaded file executable using the command

chmod +x Discovery.run

4. Run the script with the -h option to see the installer's help message:

```
./Discovery.run -h
```

Online installer for Guralp Systems Discovery application

Usage: ./Discovery.run [parameters]

Parameters:

-h : this message

-i : perform installation

```
-o <directory> : output directory (default
/opt/guralp/discovery)
```

5. Execute the script, either accepting the default installation directory

./Discovery.run -i

or providing your own, alternative location

```
./Discovery.run -i -o /usr/lib/discovery
```

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The script proceeds through the following installation stages:

1. A confirmation prompt:

```
Guralp Discovery will be installed in:
/opt/guralp/discovery. [C]ontinue/[A]bort
```

Type C to continue installation in listed directory, or A to abort and change directory using the  $-\circ$  execution parameter

2. Downloading. The following message is printed:

```
Downloading Discovery from Guralp Systems server [Downloading]
```

This step downloads the discovery package from the Güralp server. It is around 50 MiB in size so downloading may take a long time if you have a slow Internet connection.

3. Next, the following message is printed:

```
Creating installation directory: /opt/guralp/discovery [OK]
```

This step creates the installation directory. If an error occurs at this stage, please make sure that the user running the installation script has permission to create the specified directory.

4. The downloaded archive is now unpacked into the specified installation directory. The following message is printed:

Unpacking Discovery to /opt/guralp/discovery [OK]

5. The next step removes the downloaded file from the disk.

Removing downloaded Discovery archive [OK]

6. A this point, the installation is complete. The message

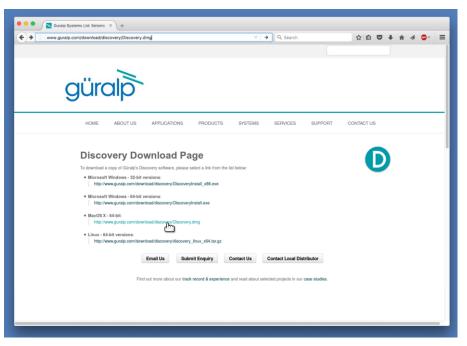
Discovery is now installed in: /opt/guralp/discovery/discovery

is displayed and the application is available in the specified directory.

### 14.2 Installation in Mac

To install Güralp Discovery in a macOS machine:

1. Open Safari, visit www.guralp.com/sw/download-discovery.shtml and download the appropriate disk-image file.



2. Either save the downloaded file on a local drive, or automatically open it with DiskImageMounter.

Guraio Systems Ltd: Seismic X +	v 🔿 Q, Search	☆ û ♥ ♣ ★ ⋪ ♥・ ☰
güralp номе авоитиз авт	Opening Discovery.dmg SUPPORT	CONTACT US
Discovery Down To download a copy of Guraph's Discovery Microsoft Windows - 32-bit version http://www.guraph.com/download of http://www.guraph.com/download is - Macciolity - 46-bit http://www.guraph.com/download islat	You have chosen to open: Discovery.dmg which is: Document (BA (MB) from: http://www.guralp.com What should Fierlox do with this file? Open with DiskimageMounter (default) Save File Do this automatically for files like this from now on. Cancel	D
Email U		
Find out more	about our track record & experience and read about selected projects in our case studies.	

3. If you saved the file to disk, navigate to the download location and open Discovery.dmg with DiskImageMounter.

4. Successful mounting should result in the display of the Discovery drag and drop installation window:

•••	Dis	covery	güralþ
	discovery.app	Applications	
	11 - 000		
		MMMmmm-	

- 5. Drag and drop discovery.app to the Applications folder.
- 6. When finished, the installation is complete and the Discovery app can be found in Launcher or Applications folder in Finder.

🚫 D		
Google Earth discovery		
🛂 😞 🔗 🎫 🛐 🍯 🔟 🚺	i 🛆 🞯 🖿 🥹 🍖 📝 🕸 📭 🔤 📄 👔	

# 14.3 Installation in Windows

To install Güralp Discovery on a Windows machine:

1. Download the appropriate installer – 32-bit or 64-bit – from

https://www.guralp.com/sw/download-discovery.shtml

- 2. Double-click the downloaded file. You may be asked whether you wish to continue: answer yes.
- 3. The following screen asks where, in the Start Menu, you would like to place the Discovery short-cut. The default location is normally satisfactory but you can change it from here if you wish.

•					
Setup - Discover		-			×
Select Start Menu Folder				Ĩ	$\sim$
Where should Setup place the program's short	cuts?			Ć	
Setup will create the program's shorted	uts in the followi	ng Start I	Menu f	older.	
To continue, click Next. If you would like to sel	ect a different fo	lder, click	Brows	e.	
Guralp Systems\Discover			Brow	se	
-					
	< Back	<u>N</u> ext >		Cano	el
		-			
		-			
lick <u>Next</u> > key <sup>™</sup> or	key Alt		N		

to continue.

4. The next screen asks whether you would like to place an icon for Discovery on the desktop:

📵 Setup - Discover		-			
Select Additional Ta Which additional ta	<b>isks</b> sks should be performed?				
Select the additionation then click Next.	I tasks you would like Setup to pe	erform while installing Di	scover,		
Additional icons:					
Create a <u>d</u> eskt	op icon				
				_	
	< <u>B</u>	<u>ack N</u> ext >	Cancel		
Tick the check	-box if you wish	and then cli		t>, key 📕 d	or key

5. The installer then offers a last chance to change any of your decisions:

D Setup - Discover	– X
Ready to Install	
Setup is now ready to begin installing Discover on your computer.	
Click Install to continue with the installation, or click Back if you want change any settings.	to review or
Destination location: C:\Program Files (x86)\Guralp Systems\Discover	^
Start Menu folder: Guralp Systems\Discover	
Gurap systems piscover	
<	×
< Back	tall Cancel
— BB.	
1:-1. Install	
	+ L if you are happy with your choices
lick $< \underline{Back}$ (or key $Alt + B$ ) if	you wish to revisit any of them.

6. Once you have clicked **Install**, the installation begins and a progress screen is displayed:

i Setup - Discover	
Installing Please wait while Setup installs Discover on your computer.	
Extracting files C:\Program Files (x86)\Guralp Systems\Discover\Qt5Webkit.dll	
	Cancel

Pressing Cancel or keying Esc now will remove all of the installed files (except the installer itself) and reverse any changes made so far.

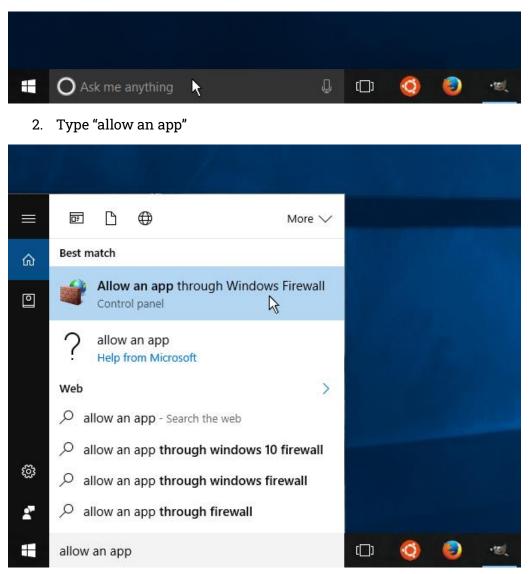
7. Once installation is complete, the following screen is displayed:

Osetup - Discover	- 🗆 ×	
	Completing the Discover Setup Wizard	
	Setup has finished installing Discover on your computer. The application may be launched by selecting the installed icons.	
	Click Finish to exit Setup.	
	Launch Discoveri	
	Einish	
Press <u>Finish</u>	key or key Alt + F to close	the installer and launch
Discovery.		
Note: Dise	covery for Windows 64-bit requires	Microsoft Visual C++ 2015.
	y may ask to install it if it is not inst	

# 14.4 Configuring Windows Firewall

Windows Firewall can interfere with Discovery's ability to send information to instruments and/or receive information from instruments over the network. If you use Windows Firewall, you should make special provision for allowing Discovery to communicate, as described in this section.

1. Click in the "Ask me anything" search box at the bottom left of your Windows screen:



- 3. Select "Allow an app through Windows Firewall" from the search results.
- 4. Windows will display the "Windows Firewall Allowed Applications" screen.

This displays a list of applications in alphabetical order. Each application is provided with three check-boxes which indicate whether the application can communicate

with networked devices in the "Domain" profile, the "Private" profile or the "Public" profile. (Profiles are also known as "network locations".)

Allowed applications			_		
→ ↑	<u>ن</u>	Search Con	trol Panel		
Allow apps to communicate through Windows Firewall To add, change or remove allowed apps and ports, click Change settings. What are the risks of allowing an app to communicate?		<b>€</b> Ch	ange setti	ings	
Allowed apps and features:					
Name	Domain	Private	Public	^	
✓ Core Networking			<b>~</b>		
✓ Cortana	<b>~</b>		<b>~</b>		
☑ Delivery Optimization	<b>~</b>		<b>~</b>		
☑ DiagTrack	<b>~</b>	<b>~</b>	<b>~</b>		
✓ DIAL protocol server					
discovery	<b>~</b>			>	
Distributed transaction Co-ordinator					
✓ Dropbox	<b>~</b>	✓	✓		
Email and accounts	<b>~</b>	$\checkmark$	✓		
✓ Feedback Hub	<b>~</b>	<ul><li>✓</li></ul>	✓		
File and Printer Sharing	$\checkmark$				
Films & TV	✓	✓	✓	*	
	Def	tails	Remove	2	
		Allow ar	other app	)	
		OK	Cano	el	

The "Domain" profile applies to networks where the host system can authenticate to a domain controller. The "Private" profile is a user-assigned profile and is used to designate private or home networks. The default profile is the "Public" profile, which is used to designate public networks such as WiFi hotspots at coffee shops, airports, and other locations.

For a more complete discussion of this topic, please see http://www.tenforums.com/tutorials/6815-network-location-set-private-publicwindows-10-a.html or your Windows documentation.

5. First click the **Change settings** buttons to activate the interface.

6. Highlight the "discovery" line and then click the **Details...** button. The "Edit an app" window is shown:

	pp	×				
	llow communication with this the Internet or just from co	app from any computer, including mputers on your network.				
Name:	() discovery					
Path:	C:\program files\gura	lp systems\discovery\discovery.exe				
What are !	the risks of unblocking an ap	<u>p?</u>				
ou can ch	oose which network types t	o add this app to.				
Netw	ork types	OK Cancel				
	Click the № s shown:	twork types butto	on. The "C	hoose ne	etwork ty	vpes" wind
Allowe	ed applications				- 0	×
∠ →	<ul> <li>M 🔐 « Windows F</li> </ul>	irewall > Allowed applications	ٽ v	Search Contr	rol Panel	Q
	To add, change or remove	nunicate through Windows Fi allowed apps and ports, click Change				
	To add, change or remove What are the risks of allow Allowed apps and fease Name	0	settings.	Cha X ate g j	Public	
	To add, change or remove What are the risks of allow Allowed apps and fast Edit Name Core Network Cortana Delivery Optir DiagTrack DIAL protoco Pat	allowed apps and ports, click Change ing an app to communicate? Choose Network Types Allow this app or port to communicate thro Firewall for the selected network type: Domain: Networks at a workplace to attached to a domain Private: Networks at home or work know and trust the people and dev network	wugh Windows that are where you vices on the	x ate g 1 1 2 ery 1 3	Public	
	To add, change or remove What are the risks of allow Allowed apps and fease Name ☑ Core Network ☑ Cortana ☑ Delivery Optin ☑ DiagTrack	allowed apps and ports, click Change ing an app to communicate? Choose Network Types Allow this app or port to communicate thro irewall for the selected network type: Domain: Networks at a workplace to attached to a domain Private: Networks at home or work know and trust the people and dev	wugh Windows that are where you vices on the	× ate g 1 j j	Public Y Y Y V V	
	To add, change or remove What are the risks of allow Allowed apps and fease Core Network Core Network Core Network Cortana Core Network Core Network DiagTrack DiagTrack DIAL protoco discovery Distributed Tr You Emil and acc Feedback Hub	allowed apps and ports, click Change ing an app to communicate? Choose Network Types Allow this app or port to communicate thro "irewall for the selected network type: Domain: Networks at a workplace to attached to a domain Private: Networks at home or work know and trust the people and dev network Public: Networks in public places su	wugh Windows that are where you vices on the	× ate g 0 g 0 g 0 g 0 g 0 g 0 g 0 g 0	Public ^ V V V V V V V V V V V V V V V V V V	
	To add, change or remove What are the risks of allow Allowed apps and fease Core Network Core Network Core Network Core Network Core Network Core Network DiagTrack DiagTrack DIAL protoco discovery Distributed Tr You Email and acc Feedback Hub File and Printer Sha	allowed apps and ports, click Change ing an app to communicate? Choose Network Types Allow this app or port to communicate thre Firewall for the selected network type: Domain: Networks at a workplace to attached to a domain Private: Networks at home or work know and trust the people and dev network Public: Networks in public places su or cafés	e settings. uugh Windows that are twhere you vices on the ich as airports Cancel	× 4 ate 9 0 10 0	Public Y Y Y Y Y Y Y Y Y	
	To add, change or remove What are the risks of allow Allowed apps and fease Core Network Core Network Core Network Cortana Core Network Core Network DiagTrack DiagTrack DIAL protoco discovery Distributed Tr You Emil and acc Feedback Hub	allowed apps and ports, click Change ing an app to communicate? Choose Network Types Allow this app or port to communicate thre Firewall for the selected network type: Domain: Networks at a workplace to attached to a domain Private: Networks at home or work know and trust the people and dev network Public: Networks in public places su or cafés	e settings.	× ate g 0 g 0 g 0 g 0 g 0 g 0 g 0 g 0	Public ^ V V V V V V V V V V V V V V V V V V	
	To add, change or remove What are the risks of allow Allowed apps and fease Core Network Core Network Core Network Core Network Core Network Core Network DiagTrack DiagTrack DIAL protoco discovery Distributed Tr You Email and acc Feedback Hub File and Printer Sha	allowed apps and ports, click Change ing an app to communicate? Choose Network Types Allow this app or port to communicate thre Firewall for the selected network type: Domain: Networks at a workplace to attached to a domain Private: Networks at home or work know and trust the people and dev network Public: Networks in public places su or cafés	settings.	× ate g g g g g g g g g g g g g g g g g g g	Public Y Y Y Y Y Y Y Y Y	

8. After making appropriate changes, click OK first in the "Choose network types" window, then in the "Edit an app" window, then in the "Windows Firewall Allowed Applications". This closes the Windows Firewall "Allowed Applications" tool and saves the changes that you have made.

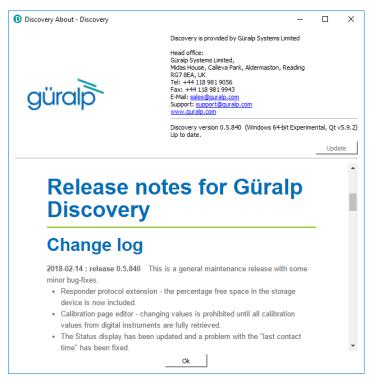
#### Update 14.5

If a PC running Güralp Discovery has an Internet connection, Discovery can check whether an update is available. To initiate this, click About from the Help menu or 

type Att + E	followed by A:	
--------------	----------------	--

D G	iüralp S	ystems -	Disc	overy				
ile	Edit	View	Hel	p				
		Status	D	About	System	Name	Firmware Ver	WAN Addres
1		0	0	Help	Minimus	MIN-B056	1.0-1271	95.6.57.152
2	Ø	0		SalesDEMO	Minimus	MIN-8256	1.1-1022	89.213.16.117
3	Active	2		fishyNAM	NAM2	SUPRT-NAM2	1.0-15757	89.213.16.113
4		0		Murray	Minimus Plus	MINP-6158	1.2-8599	89.213.16.113
5		0		NO LABEL	Minimus Plus	MINP-E658	1.2-8563	89.213.16.113
6		0		NO LABEL	Minimus Plus	MINP-DD58	1.2-8555	89.213.16.113
7		0		NO LABEL	Minimus Plus	MINP-E558	1.2-8563	89.213.16.113
8	Ø	0		NO LABEL	Minimus Plus	MINP-E058	1.2-8555	89.213.16.113
9		0		NO LABEL	Minimus Plus	MINP-6458	1.2-8563	89.213.16.113
10		0		NO LABEL	Minimus Plus	MINP-E958	1.2-8563	89.213.16.113

#### A screen like the following is displayed:



The currently installed version is shown. If this is the most recent version available,

Update the screen will say Up to date and the \_ button will be disabled, as shown above.

If a newer version is available, the screen will look like this:

Discovery About - Guralp Disco	very	—		×
	Discovery application is provided by Guralp Systems Limited.			
güralþ	Head office: Gurajp Systems Limited, Midas House, Calleva Park, Aldermaston, Reading. RG7 8EA, United Kingdom Tel: +44 113 981 9056 E-Mail: sales@guralp.com			
	Discovery version: Experimental 0.1.351 Dipdate to version 0.1.669 is available online. Please use "Update" button	to downl	oad the in Upd	1
	Ok			

installer. If you do not wish to download the installer, click \_\_\_\_\_\_ to close the "Discovery About" dialogue.

If you clicked \_\_\_\_\_\_, you may see the following warning if the previous installer is still in your download folder:

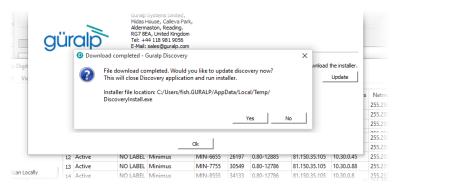
File downloa	ad - Guralp Discovery	>	<
0	File already exists Guralp Discovery	×	taller.
ile	File already exists - overwrite?		te
	C:/Users/fish.GURALP/AppData/Local/Temp/DiscoveryInstall.eo	(e	s Netmas
	Yes No		255.255.0
Class this wine	dow automatically when finished.		255,255.
Close this wind			255,255.
	Cancel Ok		255.255.0
gürc			255.255.0
guid			255.255.0

Simply click Yes or key to continue: the download will start immediately.

While the download is in progress, the following indicator will be displayed:

File download - Guralp Discovery		_	×
	Downloading discovery installer.		
	Completed in 41%		
	(12335614B of 29530541B)		
Close this window automatically when finished.	Cancel Ok		

£.



When the download is complete, the following screen is displayed:

If you wish to complete the installation imme	ediately, click <u>Yes</u> . If you would
rather defer the installation, click	and run the installer at a more
convenient time.	

Once the upgrade is complete, start Discovery in the usual way. Windows, recognising that the program has changed, may ask you to specify how you wish Discovery to interact with the Windows Firewall. Because Discovery requires network communication in order to function, it is important that you understand the options available.

The following screen is displayed:

Windows Security Alert ×			×		
Windows Firewall has blocked some features of this app					
Windows Firewall has blocked some features of discovery on all public, private and domain networks.					
	Name:	discovery			
	Publisher:	Unknown			
	Path:	C:\program files (x86)\guralp systems\discovery \discovery.exe			
Allow discovery to communicate on these networks:					
☑ Domain networks, such as a workplace network					
Private networks, such as my home or work network					
Public networks, such as those in airports and cafés (not recommended because these networks often have little or no security)					
What are the risks of allowing an app through a firewall?					
		Allow access	el		

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The screen provides three check-boxes which indicate whether Discovery can communicate with networked devices in the "Domain" profile, the "Private" profile or the "Public" profile. (Profiles are also known as "network locations".)

The "Domain" profile applies to networks where the host system can authenticate to a domain controller. The "Private" profile is a user-assigned profile and is used to designate private or home networks. The default profile is the "Public" profile, which is used to designate public networks such as WiFi hotspots at coffee shops, airports, and other locations.

For a more complete discussion of this topic, please see www.tenforums.com/tutorials/6815-network-location-set-private-public-windows-10-a.html or your Windows documentation.

# 15 Appendix 5 – I.P. address configuration on PC or Laptop

With APIPA (Automatic Private I.P. Addressing), a laptop or PC can automatically configure itself with an IP address in the range 169.254.0.1 to 169.254.255.254. The default subnet mask is 255.255.0.0.

Connect the Certimus to the laptop or PC using the blue Ethernet cable and power it up.

## 15.1 On Linux

On your Linux computer, open the terminal and type the command

sudo bash



Key 🛄 and provide the appropriate password. Then, enter the command

ifconfig

to identify the Ethernet network interface to which the Certimus is connected. Once you have identified the correct interface, connect the Certimus, power it up and enter the commands

ifconfig *wlp2s0* down ifconfig *wlp2s0* up

- - -

replacing **w1p2s0** with the name of the appropriate interface on your PC.

Enter the command *ifconfig* again to verify that the IPv4 address of the Ethernet adapter is now included in the network 169.254.0.0/16 - i.e. the address begins 169.154....



In the example above, the interface has been allocated address 169.254.139.29, which is in the correct network.

## 15.2 On macOS

Click the Apple icon in the upper-left corner of the screen, and select "System Preferences."

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1. Click the "Network" icon to open the Network Preferences pane and select "Ethernet" from the list on the left side of the window.

0 0	Network	
Show All		٩
Lo	cation: Automatic	•
• Ethernet Connected       •••         • Bluetooth Not Connected       ••         • FireWire Not Connected       ••         • AirPort On       ••	Configure: IP Address: Subnet Mask:	Connected Ethernet is currently active and has the IP address 192.0.2.143 Using DHCP 192.0.2.143 255.255.255.0 192.0.2.254
+ - &-	further changes.	Advanced ? Assist me Revert Apply

- 2. Click the gear button, in the lower-left corner of the window, then click "Make Service Inactive." Click the "Apply" button to disable the NIC (Network Interface Card).
- 3. With the Certimus connected and powered up, click the button again, click "Make Service Active" and click "Apply" to re-enable the NIC.
- 4. Check that the interface has been assigned an address in the correct network:



In the example above, the interface has been allocated address 169.254.56.230, which is in the correct network.

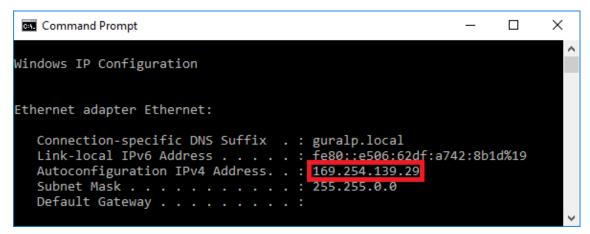
## 15.3 On Windows

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On a Windows computant and key	ıter, key 💶 +	R to open the "Run" dialogue, enter ncpa.cpl
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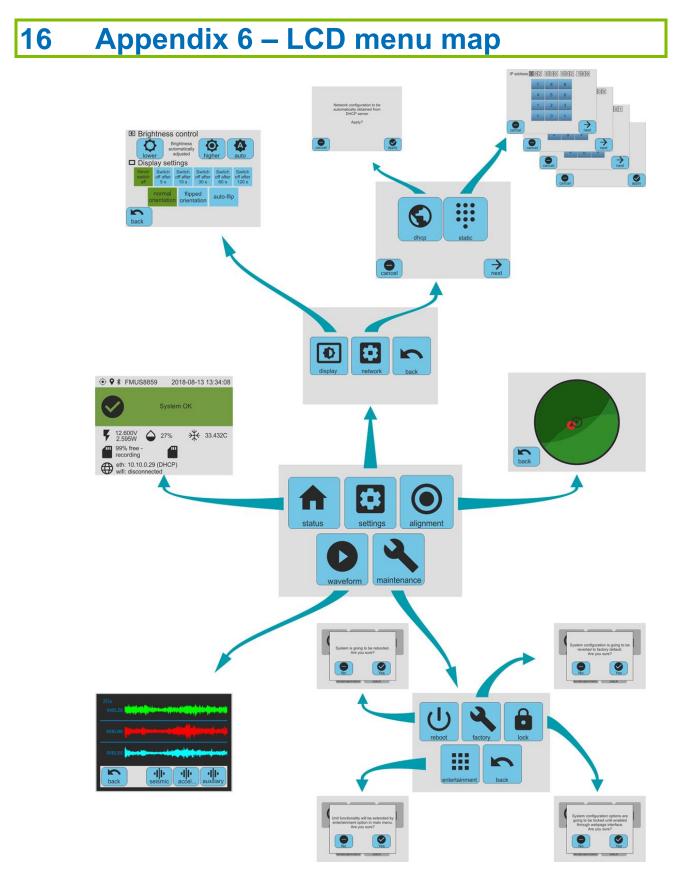
Right-click on the network adapter which is connected to the CertimusCertimus and select "Disable" from the context menu. Right-click on the same adapter again and select "Enable". Close the network settings window.

Key **H** + **R** and type cmd., then **h**. This opens a command window. Type the command **ipconfig** and verify that the IPv4 address of the Ethernet adapter is included in network 169.254.\*.\*.



In the example above, the interface has been allocated address 169.254.56.230, which is in the correct network.

#### **Revision History**



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# **17 Revision History**

- D 2020-12-01 Additions to SoH
- C 2020-01-06 Corrected labels for main illustration in system description.
- B 2019-12-02 Updated web page screenshots. Updated Data Stream and Data Storage. Updated stream and file names. Updated and added Transforms. Updated EEW and Triggering. Added back-fill from microSD card.
- A 2018-08-19 Initial release