

# Güralp Minimus and Minimus+

including Güralp Discovery software and the GüVü app

# **Technical Manual**

Document Number: MAN-MIN-0001

Issue Q – September 2021

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

# **Table of Contents**

### 

1.1 Proprietary Notice	6
1.2 Cautions and Notes	
1.3 Manuals and Software	6
1.4 Conventions	6

2	Sys	stem Overview	7
	2.1	Key features	7
	2.2	Typical applications	B

2.1. Cürala Minimus digitioan	
3.1 Güralp Minimus digitiser	
3.1.1 LED indicator	
3.1.2 Bluetooth connectivity	
3.1.3 Data storage	
3.1.4 Web interface	
3.2 Accessory package	17
3.2.1 Ethernet cable	
3.2.2 Compact GNSS receiver and cable	17
3.2.3 Power cable	18
3.2.4 Diagnostic GNSS to Serial cable adapter	18
3.3 Güralp Discovery software	19
3.4 Güralp GüVü Android and iOS app	20

4	Getting started	21
	4.1 System set-up	21
	4.2 Güralp Discovery software installation	
	4.3 Viewing waveforms and system state-of-health	
	4.3.1 Using Discovery's "Live View" window	
	4.3.2 Using Scream!	30

5	System configuration	
•	5.1 Web Page login	
	5.2 System status	
	5.3 Station meta-data	
	5.4 Network configuration	
	5.4.1 I.P. address and gateway	35
	5.4.2 NTP (Network Timing Protocol) configuration	
	5.5 GDI push (auto-connection)	
	5.6 QSCD	
	5.7 Data storage	
	5.8 Storage.	
	5.8.1 Recording status	
	5.8.2 MicroSD card re-formatting 5.8.3 MicroSD card data flushing and unmounting	
	5.8.4 Downloading recorded data	
	5.8.5 Downloading data for specific time-intervals	
	5.8.6 Bulk data extraction	
	5.8.7 The contents of the microSD card	
	5.8.8 Request data from microSD card	
	5.9 Data transmission	51
	5.9.1 Scream! (GCF format + Scream protocol)	52
	5.9.2 GDI-link protocol	53
	5.9.3 SEEDlink protocol	
	5.10 Synchronisation of the sample-clock	
	5.10.1 GNSS lock status	
	5.10.2 PTP (Precision Time Protocol)	
	5.11 Deploy mode: Full power-save	62
	5.12 Configuration and control of connected analogue instruments	
	5.12.1 Setting instrument type 5.12.2 Setting instrument (sensor) gain for Güralp Fortis	
	5.12.3 Setting digitiser gain	
	5.12.4 Mass control	
	5.12.5 Instrument response parameters	
	5.13 Configuration and control of connected digital instruments	
	5.14 Setting sensor orientation and depth parameters	
	5.14.1 Applied rotation	
	5.14.2 Instrument installation parameters	71
	5.14.3 Inject a calibration signal	72
	5.15 Transforms	
	5.15.1 Pass-through	
	5.15.2 Differentiation	
	5.15.3 1 <sup>st</sup> order LPF	
	5.15.4 1 <sup>st</sup> Order HPF	
	5.15.5 1 <sup>st</sup> Order Band/Notch filter	
	5.15.6 2 <sup>nd</sup> Order biquad	/ 8

5.15.7 Integration	79
5.15.8 Double Integration	
5.15.9 EEW Parameters – Observer	81
5.15.10 STA/LTA Ratio	
5.15.11 Three-dimensional Rotation	84
5.15.12 QSCD Sender (triplet)	
5.15.13 MMA Logger	
5.16 Earthquake Early Warning	
5.16.1 Trigger sources	
5.16.2 Trigger destinations	
5.16.3 Low Latency Mode	94
5.16.4 CAP receiver	
5.16.5 Seismic Event Table	97
5.17 Using a Registry	99
5.17.1 Configuring a Minimus for use with a registry	99
5.17.2 Configuring Discovery for use with a registry	
5.17.3 Registry mode: using WAN or LAN addresses	
5.18 Updating Minimus firmware	103
5.19 Import / Export an existing configuration	
5.20 Control Centre	

6	Gü	Vü app	111
	6.1	Getting stated	
	6.2	Selecting data sources	113
	6.3	View settings	113
		Instrument control	
6.4.1 Setting the PIN code		6.4.1 Setting the PIN code	115
		Emailing a deployment report	

7	Adv	vanced troubleshooting	118
	7.1	Reset all settings during boot phase	119

8	Арр	pendix 1 – Instrument/channel names	125
	8.1	Minimus' internal sensors	126
	8.2	Analogue Instruments	127
		Digital Instruments	

### 9 Appendix 2 – Minimus network ports......131

10 Appendix 3 – Connector pin-outs		132
10.1	Ethernet	
10.2	Power	
10.3	GNSS/serial	
10.4	Digital	
	Analogue 1 and Analogue 2	

11 Ap	endix 4 – Dimensions and drawings	
11.1	Minimus	
11.2	Minimus+	138

12 Ap	oendix 5 – Güralp Discovery installation	139
12.1	Installation in Linux	
12.2	Installation in Mac	140
12.3	Installation in Windows	142
12.4	Configuring Windows Firewall	145
	Update	
	•	

13 App	pendix 6 – I.P. address configuration on PC or Laptop	153
13.1	On Linux	
13.2	On macOS	154
13.3	On Windows	

14 E	EU Declaration	of Conformity	′1	156	3
------	----------------	---------------	----	-----	---

15	<b>Revision History</b>	rŕ	15	7
1 J	Revision history	· · · · · · · · · · · · · · · · · · ·	I.	J

# 1 Preliminary Notes

### 1.1 Proprietary Notice

The information in this document is proprietary to Güralp Systems Limited and may be copied or distributed for educational and academic purposes but may not be used commercially without permission.

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 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: <u>www.guralp.com</u> 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

# 2 System Overview

Thank-you for purchasing a Güralp Minimus or Minimus+ digitiser.

This section describes the key components of a Minimus system or Minimus+. The Minimus or Minimus+ 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.

The Minimus has four fully-featured analogue input channels. The Minimus+ is physically wider, with an additional analogue sensor input connector, and provides eight fully-featured analogue input channels. Otherwise, the two units are very similar.



**Note:** In this document, the symbol  $\triangle$  is used to identify information that relates only to the Minimus+ and not to the Minimus. All other information relates to both units, unless obviously contradicted by a clause containing  $\triangle$ .

### 2.1 Key features

- 24-bit, four-channel (A eight-channel) digitiser with nominal 2.44  $\mu V/count$  sensitivity.
- Compact form, measuring just 134 × 99 × 45 mm (A 134 × 139 × 45 mm) and weighing just 0.67 kg (A 0.78 kg).
- Compatible with all analogue seismic sensors with a voltage output.
- Simultaneously accommodates one (A two) triaxial sensor(s), one (A two) infra-sound sensor(s) and a digital feed from a Radian post-hole or borehole instrument.
- Supports automatic Identification of I.P. addresses via Güralp Discovery software and a cloud-based or organisational registry server.
- Remote instrument and data management via Discovery.
- Bluetooth Android app for installation integrity checking.
- Low-latency mode for Earthquake Early Warning (< 40 ms).
- Hot-swappable data storage with dual redundant microSD cards.
- GNSS time-synchronisation, compatible with Navstar (GPS), GLONASS, Galileo and BeiDou constellations. PTP is available for when GNSS is impractical.

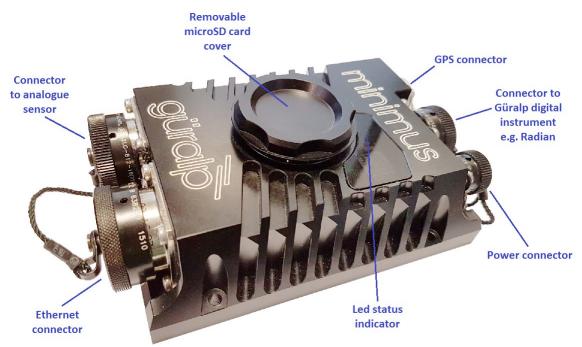
# 2.2 Typical applications

- Earthquake Early Warning systems.
- Volcanology.
- Multi-scale seismic networks.
- Structural health monitoring.
- Hydrocarbon exploration.
- Permanent reservoir monitoring.
- Induced seismicity detection.
- Explosion monitoring.

# 3 System description

# 3.1 Güralp Minimus digitiser

The Güralp Minimus is a combined digitiser and advanced communications unit. The Minimus acquires data from – and allows direct control (where appropriate) of – connected analogue instruments (*e.g.* Güralp Fortis, 3-series, 5-series, 40T and 6T sensors) and digital instruments (*e.g.* the Güralp Radian).



The Güralp Minimus functions as the Surface Interface Unit (SIU) for Radian posthole instruments in shallow (<100 metres).

A The Minimus+ features an additional analogue sensor connector:



A full description of the operation, control and configuration of the Güralp Radian instrument via the Minimus is not within the scope of this manual; please refer instead to the Radian manual, <u>MAN-RAD-0001</u>.



**Caution**: Analogue sensors with true floating outputs connected to the Minimus – included geophones, infra sound sensors, pressure gauges, etc. – must have their outputs ground-referenced using a >100 kΩ resistor.

### 3.1.1 LED indicator

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

**Flashing white rapidly**: This occurs from power-up until the 1 kHz clock is set and typically lasts for a period of two to three seconds.

**No flashing**: This occurs during the boot-up and initialization stages and typically lasts for a period of twenty to thirty seconds.

- One quick red flash followed by a one second pause: the removable microSD card is present in the Minimus' external slot, but no fixed microSD card is present inside the Minimus.
  - **Two quick red flashes followed by a one second pause**: the fixed microSD card is present inside the Minimus but no removable microSD card is present in the Minimus' externally-accessible slot.
  - 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.



**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.

### 3.1.2 Bluetooth connectivity

The Minimus features Bluetooth connectivity, allowing sensor and state-of-health data to be monitored using the Güralp GüVü app (see section 3.4 on page 20) on an Android mobile phone or tablet.

The 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 6 on page 111 for further details on connecting to the Minimus and its attached sensors using a phone or tablet.

### 3.1.3 Data storage

The Minimus uses microSD (non-volatile) memory technology to store seismic data locally. The Minimus 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 Minimus is supplied with two microSD cards that are of equal storage capacity (*e.g.* two 64 GB cards).



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



**Caution:** When the external microSD card is removed, the internal card keeps recording data. However, when the external card is re-connected, any data written to the internal card while the removable card was absent will overwritten.

Starting from summer 2018, two designs of the card-holder for the removable card became available. The following two sections describe how to change the card in the newer models (section 3.1.3.1 on page 12) and the original models (section 3.1.3.2 on page 13).

#### 3.1.3.1 Primary (hot-swappable) microSD card – new style

The upper surface of the Minimus has a waterproof screw-in card-holder that is sealed by an O-ring.

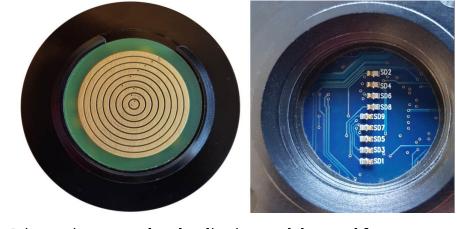
To insert or replace a microSD card, proceed as follows:

1. Rotate the card-holder in an anti-clockwise direction, unscrewing it from the body of the digitiser.





**Caution:** The card holder connects electrically to the Minimus via a series of slip-rings which ride on metal fingers in the main body of the digitiser:



It is very important that the slip-rings and the metal fingercontacts do not become damaged or tarnished. Take care not to touch either part. If a Minimus has had its card-holder removed, do not leave it exposed to the elements. If a card-holder is to be transported when it is not installed in a Minimus, enclose it in a protective bag or covering so that it cannot be scratched or contaminated.

- 2. The microSD card is accessible via the slot in the side of the card-holder. Using a pair of tweezers, first push the card in gently and then release the pressure: the card will spring outwards a little. It can now be grasped and withdrawn.
- 3. To insert a new card, line it up with the slot as shown and push it gently into place. Once you feel the spring pressure, continue pushing until more resistance is felt and then release the pressure: the card will lock into place.



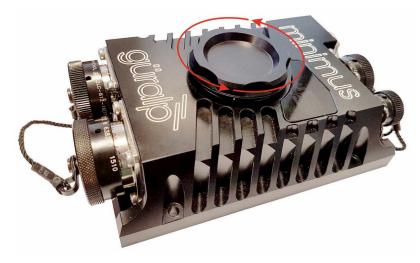
4. Finally, replace the cap and rotate clockwise until hand-tight. Do not overtighten and do not use tools.

#### 3.1.3.2 Primary (hot-swappable) microSD card – old style

Early models of the Minimus had a different arrangement. The upper surface of the Minimus had a waterproof screw-cap that is sealed by an O-ring. This protects the microSD card slot from the environment.

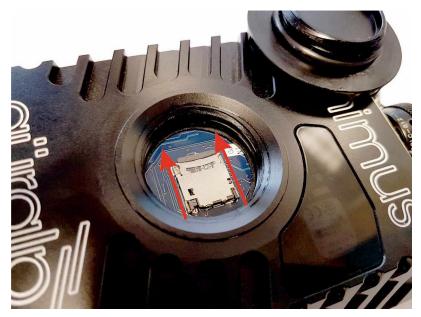
To insert or replace a microSD card in an older Minimus, proceed as follows:

1. To reveal the microSD card slot, rotate the cap in an anti-clockwise direction.



2. The microSD card is now exposed.

3. To make the microSD card slot available, use your finger to move the card carrier in the "Open" direction:



4. Gently lift up the free end of the card carrier, which hinges at the other end, as shown:



5. You should now be able to insert/remove a microSD card. The replacement should be positioned so that the gold contacts on the microSD card will be facing downwards when the carrier is hinged back down.



6. Push the hinged carrier firmly down and slide it in the "LOCK" direction:



7. Finally, replace the cap and rotate clockwise until hand-tight. Do not overtighten and do not use tools.



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



**Caution:** When the external microSD card is removed, the internal card keeps recording data, unless stopped using the Unmount Cards button (see Section 5.8.3 on page 42). However, when the external card is reconnected, any data written to the internal card while the removable card was absent will overwritten.

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

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

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

#### 3.1.4 Web interface

The Minimus contains on-board firmware that presents monitoring and configuration interfaces. These are accessible through Güralp's Discovery software (see section 3.3 on page 19) or, with the built-in web server, via Discovery's browser interface or any standards-conformant web browser.

							Minimu
	Status Netw	ork Setup Trigg	er Data Stre	am Data Record	l Storage	Logout Help	
System type: Minimus	Host label: SPR	T-MIN   Host name: MIN	-C555 (10.10.0.1	0)   Serial number: 00	C555		
System Status							
			General in	formation			
Host name	MIN-C555	Host label	SPRT-MIN	System type	Minimus	Product type	Minimus
Serial number	00C555	Firmware version	2.0-7545	IPv4 address	10.10.0.10 (DHCP)	SEED network and station	DG.TEST (No site)
Digitiser temperature	31.496 °C	Digitiser humidity	26.64%	Input voltage	13.165 V	Power over Ethernet voltage	0.000 V
System time	11:51:26 AM Thu 7-Nov-2019	Uptime	50m 28s	ETH status	sckt: 12/20 data: 2/6		
			GNSS	Status			
GNSS connection statu	s Connected	Last timestamp	2019-11-07 11:51:26	IN ALL SU	1100	Hills AONB	
Last lock time	2019-11-07 11:42:57	GNSS stability	100%	+	North Wessex	HITS ADIVE	London
Latitude	51.3606	Longitude	-1.1633	0-500	Downs	AAAA	75ASA
Altitude	116.3	Horizontal dilution of precision	1.03		A A	SEX	ALL
GNSS PPS status	Trusted Pulsing	GNSS NMEA stream	Input OK	A	1 A	Report a problem   © OpenS	-144
GNSS Lock state	3D locked	Number of satellites	Used: 11 In view: 12		102 AN	Report a problem   @ OpenS	treetinap contributo
			Data reco	rd status			
microSD status	Recording	microSD total	60686336 KiB	microSD used	1226560 KiB	microSD free	97%
Number of concern		1	Sens	sors		I	
Number of sensors detected	1						
Senso	r0	Serial number (0)	TF064	Firmware ver (0)	6.0		
		Integrator Z (0)	-6	Integrator N (0)	-5	Integrator E (0)	-6
		Seismometer Z (0)	70	Seismometer N (0)	292	Seismometer E (0)	484

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 5 on page 32 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 cable that connects to the Minimus has a metal cover which is IP68-rated and ensures consistent connections 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 10.1 on page 132 for the pin-out and further details.

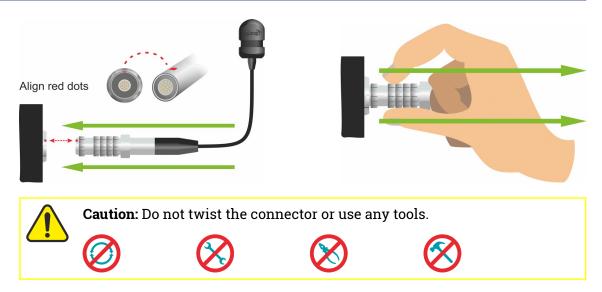
#### 3.2.2 Compact GNSS receiver and cable

The Minimus 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.



#### System description



Please see section 10.3 on page 134 for pin-out details.

### 3.2.3 Power cable

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



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

Please see section 10.2 on page 133 for the pin-out details.



**Caution:** We recommend fitting an in-line 3.5 A anti-surge fuse in the positive power lead to protect the external wiring of the installation.

### 3.2.4 Diagnostic GNSS to Serial cable adapter

The Minimus 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 Minimus using a serial terminal emulator (see section 7 on page 118).



**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 Minimus 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 10.3 on page 134 for full pin-out details.

# 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.

Stati	Label	System	Name	Firmware Ver	WAN Address	LAN Address	Uptime	Last Contact	Latitude	Longitude
0	NO LABEL	Fortimus	FMUS-C65A	1.3-16444	89.213.16.113	10.20.0.155	20:50:54	Just Now	51.3607	-1.1634
0	NO LABEL	Fortimus	FMUS-BB5A	1.3-16444	89.213.16.113	10.20.0.118	7 days 8 Hrs	Just Now	51.3606	-1.1635
0	Radian Vertica	Minimus	MIN-2456	1.2-8572	89.213.16.113	10.20.0.227	145 days 18 Hrs	Just Now	51.3610	-1.1638
0	NO LABEL	Fortimus	FMUS-BF5A	1.3-16444	89.213.16.113	10.20.0.224	13 days 23 Hrs	Just Now	51.3606	-1.1635
0	NO LABEL	Fortimus	FMUS-545A	1.3-14268	89.213.16.113	10.30.0.18	8 days 20 Hrs	Just Now	51.3611	-1.1642
0	NO LABEL	Minimus	MIN-002757	2.0-2019	89.213.16.113	10.30.0.127	14 days 1 Hrs	Just Now	-59.9000	87.2170
0	Radian Rack 2	Minimus	MIN-2856	1.2-8701	89.213.16.113	10.20.0.86	1 days 16 Hrs	Just Now	51.3611	-1.1638
0	SUPRT-FMUS	Fortimus	FMUS-8859	2.0-1077	89.213.16.113	10.10.0.19	16 days 0 Hrs	Just Now	51.3606	-1.1630
0	NO LABEL	Minimus	MIN-4056	1.2-8707	89.213.16.113	10.20.0.53	20:30:22	2019-08-07T10:40:20	51.3607	-1.1635
0	3T ref	Minimus	MIN-004058	2.0-402	89.213.16.113	10.30.0.152	4 days 22 Hrs	Just Now	51.3616	-1.1640
0	Radian Rack 5	Minimus	MIN-E256	1.2-8706	89.213.16.113	10.20.0.232	2 days 2 Hrs	Just Now	51.3609	-1.1638
0	Radian Rack 1	Minimus	MIN-C757	1.2-8700	89.213.16.113	10.20.0.134	4 days 19 Hrs	Just Now	51.3609	-1.1637
0	SHAKER MK I	Minimus	MIN-B157	1.2-8701	89.213.16.113	10.20.0.127	1 days 3 Hrs	Just Now	0.0000	0.0000
0	Radian Rack 4	Minimus	MIN-E457	2.0-35	89.213.16.113	10.20.0.137	7 days 18 Hrs	Just Now	51.3609	-1.1638
0	ENG-TEST	Minimus	MIN-6955	1.2-8700	89.213.16.113	10.30.0.103	45 days 21 Hrs	Just Now	51.3612	-1.1642
	BEN	Minimus	MIN-00D057	2.0-2670	89.213.16.113	10.30.0.23	1 days 2 Hrs	Just Now	-59.9044	87.7204

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 Minimus firmware from the Internet and remotely install it onto any connected Minimus digitisers.

### 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 6 on page 111 for installation and usage instructions.

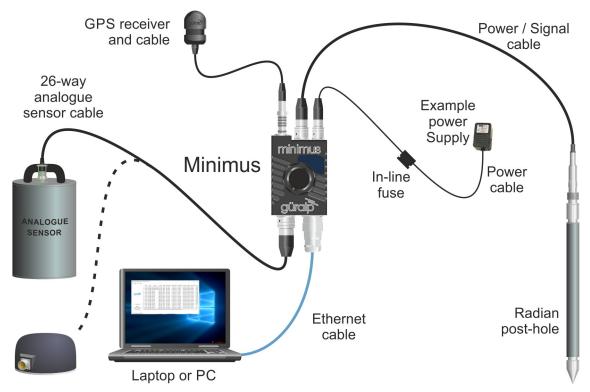


# 4 Getting started

## 4.1 System set-up

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

A typical set-up for the Minimus connected to an analogue sensor (including an optional digital Radian Post-hole instrument) 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 17 (and, optionally, Section 4.3 of the Radian manual, <u>MAN-RAD-0001</u>).

Power up the Minimus using a power supply with a DC output of between 10 and 36 Volts. We recommend fitting an in-line 3.5 A anti-surge fuse in the positive power lead to protect the external wiring of the installation. The Minimus will, in turn, provide power to all connected instruments.

**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 digitiser, the power supply and any connected instruments. If the Minimus 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 13 on page 153.

## 4.2 Güralp Discovery software installation

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

Visit <u>www.guralp.com/sw/download-discovery.shtml</u> 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 12 on page 139.)

**Note:** Windows users may have to reconfigure the Windows FireWall in order to allow Discovery to communicate properly. Please see section 12.4 on page 145 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 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 or	these networks:						
🗹 Domain netv	vorks, such as a	workplace network						
Private netv	vorks, such as n	ny 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 a	pp through a firewall?						
		Ca	ancel					

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 Wi-Fi hotspots at coffee shops, airports, and other locations.

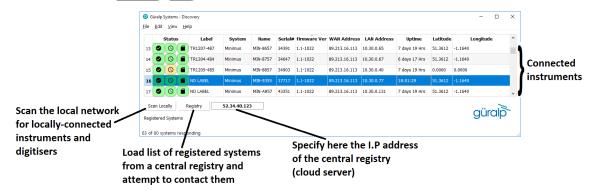
For a more complete discussion of this topic, please see <u>www.tenforums.com/tutorials/6815-network-location-set-private-public-windows-</u> <u>10-a.html</u> or your Windows documentation.

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 be refreshed by clicking the <u>Scan Locally</u> button or by pressing the

short-cut keys Ctrl +

L . These features are identified below:



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	Edit	View	Help										
	Statu	s	Label	System	Name	Firmware Ver	LAN Address	Uptime	Last Contact	Latitude	Longitude	Altitude	Timing qualit
Ø	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
Ø	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
Ø	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	leceiver				
								Add D					
		1		1					EED Extractor				
Sca	n Loca	illy	Registry	53	2.34.40.123				board control				"rale
ocal Systems								Sonar	dyne Debugger		güralp		

The following dialogue is displayed:

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

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



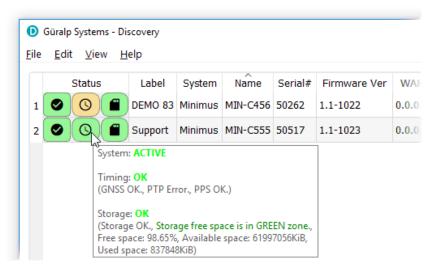
**Note:** The newly added device will be removed from the list and not automatically re-added if a local network scan is performed.

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.

	_		( no sta Live Vie	ition selected ) w	×.	tem	Name	Firmware Ver	WAN Address	LAN Address	Netmask	Uptime	Last Contact	Latitude	Longitude	Altitude	Timing quali
	0		Scan Lo	1 A A A A A A A A A A A A A A A A A A A	l+L	us us		1.2-8138	89.213.16.113 89.213.16.113	10.30.0.131	255.255.0.0	7 days 18 Hrs 10 days 20 Hrs	Just Now		-1.1640	105.20	100
	Ö		Registr	y Ctr	ITK	E.		:4779	89.213.16.113	10.30.0.5	255.255.0.0	67 days 5 Hrs	Just Now	0.0000	0.0000	0.00	100
	0	0	Show	BGS string	Minir		Status Label	-8560	89.213.16.113	10.30.0.92	255.255.0.0	2 days 19 Hrs	Just Now	51.3612	-1.1640	113.30	100
	÷	÷-		J	Minir		System										
	0	0		BK64	-	~ 1	Name	-8563	169.229.12.201		255.255.255.0	11:07:10	Just Now	37.8763	-122.2355	211.10	0
	▲	0		CVTG	Minir	_	Serial#	-1022	201.191.198.155		255.255.255.0	02:48:19	2018-04-05T19:45:34		-84.0521	1206.19	100
ļ	Active	e		EAM2243	EAM		Firmware Ver Connection Type	-15695	89.213.16.113	10.10.0.27	255.255.0.0	8 days 16 Hrs	2018-04-06T09:58:20	0.0000	0.0000	0.00	0
Į	0	0		EF00 Test	Minir	_	WAN Address	1031	166.247.216.249	192.168.2.2	255.255.255.0	6 days 14 Hrs	Just Now	29.1281	-98.3803	171.00	100
	0	0	)( 🕋 )	Eng_Test	Minir		LAN Address	-1022	89.213.16.113	10.30.0.58	255.255.0.0	2 days 23 Hrs	Just Now	51.3611	-1.1642	113.20	100
	0	0		Engineering Test	Minir		Netmask Uptime	-8563	89.213.16.113	10.30.0.39	255.255.0.0	22:13:05	Just Now	0.0000	0.0000	0.00	0
ĺ	0	0		GSL Minimus	Minir		Last Contact	-8562	62.49.27.35	192.168.254.246	255.255.255.0	1 days 19 Hrs	Just Now	51.3613	-1.1635	88.70	100
Ì	0	0		HS	Minir		Latitude	1022	121.66.142.170	192.168.0.165	255.255.255.0	1 days 23 Hrs	Just Now	36.3676	127.3194	80.90	100
Ì	0	0		Horizontal Soak 2	Minir		Longitude Altitude	-1022	89.213.16.113	10.20.0.86	255.255.0.0	8 days 23 Hrs	Just Now	51.3610	-1.1639	110.60	100
Ì	0	0		Horizontal soak 1	Minir		Timing quality	-1022	89.213.16.113	10.20.0.232	255.255.0.0	14 days 0 Hrs	Just Now	51.3611	-1.1638	131.00	100
Ì	0	0		IDL	Minir		Voltage	1022	194.117.40.80	10.101.80.77	255.255.255.0	91 days 15 Hrs	Just Now	38.7569	-9.1567	91.70	100
Ì	0	0		Murray	Minir		Humidity Temperature	-8574	89.213.16.113	10.30.0.14	255.255.0.0	16:13:09	Just Now		-1.1642	111.20	100
	0	0		NO LABEL	Minir		Free storage	-8555	89.213.16.113	10.20.0.88	255.255.0.0	00:08:50	Just Now		-1.1634	108.70	0
	<b>v</b>		,∎,	NO LABEL	Minin	-		CCC81	89.213.10.113	10.20.0.88	200.200.0.0	00:08:50	JUST NOW	51.3009	-1.1034	108.70	U >
	n Loc ered	ally Syste		gistry 52	.34.40	.123										g	üralp

The "Status" column is composed of three icons that represent the Minimus connectivity status (whether Minimus is reachable/active or not), timing status (GNSS or PTP) 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:



Within Discovery, internal and connected sensors are referred to as follows:

Sensor	Minimus designation	A Minimus+ designation
All internal sensors	Sensor O	Sensor O
First analogue sensor	Sensor O	Sensor O
A Second analogue sensor	n/a	Sensor 1
First Radian (digital sensor)	Sensor 1	Sensor 2
Second Radian (digital sensor)	Sensor 2	Sensor 3
Third Radian (digital sensor)	Sensor 3	Sensor 4
Last Radian (digital sensor)	Sensor 8	Sensor 8

# 4.3 Viewing waveforms and system state-of-health

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

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

#### 4.3.1.1 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".

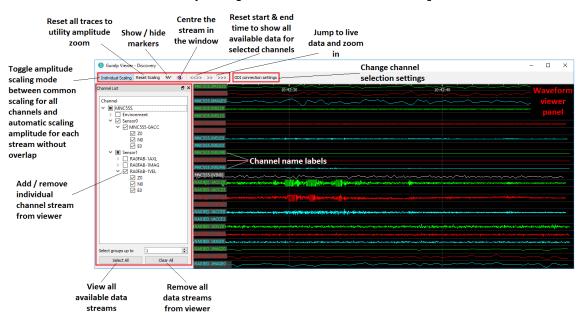
The menu will then present three options for data streaming:

- 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

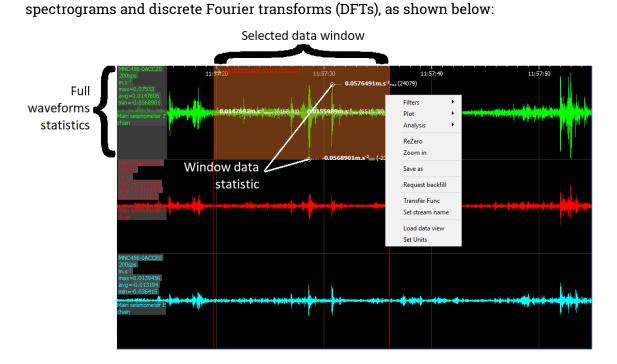
a different group number from the "Select group up to" box at the bottom of the channel list.



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 first 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),



MAN-MIN-0001

#### 4.3.1.2 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	
	Increase/decrease amplitude of all traces
+ 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	
Ctrl +	Pan time-scale right/left
<u></u>	Zoom time-scale in/out
Trace focus	
on trace label	Focus on individual trace
Trace selection	
Del + hover cursor over on individual trace / trace label	Remove / de-select trace from Viewer window
Details control	
+ hover cursor over on individual trace / trace label	Reset the maximum and minimum values to the average value of the selected data

#### 4.3.1.3 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 Minimus 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 Minimus 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.

MIN-C555 - GDI connectio	n settings - Discovery			– 🗆 X
General				
Automatically connect when	n server is available			Disconnect
Subscription configuration	Storage configuration			
O Automatically subscribe to	all available channels			
Our Subscription list				
Subscribed channels				Available channels
		<< < > >>	MNC555-0ACCE0 MNC555-0AXLX0 MNC555-0AXLX0 MNC555-0AXLZ0 MNC555-0CGPS0 MNC555-0CGPS0 MNC555-0CPDMS MNC555-0CPDMS MNC555-0CPMPD MNC555-0CPMPD MNC555-0CPMPD MNC555-0SLRN0 MNC555-0SLRN0	~
				Apply Close

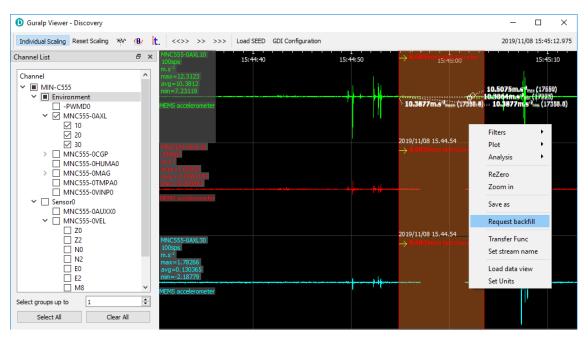
Channels can be moved between lists – *i.e.* switched between being subscribed and being unsubscribed – by using the arrow buttons on the middle:

<<	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

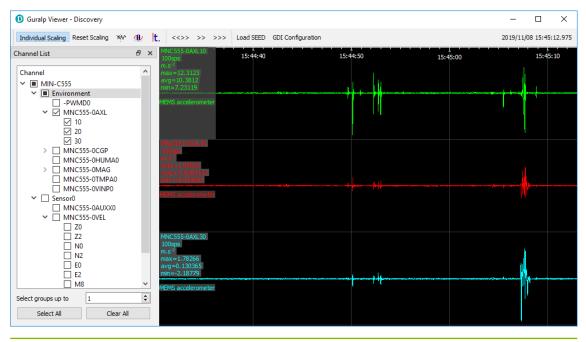
#### 4.3.1.4 Backfill from microSD card

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.



### 4.3.2 Using Scream!

Data from the Minimus and attached sensors 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 4.2 on page 22).

	Status Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude
1	Support	Minimus	MIN-C555	50517	1.1-1022	0.0.0.0	10.10.0.13	00:15:10	51.3607	-1.1630

Right-click on the newly-added server and select GCFSEND:B (or Connect) from the context menu. This sends a command to the Minimus 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.

🔁 Scream!						_		<
<u>File View Windows H</u> elp								
MIN-6855	Stream ID	Rec.	Comp.	SPS	End Time	Date	RIC	<b></b>
🖻 🖉 Sensor0	1AXLE0	No	16 bit	100	13:30:55	14/07/2016	130	
- ₿MN6B55-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	
BMN6B55-HUM	1INTE0	No	8 bit	100	13:30:59	14/07/2016	-12068	
- BMN6B55-INT	1INTN0	No	8 bit	100	13:30:58	14/07/2016	-8782	
	1INTZ0	No	8 bit	100	13:30:57	14/07/2016	-22655	
BMN6B55-MAG	1MAGE0	No	8 bit	5	13:29:23	14/07/2016	-5322	
- 🗑 MN6B55-MAS	1MAGN0	No	8 bit	5	13:29:51	14/07/2016	-6660	
- 🖯 MN6855-0VIN -	- 1MAGZO	No	8 bit	5	13:28:55	14/07/2016	-1344	
MN6B55-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	
MN6B55-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	
BMN6B55-XAXL	1ROTR0	No	8 bit	5	13:28:11	14/07/2016	0	
–	1ROTY0	No	8 bit	5	13:28:11	14/07/2016	-30336	
	1TMPA0	No	8 bit	5	13:28:11	14/07/2016	4222	
BA03ED-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	
BRA03ED-1MAG	1VELN0	No	32 bit	200	13:31:00	14/07/2016	-1617447	
- 🖯 RA03ED-1MAS	1VELNC	No	32 bit	200	13:31:00	14/07/2016	-1512488	
BRA03ED-1ROT	1VELZ0	No	32 bit	200	13:31:00	14/07/2016	-493488	
BRA03ED-1TMP	1VELZC	No	32 bit	200	13:31:00	14/07/2016	-201964	
	AXLEO	No	16 bit	100	13:30:56	14/07/2016	-672	
-		No	8 bit	100	13:30:58	14/07/2016	-296	-
Server: 10.10.0.5:1567	51 streams		1,372,1	40 Kb s	stream buffer	PC Time (UTC):	: 13:31:06	1

To configure the Minimus, 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  $\rightarrow$ Setup dialogue</u>) is set to

YYYY\YYYMM\YYYYMMDD\I A YYYYMMDD 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 System configuration

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 or WAN address of the instrument from any common web browser.

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

### 5.1 Web Page login

The web interface can be protected by username and password. There are two levels of access to the web page: normal user and administrator.

UNDERSTAND Mmmm OPTIMISE güralp PROTECT Minimus Status Login Help System type: Minimus | Host label: SPRT-MIN | Host name: MIN-C555 (10.10.0.10) | Serial number: 00C555 System Status General information Host name MIN-C555 Host label SPRT-MIN System type Minimus Product type Minimus 10.10.0.10 SEED network and DG.TEST Serial number 000555 Firmware version 2.0-7545 Pv4 address (DHCP) tation (No site) Power over Etherne voltage Digitiser temperature 31.368 °C Digitiser humidity 26.70% nput voltage 13.119 V 0.000 V 12:23:03 PM sckt: 12/20 System time Uptime 1h 22m 5s ETH status Thu 7-Nov-2019 data: 2/6 GNS Status 2019-11-07 GNSS connection status Connected ast timestamp 12:23:02 2019-11-07 + Last lock time GNSS stability 100% 11:42:57 Latitude 51.3605 Longitude -1.1633 Horizontal dilution of Altitude 117 0.80 Trusted GNSS PPS status GNSS NMEA stream Input OK Pulsing Used: 12 GNSS Lock state 3D locked lumber of satellites In view: 12 Data record status icroSD status nicroSD total 1228504 KiB microSD free 97% Recording 60686336 KiB umber of sensors 1 letected Sensor0 Serial number (0) **TF064** Firmware ver (0) 6.0 ntegrator N (0) ntegrator E (0) ntegrator Z (0) -6 -5 -6 77 485 Seismometer Z Seismometer N (0) 293 Seismometer E (0 Midas House, Calleva Park, Aldermaston, Reading, RG7 8EA, UK Tel: +44 118 981 9056, Fax: +44 118 981 9943 E-Mail: <u>sales@guralp.com</u>, <u>support@guralp.com</u>

If the login is required, the web interface will initially show a status display only.

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



Logging in with normal user account unlocks only basics configuration and control features in order to prevent any advanced settings to be modified. The default username for normal user login is user and password of user.

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

Once logged in, the "Web Login" drop-down menu in the Network tab allows to disable the request of login every time the web page is accessed. The user-name and password for both normal user and administrator login are configurable in the "Network" tab.

										UNDERSTAND OPTIMISE PROTECT
										Minimus
	Status	Network	Setup	Trigger	Data Stream	Data Record	Storage	Logout	Help	
System type: Minimus   Host label: SPRT-MIN   Host name: MIN-C555 (10.10.0.10)   Serial number: 00C555										
Network Config										
DHCP	Ena	bled $\sim$								
DNS1 209.244.0.3			ON S2 84.20	00.69.80					Reboot	
Web Login	Required		Jsername (N	lormal)	user	Password (Normal)	******	HTTP Port		80
Web Timeout	Not Required		lsername (A	\dmin)	admin	Password (Admin)	*******			
				L		Send See	dl ink	1		

# 5.2 System status

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

- Host name: the serial number and model of the device;
- Host label: the customisable name of the Minimus system;
- System type: the name of the connected digitiser, e.g. "Minimus";

- Product type: the type of the connected digitiser, e.g. "Minimus";
- Serial number: the serial number of the Minimus;
- Firmware version: the DIG firmware version running on the Minimus;
- IPv4 address: the static or Dynamic LAN I.P. address of the Minimus;
- SEED network and station: Network and Station SEED codes of the Minimus;
- Digitiser temperature, humidity, Input voltage and PoE voltage (A Minimus+ only): the internal temperature and humidity of the Minimus; input voltage supplied and optional PoE voltage (A Minimus+ only) supplied to the Minimus;
- System time: the current internal system date and time;
- Uptime: the time the Minimus 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 time-stamp, 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 time-stamp**, **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;
- Number of instruments connected; and
- **Real-time sensor values** from the connected instruments.

### 5.3 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 8 on page 125).

# 5.4 Network configuration

### 5.4.1 I.P. address and gateway

By default, the Minimus 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 Netmask and the address of the Gateway (default router), as shown:

	güralp UNDERSTAN OPTIMISE PROTECT						
Sta System type: Minimus   Ho		Setup Trigger Host name: MIN-C555	Data Stream (10.10.0.10)   Se	Data Record	Storage	Logout	<b>Minim</b> Help
Network Config							
DHCP	Disabled 🗸 Sta	atic IP addr 10.10.0.1	)	let Mask 255.255	.255.0	Gateway	10.10.255.1
DNS1 209.244.0.3	DNS1 209.244.0.3 Disabled DNS2 84.200.69.80 Enabled					Reboot	
Web Login R		ername (Normal)	licer	Password Normal)	******	HTTP Port	80

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



**Note:** By default, the static I.P. address assigned to each Minimus is unique and derived from the specific serial number of the device. These addresses are in the default network for link-local (APIPA) addresses: 169.254.0.0/16 (in CIDR notation).

The first two octets of the address, therefore, are always 169.254. The third octet is the equal to the last two characters of the serial number interpreted as a hexadecimal number and then converted into base 10. The forth octet is the equal to the next-to-last two digits of the serial number, also converted from hexadecimal into base 10.

For example, if the serial number of the Minimus is MIN-C555, the preassigned Static I.P. address will be 169.254.85.197, where

- MIN-C555  $\Rightarrow$  "55"  $\Rightarrow$  (55)<sub>16</sub>. = (85)<sub>10</sub>  $\Rightarrow$  85 and
- MIN-C555  $\Rightarrow$  "C5"  $\Rightarrow$  (C5)<sub>16</sub> = (197)<sub>10</sub>  $\Rightarrow$  197

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

Edit Network Address - Discovery										
Device Serial #: 50517 Update IP configuration:										
Network Address:										
Netmask:	Netmask: 255.255.0 .0									
Gateway:	Gateway: <keep existing=""></keep>									
Obtain IP address automatically (DHCP)										
Local : 169.254.185.6 OK Cancel										

### 5.4.2 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 5.10on page 57 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 (located 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.

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 Transmission Multicast V Mode
NTP Server Pool 🗸	
Registry Disabled	
Registry Update Eve Static	Group ID SOF Registry Address 52,34.40,123

# 5.5 GDI push (auto-connection)

A Minimus 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 Minimus 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 Minimus to a host is configured, the Minimus 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 Minimus will then negotiate a link and start streaming data.

If the connection drops, the Minimus 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 9 on page 131 for a list of the network ports used by the Minimus.

# 5.6 QSCD

The Minimus can push data in QSCD format (**Q**uick Seismic **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 9000, 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 Minimus 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 5.15.12 on page 86 for details on how to configure this transform.

Use the "QSCD code sensor" drop-down menu to select the sensor and assign the desired QSCD code.

# 5.7 Data storage

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

		M	·····	güralp UNDERSTAND OPTIMISE PROTECT		
System type: Minir	Status Netv nus   Host label: SPR	vork Setup Trigger Data St (T-MIN   Host name: MIN-C555 (10.10.0.		Minimus Logout Help		
Disable All		Restore default	The "Disable All" and "Restore default" button will ALSO affect settings of any other sensors	Reboot		
Copy to Data St Display Streams	ream All ~	settings from this page to streaming configuration of all of the sensors.	Recording status Recording	cards status please visit "Storage" tab Display On Page Sensor 0 ~		
Channels con	figuration					
Channel s	ampling rate	Data transform	SEED name - please use check-box to modify the default	RESPonse file - if available		
		Seismic	channels	-		
S0SeisXA	200 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .HDF	RESP_file_6		
S0SeisZA	200 Hz 🗸	Transforms Disabled for this tap $ \lor $	DG.TEST.00 .HHZ	<u>RESP_file_9</u>		
SOSeisNA	200 Hz $\sim$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HHN	RESP_file_13		
S0SeisEA	200 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .HHE	RESP_file_17		
S0SeisZB	Disabled ${\scriptstyle\smile}$	Tap Disabled $\smallsetminus$	DG.TEST.00 .AHZ	RESP_file_10		
SOSeisNB	Disabled ${\scriptstyle\bigtriangledown}$	Tap Disabled ${\scriptstyle\bigtriangledown}$	DG.TEST.00 .AHN	RESP_file_14		
SOSeisEB	Disabled ${\scriptstyle\smile}$	Tap Disabled $\!$	DG.TEST.00 .AHE	RESP_file_18		
		Mass positi	on channels			
S0IntZ	100 Hz $$ $$ $$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HMZ			
SOIntN	100 Hz $\lor$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HMN			
S0IntE	100 Hz $$ $$ $$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HME			
		MEMS accelere	ometer channels			

This page allows to configure the recording channels for each of the connected instruments and sensors internal to the Minimus.

The names and contents of each channel are described in Section 8 on page 125.



•

**Note:** When changing a setting in the Minimus 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.* S0SeisZA, S0SeisNA, S0SeisEA. The drop-down box at the top-right of the page named "Display On Page" allows to move from different instruments, *e.g.* Sensor 1.

The page is divided in four columns:

in the left-most 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. The same configuration can be applied to real-time transmission channels by clicking the Copy to Data Stream button. The 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 5.15 on page 73);
- 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 5.12.5 on page 66).

Upon changing the sample rate, enabling a transform or changing Location and Channels codes, the Minimus 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 3.1.1 on page 10) and the instrument web page will display the following screen.

D MIN-C555 - - Discovery

MIN-C555 is rebooting ...

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

# 5.8 Storage

### 5.8.1 Recording status

MicroSD cards need to be specifically formatted to operate with the Minimus. The cards shipped with the Minimus 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 mini SEED 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 **Quicklomat Cards** or **Fullformat Cards** 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).

# 5.8.2 MicroSD card re-formatting

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

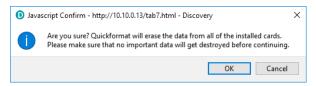
There are two methods for card reformatting: "Quick format" and "Full format". The quick format mode should be used for pre-deployment tests (*e.g.* stomp/huddle tests) to ensure that the instruments are operating properly. This mode simply marks the existing files as empty without deleting their contents. 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 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, overwriting any data remaining from the tests. The miniSEED extractor utility described in section 5.9.3.1 on page 56 can be used to remove the residual data if they cause any problems.

#### 5.8.2.1 Quick format

Ensure that the external microSD card is correctly inserted. Click the QuickformatCards button in the "Storage" tab: a dialogue box will appear to confirm the formatting operation – click on OK button to continue.



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

#### 5.8.2.2 Full format

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

D Java	script Confirm - http://10.10.0.13/tab7.html - Discovery	×
1	Are you sure? Fullformat will erase the data from all of the installed cards. Plea make sure that no important data will get destroyed before continuing.	se
	OK Cancel	

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.

# 5.8.3 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 5.8.4 on page 42) or event table (see Section 5.16.5 on page 97).

The <u>Unmount Cards</u> 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.

# 5.8.4 Downloading recorded data

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

		Mmm	güralp UNDERSTAND
Status	1 33	er Data Stream Data Reco 2555 (10.10.0.10)   Serial number; (	5
SD Card control	abel. SPICI-Mille [1105: Italife, Miller	5555 (10.10.0.10)   Serial Hamber. (	
Flush data	Unmount Cards	Quickformat Ca	rds Fullformat Cards
			Formatting status: idle
SD Cards status			
External microSD card presen	t PRESENT	Number of 128-MiB	miniSEED files 463
External microSD card usable	USABLE	Internal microSD ca	
External microSD card init cou		Internal microSD ca	
External microSD card is prim			ard is primary microSD card BACKUP
Primary microSD card is reco		Backup microSD ca	rd is recording samples <b>RECORDING</b>
Channel data download	d by time selection		
Channel:	DG.TEST.00.HDF 🗸 From: dd /	mm / yyyy : To: dd /	mm / yyyy : Download
SD Card files			
\$	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_S0SeisZA	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_S0IntE	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 16:28:53.000000000
table of events.bir	n	537600	2019-11-07 16:10:56.00000000
Download selected files			
Auxiliary files			
Filename	\$	Descr	ription 🔶
DG.dataless	Dataless SEED f		
fram.log calvals.txt	FRAM log file	tion mluos	
calvals.txt polezero.txt	SCREAM! calibra SCREAM! zeros,	poles and gains	
calib.txt	Calibration tex		
	Tel: +4	Guralp Systems Limited alleva Park, Aldermaston, Reading, RG7 4 118 981 9056, Fax: +44 118 981 9943 : <u>sales@guralp.com</u> , <u>support@guralp.com</u>	

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

#### Güralp Minimus and Minimus+

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	
Save File	
Do this <u>a</u> utomatically for files like this from now on.	
OK Cancel	
	_

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.

# 5.8.5 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:

Channel data downloa	Channel data download by time selection							
Channel:	DG.TEST.00.HDF 🗸 F	rom: dd / mm / yyyy	:- To: dd/mm/	уууу: 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	ed	102875136	2019-11-07 16:52:23.195000000				
00C555_SOSeisNA	DG.TEST.00.HHN	ed	102842368	2019-11-07 16:51:18.075000000				
00C555_S0SeisZA	DG.TEST.00.HHE	⊧d	115867648	2019-11-07 16:51:30.735000000				
00C555_SOSeisXA	DG.TEST.00.HHE	ed	95268864	2019-11-07 16:51:50.500000000				
00C555_S0AccNA	DG.TEST.00.HMZ	ed	68534272	2019-11-07 16:50:45.090000000				
00C555_S0AccZA	DG.TEST.00.HMZ	ed	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	ed	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	٤d	4960256	2019-11-07 16:45:55.700000000				
00C555_S0Voltage_	DG.TEST.00.HME	ed	8941568	2019-11-07 16:47:53.500000000				

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

Channel data download by time selection									
Channel: DG.TEST.00.HDF 🗸 From	: dd/mm	/ ууу	Y I	: -	- '	To: dd	/mm/;	Download	
SD Card files	<	Γ	Noven	nber 2	019	~	>		
Filename	Mon	Tue	Wed	Thu	Fri		Sun	Last data timestamp	\$
00C555_S0AccEA00100_00000.mseed		100			FTI	Sat	Sun	2019-11-07 16:53:08.470000000	
00C555_S0SeisEA00200_00001.mseed	28	29	30	31	1	2	3	2019-11-07 16:52:23.195000000	
00C555_S0SeisNA00200_00002.mseed	4	5	6	7	8	9	10	2019-11-07 16:51:18.075000000	
00C555_S0SeisZA00200_00003.mseed	11	12	13	14	15	16	17	2019-11-07 16:51:30.735000000	
00C555_S0SeisXA00200_00004.mseed	18	19	20	21	22	23	24	2019-11-07 16:51:50.50000000	
00C555_S0AccNA00100_00005.mseed								2019-11-07 16:50:45.090000000	
00C555_S0AccZA00100_00006.mseed	25	26	27	28	29	30	1	2019-11-07 16:51:14.460000000	
00C555_S0IntE00100_00007.mseed	2	3	4	5	6	7	8	2019-11-07 16:49:50.320000000	
00C555 S0IntN 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.

# 5.8.6 Bulk data extraction

To view files saved on the external microSD card, remove the card, as described in Section 3.1.3 on page 11. 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 Minimus 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	, <del>,</del> Home Share	View Mar		;)				-	
lavigation	Preview pane	Small icons	ns 💽 Large icons BB List E Content	Kan Medium-sized icons ↔ CEE Details ↔ F	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	Options
	Panes		Layout			Current view	Show/hide		
$\leftarrow \rightarrow$		s PC > Removab	Disk (D:)				マ ひ Search Re	emovable Disk (	D:)

# 5.8.7 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 filename prefix is the same as the channel name description given in the "Data Record" tab. Each file is 128 MiB in size.

🛖 Removable Disk (D:)			- 🗆 X
$\leftarrow \rightarrow$ $\checkmark$ $\uparrow$ $\blacksquare$ $\Rightarrow$ This $\Rightarrow$ Removable	e Disk (D:) 🗸 🗸	Search Remova	ble Disk (D:) 🔎
Name	Date modified	Туре	Size
all_miniSEED_files_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_Win32DiskImager.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 all\_miniSEED\_files\_are\_in\_here directory looks like this:

📝 📙 🗧   all_miniSEED_files_are_in_here			>
File Home Share View			~
· . A Removable Dis > all_miniSEED_fil	les_are_in_here v ♂	Search all_mini	SEED_files_are 🔎
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_0000000100_00018.mseed	22/07/2016 09:21	MSEED File	131,072 KB
Sensor0MassPosNR_0000000100_00002.mseed	22/07/2016 09:21	MSEED File	131,072 KB
Sensor0MassPosZR_0000000100_00004.mseed	22/07/2016 09:21	MSEED File	131,072 KB
Sensor0TemprCRou_0000000010_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_0000000100_00012.mseed	22/07/2016 09:21	MSEED File	131,072 KB
Sensor1MassPosNR_0000000100_00014.mseed	22/07/2016 09:21	MSEED File	131,072 KB
Sensor1MassPosZR_0000000100_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_0000000200_00020.mseed	22/07/2016 09:21	MSEED File	131,072 KB
Sensor1VelocZSmo_0000000200_00000.mseed	22/07/2016 09:21	MSEED File	131,072 KB
4 items			EEE

The file-name consists of four components:

- The stream name, truncated to 16 characters see Section 8 on page 125 for a full list of these;
- The sample rate (in samples per second) as a ten-digit decimal number, leftpadded with zeros;
- A number which functions as a counter to ensure unique file-names 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 Minimus' flash RAM or are dynamically generated:

Auxiliary files			
Filename	¢	Description	\$
DG.dataless		Dataless SEED file	
fram.log		FRAM log file	
calvals.txt		SCREAM! calibration values	
polezero.txt		SCREAM! zeros, poles and gains	
calib.txt		Calibration text file	

- network.DATALESS: This is a dataless SEED volume that contains meta-data including instrument responses, coordinates, compression type and more. It is generated from the RESP files for each channel. The first component of the file name depends on the the two-character Network code defined in the "Setup" tab. If, for example, this is GU, the file is called GU.DATALESS.
- fram.log:this is the FRAM log file. It is stored in FRAM.
- calvals.txt: this file contains calibration information in a format compatible with the Scream software package. It is dynamically generated.
- calib.txt this file contains calibration information with poles, zeros etc expressed in hexadecimal notation. It is stored in FRAM.
- polezero.txt: this file contains definitions of frequency responses in a format compatible with the Scream software application. It is dynamically generated.

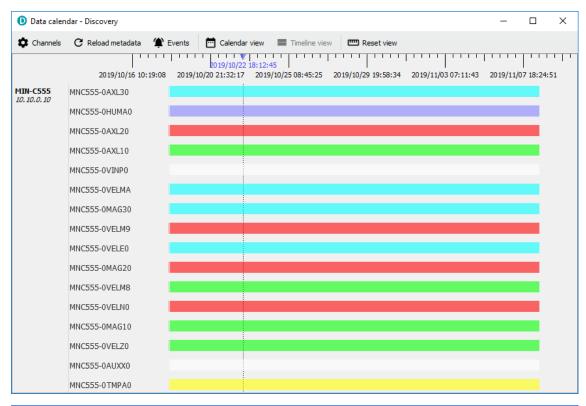
# 5.8.8 Request data from microSD card

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

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

			- Discovery Help													-	
	Statu	s	Label	System	Name	Firmware Ver	LAI	N Address	Uptime	Last Contact	Latit	ıde	Longitude	Altitude	Timing quality		
9	0		SPRT-MIN	Minimus	MIN-C555	2.0-7548	10.	Contro	l Centre		51.36	08 ·	-1.1632	123.90	100		
9	0		SPRT-FMUS	Fortimus	FMUS-DE5B	2.0-7548	10.	Live Vi		•	i1.36	05 ·	-1.1632	-12.34	0		
9	0		NO LABEL	Minimus	MIN-AF55	1.2-8707	10.	Firmware Update ).		).000	)	0.0000	0.00	0			
9	0		DEMO 83	Minimus	MIN-C456	2.0-7548	10.		Configuration	ı	51.36	D6	-1.1633	-12.34	0		
								Data ca	alendar view								
									twork Address hange	;							
Scan Locally Registry 52.34.40.123				Show On Map View Web Page							aüı	5					
cal	Systen	ns						View W	View Web Page (in system browser)							gu	1
f 4	system	ns res	ponding					Calibra	ition	•							

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.



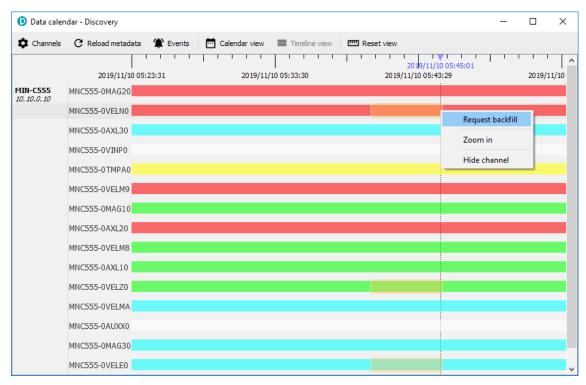


**Note:** Any gap in the calendar view is symptom of a gap in the recorded data.

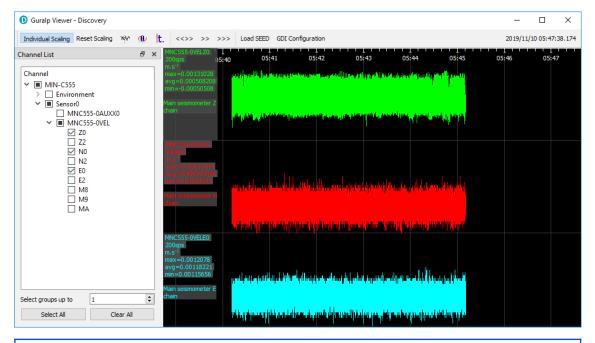
Use the mouse-wheel scrolling (or track- / touch-pad scrolling on a laptop) or highlight a portion of data, right-click and select "Zoom in" to zoom into the data. Multiple channel are selectable using key Ctrl.

In Discovery, right-click on the Minimus 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.

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



The requested data are 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.

# 5.9 Data transmission

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

		Murray	V	güralp UNDERSTAND OPTIMISE PROTECT
	Olation Nation			Minimus
	Status Netv		5	Logout Help
System type: Minimu Data Stream	is   Host label: SPR	T-MIN   Host name: MIN-C555 (10.10.0.	10)   Serial number: 00C555	
Disable All Stream	15	Restore default	The "Disable All" and "Restore default" button will ALSO affect settings of any other sensors	Reboot
Copy to Data Reco	ord	"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	juration			
Channel sam	npling rate	Data transform	SEED name - please use check-box to modify the default	RESPonse file - if available
		Seismic	channels	
0AUXX0	200 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .HDF	RESP_file_5
0VELZ0	200 Hz 🗸	Transforms Disabled for this tap $ \sim$	DG.TEST.00 .HHZ	<u>RESP_file_7</u>
OVELNO	200 Hz $\sim$	Transforms Disabled for this tap $ \sim$	DG.TEST.00 .HHN	RESP_file_11
0VELE0	200 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .HHE	RESP_file_15
0VELZ2	5 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .MHZ	<u>RESP_file_8</u>
0VELN2	5 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .MHN	RESP_file_12
0VELE2	5 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .MHE	RESP_file_16
		Mass positi	on channels	
0VELM8	100 Hz $\!$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HMZ	
OVELM9	100 Hz $\lor$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HMN	
OVELMA	100 Hz $\lor$	Transforms Disabled for this tap $\!$	DG.TEST.00 .HME	
		MEMS accelero	meter channels	
0AXL10	100 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.99 .HN1	RESP_file_31
0AXL20	100 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST. 99 .HN2	RESP_file_35
0AXL30	100 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.99 .HN3	RESP_file_39

This page allows to configure the transmitted channels for each of the connected instruments and sensors internal to the Minimus.

The names and contents of each channel are described in Section 8 on page 125.



**Note:** When changing a setting in the Minimus 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.* 0VELZ0, 0VELN0, 0VELE0. The drop-down box at the top-right of the page named "Display On Page" allows to move from different instruments, *e.g.* Sensor 1.

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 5.15 on page 73);
- 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 5.12.5 on page 66).

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

During the reboot, the LEDs will flash, displaying the starting-up sequence (see Section 3.1.1 on page 10) and the instrument web page will display the following screen.

MIN-C555 is rebooting ...

MIN-C555 - - Discovery

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

# 5.9.1 Scream! (GCF format + Scream protocol)

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

This is primarily intended to support Güralp's Scream! Software (see Section 4.3.2 on page 30) or any software that can communicate using the Scream! Protocol, including Earthworm.

These include:

Güralp instruments with embedded acquisition modules (e.g. 40TDE)

- Güralp DM24 and CD24 digitisers with embedded acquisition modules (*e.g.* Güralp DM24S*x*EAM[U])
- Güralp Affinity digitiser
- Network Acquisition Module (Güralp NAM)



**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.

### 5.9.2 GDI-link protocol

The Minimus can 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 DM24S*x*EAM[U])
- Güralp Affinity digitisers
- Güralp NAM (Network Acquisition Module)
- Earthworm software (<u>www.isti.com/products/earthworm/</u>)

GDI-link supports both data push and pull from/to the Minimus. See Section 5.5 on page 37 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. The topology can be many-to-one or one-to many. This means that 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.

### 5.9.3 SEEDlink protocol

The Minimus 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 Minimus SEEDlink back-fill implementation is packet-based.

In the "Network" tab of the Minimus' web page, select the desired SEEDlink mode:

Network (	Config			
DHCP	Enabled $\sim$			
DN S1 209	.244.0.3	DNS2 84.200.69.80		Reboot
Web Login	Required ~	Username (Normal) user	Password ************************************	HTTP Port 80
Web Timeou	Never ~	Username (Admin) admin	Password (Admin)	
SeedLink	Enabled, 65536 records V	Send status.txt Every 300 seconds	SeedLink Data Packet Format Optimal 🗸	Send SeedLink EEW Packet 0 deciseconds Every
TFTP Server	Debug, 512 records	TFTP File		
Network	Debug, 2048 records			
PTP Mode Run	Debug, 65536 records Debug, 139264 records	PTP Offset 0 nanoseconds	PTP Transmission Unicast ~ Mode	PTP Master IP 0.0.0.0
NTP Server	Enabled, 2048 records			
Registry	Enabled, 65536 records			
Registry Up	Enabled, 139264 records	Group ID SOF	Registry Address 52.34.40.123	

The choices are:

- "Enabled" This is the normal operating mode. Choose between backfill buffer sizes of 2,048 records, 65,536 records or 139,264 records;
- "Disabled" turns off the SEEDlink server; and
- "Debug" this mode produces additional messages in the file seedlink.log which may be helpful if trying to diagnose a problem. It is available with backfill buffer sizes as before and, additionally, a 512-record buffer. (622,592 is listed but not implemented).



**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 Minimus 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 Minimus web page select the interval in deciseconds (1 decisecond = 100 ms or 0.1 seconds) between miniSEED packets ("Send SeedLink EEW Packets Every").

Network Config			
DHCP Enabled ~			
DNS1 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 V	Send status.txt Every 300 seconds	SeedLink Data Packet Format Optimal ~	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 Minimus web page controls this behaviour.

Network Config			
DHCP Enabled ~			
DNS1 209.244.0.3	DN S2 84.200.69.80		Reboot
Web Login Required 🗸	Username (Normal) User	Password ******** (Normal)	HTTP Port 80
Web Timeout Never 🕔	Username (Admin) admin	Password (Admin)	
SeedLink Enabled, 65536 records 🗸	Send status.txt Every 300 seconds	SeedLink Data Packet Format Optimal 🗸	Send SeedLink EEW Packet 10 deciseconds Every
Data Record Size 512 Bytes	10.30.255.197	TFTP File	
Network Timing 512 Bytes			
PTP 256 Bytes	PTP Offset	PTP	· · ·



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

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 <u>http://ds.iris.edu/ds/nodes/dmc/software/downloads/slinktool/</u>.

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
        00 CHN D 2016-09-13 10:42:18
                                         2016-09-13 10:46:56
DG TEST
DG TEST 01 HHN D 2016-09-13 10:42:18
                                         2016-09-13 10:46:56
                                         2016-09-13 10:46:56
DG TEST 00 CHE D 2016-09-13 10:42:18 -
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, 415 samples, 100 Hz, 2016,257,10:44:02.750000
(latency ~3.0 sec)
```

The SEEDlink server on the Minimus 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.

#### 5.9.3.1 MiniSEED extractor

	Data Viewer CAP Receiver	stem	Name	Firmware Ver	LAN Address	Uptime	Last Contact	Latitude	Longitude	Altitude	Timing quality
•	Add Device	imus	FMUS-DE5B	2.0-7548	10.10.0.25	00:10:05	Just Now	51.3605	-1.1632	-12.34	0
9	miniSEED Extractor	mus	MIN-AF55	1.2-8707	10.10.0.6	6 days 6 Hrs	Just Now	0.0000	0.0000	0.00	0
•	Power board control Sonardyne Debugger	mus	MIN-C456	2.0-7548	10.10.0.17	00:16:36	Just Now	51.3606	-1.1633	-12.34	0
9	SPRT-MIN Mi	nimus	MIN-C555	2.0-7548	10.10.0.10	01:00:01	Just Now	51.3606	-1.1632	120.80	100
	Locally Registry	5	2.34.40.123								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	– 🗆 X
Choose Files to Process	Browse
Select Destination Folder	Browse
Gap Search Trim Files	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.

# 5.10 Synchronisation of the sample-clock

The Minimus 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 Minimus accessory pack includes a combined GNSS antenna and receiver for this purpose: see Section 3.2.2 on page 17 for details.

# 5.10.1 GNSS lock status

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

							Minim
	Status Netw	ork Setup Trigg	er Data Stre	am Data Record	Storage	Logout Help	
System type: Minimus	Host label: SPR	T-MIN   Host name: MIN-	C555 (10.10.0.1	0)   Serial number: 00	C555		
System Status							
			General in	formation			
Host name	MIN-C555	Host label	SPRT-MIN	System type	Minimus	Product type	Minimus
Serial number	00C555	Firmware version	2.0-7548	IPv4 address	10.10.0.10 (DHCP)	SEED network and station	DG.TEST (No site)
Digitiser temperature	29.105 °C	Digitiser humidity	26.23%	Input voltage	12.920 V	Power over Ethernet voltage	0.000 V
System time	9:03:39 AM Fri 8-Nov-2019	Uptime	16h 51m 26s	ETH status	sckt: 12/20 data: 2/6		
			GNSS	Status			
GNSS connection statu	s Connected	Last timestamp	2019-11-08 09:03:38	MAN	XAN	Hills AONB	ST TH
Last lock time	2019-11-07 16:14:26	GNSS stability	100%	+	North Wessex	1 Sta	London
Latitude	51.3608	Longitude	-1.163		Downs	And	- AXA
Altitude	116.5	Horizontal dilution of precision	0.92	and the	TA	SEX C	Ath
GNSS PPS status	Trusted Pulsing	GNSS NMEA stream	Input OK	A	A	Fr St	- TH
GNSS Lock state	3D locked	Number of satellites	Used: 12 In view: 12		12 A	Report a problem	treetwap contribut
			Data reco	rd status			
microSD status	Recording	microSD total	60686336 KiB	microSD used	1298968 KiB	microSD free	97%
		1	Sens	ors		1	
Number of sensors detected	1						
Senso	r0	Serial number (0)	TF064	Firmware ver (0)	6.0		
		Integrator Z (0)	-6	Integrator N (0)	-5	Integrator E (0)	-6
		Seismometer Z (0)	62	Seismometer N (0)	287	Seismometer E (0)	481

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)

# 5.10.2 PTP (Precision Time Protocol)

The Minimus system supports timing provided through PTP.

							Minimu
	Status Netw	vork Setup Trigg	er Data Stre	am Data Record	d Storage Lo	gout Help	
ystem type: Minimus	Host label: SPR	T-MIN   Host name: MIN	C555 (10.10.0.10	0)   Serial number: 00	0C555		
System Status							
			General int				
lost name	MIN-C555	Host label	SPRT-MIN	System type	Minimus 10.10.0.10	Product type	Minimus DG.TEST
Serial number	00C555	Firmware version	2.0-7548	IPv4 address	(DHCP)	SEED network and station	(No site)
)igitiser temperature	29.019 °C	Digitiser humidity	26.12%	Input voltage	12.966 V	Power over Ethernet voltage	0.000 V
System time	9:05:15 AM Fri 8-Nov-2019	Uptime	16h 53m 3s	ETH status	sckt: 12/20 data: 2/6		
			GNSS S	Status			
SNSS connection statu	s Disconnected	Last timestamp	0000-00-00 00:00:00	Miller ~	V TAX	Hills AONB	1 Mar
ast lock time	Never	GNSS stability	Disconnected	+	KID	NY ST	London
atitude	51.3606	Longitude	-1.1633	t- House	North Wessex	XX X	AXX X
Altitude	-12.34	Horizontal dilution of precision	Undefined	A A A	AQÍVB	P	Der
GNSS PPS status	Not Trusted No Pulse	GNSS NMEA stream	Bad input	X	1200	t sp	343
GNSS Lock state	No lock	Number of satellites	Used: 0 In view: 0	18-1-54	Report	a problem	tMap contribute
			PTP S	tatus			
PTP state	Phase Locked	Last PTP timestamp	2019-11-08 09:14:40Z	Last PTP lock time	2019-11-08 08:59:22Z	PTP stability	100%
Aaster IPv4 address	10.30.255.35	Master clock class	PRI_REF_PTP	Master clock accur	acy < 100ns (0x21)	Master time source	GPS
etwork path delay	38.1 us	Network jitter estimat	100 W 100	Network outliers	4%		
ine CD status	Description	mines CD 4+4+1	Data reco 60686336 KiB	-	4000000 1/20	mines CD from	074/
nicroSD status	Recording	microSD total	60686336 KiB	microSD used	1299032 KiB	microSD free	97%
umber of sensors	1	T	00113				
letected							
Senso	or0	Serial number (0)	TF064	Firmware ver (0)	6.0	5.40	
		Integrator Z (0)	-6	Integrator N (0)	-5	Integrator E (0)	-6
		Seismometer Z (0)	64	Seismometer N (0)	287	Seismometer E (0)	483

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 Minimus 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%  $\Rightarrow$  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								
	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.

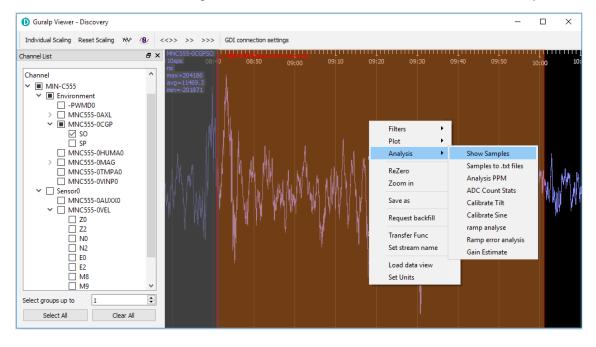
Network Timing											
	Correction 0 nanoseconds	PTP Transmission Unicast V Mode Multicast	PTP Master IP 0.0.0.0								
NTP Server Pool ~		Unicast									

#### 5.10.2.1 Special notes for PTP with Maris ocean-bottom systems.

PTP is the only source of timing available for a deployed Maris digitiser. To configure, visit the "Network" tab of the digitiser web page.

If your PTP infrastructure produces a fixed offset (when compared with GNSS), a manual correction can be applied to compensate for this.

The required correction value can be extracted from the internal clock from GNSS stream of the Minimus. In the Live View enable the OCGPSO channel and select at least 20 minutes of data. Right-click on the selection and click on Show Samples:



At the top of the resulting window, the maximum (max), average (avg) and minimum (min) values are displayed:

MNC555-0	CGPSO - Discove	ery —		<
max = 4274	103057ns			^
avg = 277	6679.21ns			
min = -8372	-201871ns			
+00002380	+00002103	57388.lns	50708.9ns	
+00002380	+00002103	57388.lns	50708.9ns	
+00002380	+00002103	57388.lns	50708.9ns	
+00002380	+00002103	57388.lns	50708.9ns	
+00002380	+00002103	57388.lns	50708.9ns	
+00002380	+00002103	57388.lns	50708.9ns	
+00002399	+00002122	57846.3ns	51167.lns	
+00002399	+00002122	57846.3ns	51167.lns	
+00002399	+00002122	57846.3ns	51167.lns	
+00002399	+00002122	57846.3ns	51167.lns	$\mathbf{v}$
<			>	

Note the value of the average, multiply by -1 and enter the resulting value in the PTP Offset Correction box in the Network Timing section of the Network web page.

# 5.11 Deploy mode: Full power-save

The Minimus digitiser offers two deployment modes: "Normal" and "Power Save". "Full power-save" mode makes a number of configuration changes in order to reduce the unit's power consumption. This mode is particularly useful when using Maris digital ocean-bottom sensors.

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

	güralp UNDERSTAND OPTIMISE PROTECT													
								Minimus						
	Status Networ	k Setup	Trigger D	)ata Stream Data	Record	Storage	Logout Help							
System type: Minimus	Host label: SPRT-I	MIN   Host name	e: MIN-C555 (1	0.10.0.10)   Serial nui	mber: 00C{	55								
Digitizer Controls	System type: Minimus   Host label: SPRT-MIN   Host name: MIN-C555 (10.10.0.10)   Serial number: 00C555 Digitizer Controls													
Reboot				Reset All Setting	15		The "Reset All Set ALSO affect settin	ttings" button will gs on other pages						
Digitizer Config							-							
Auto Refresh	1	Auto Reboot	On Error $\smallsetminus$	Low Latency Mode	Balance	ed ~	]							
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					_							
Applied Rotation	Normal													
Analogue 0	Power Save			1										

"Power Save" mode temporarily disables auto-centring of a connected the Maris digital sensor, so that it is not continually re-centring while being lowered to the sea

floor. When this mode is selected, the "Auto Centre Disable (hr)" input field appears: use this to specify the length of time before auto-centring is re-enabled.

Digitizer Confi	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 🗸	Filter quality	High	~							
Deploy Mode	Power Save $\!$	Auto Center Disable(h	r) 12	Deploy									



**Note:** Güralp recommend a value of 10 to 12 hours to fully cover the entire deployment procedure.

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

Digitizer Cont	rols						
Reboot				Reset All Settings	The "Reset All Settings" button will ALSO affect settings on other pages		
Digitizer Confi	ig				_		
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 $\sim$		
Deploy Mode	Power Save $\!$	Auto Center					
Applied Rotati	ion			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 Contro	Digitizer Controls											
Reboot			Reset All Settings				The "Reset All Settings" button will ALSO affect settings on other page					
Digitizer Config												
Auto Refresh	1	Auto Reboot	On Error $\smallsetminus$	Low Latency Mode	Balanced	$\sim$						
Host Label	SPRT-MIN	Station Code	TEST	Network Code	DG		Site Name	No site				
Bluetooth PIN	0000	Bluetooth	Enabled 🗸	Filter quality	High	$\sim$						
Deploy Mode	Power Save $\!$	Auto Center Disable	(hr) 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 Minimus via a serial connection (see Section 7 on page 118) or to use the GüVü Bluetooth app (see Section 6.4 on page 114).

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.

# 5.12 Configuration and control of connected analogue instruments

# 5.12.1 Setting instrument type

The analogue sensor type is user-selectable and the Minimus includes a choice of several Güralp sensors and accelerometers. If the sensor is not in the list, select "Generic velocity" or "Generic acceleration", according to the instrument's response.

Analogue	Inalogue Sensors												
					ļ	Analog	ue t	o Digital Converte	er				
Input gain		x1.0	$\sim$	Input range	+/-	- 20.48 V		Input resolution	2.441 uV/count				
							lde	ntification					
Sensor type	Guralp 3T		$\sim$	Status LED	ld	le							
	Guralp 3T				Mass Centring								
Centre Mas	Guralp 3ESPC	;		Mass Readout Z	-0	.00375 V		Mass Readout N	-0.00312 V	Mass Readout E	-0.00375 V		
	Guralp 40T						Ma	ss Locking					
Lock Mass	Guralp Fortis			Unlock Mass									
				Calibration									
Calibration	Guralp 5TC			Amplitude		100%	$\sim$	Channel	Normal ~				
Digital Se	Guralp 6T												
Digital Se	Guralp 3TB												
	Guralp 3V/3E	SP-V					S	election					
Initialisation	Guralp 3T5TE												
	Guralp 54T	-						Systems Limited					
				Mida				Aldermaston, Reading, 056, Fax: +44 118 981					
	Generic veloc	ity						lp.com, support@gurals					
	Generic accel	eration											

A reboot is required after this change.

# 5.12.2 Setting instrument (sensor) gain for Güralp Fortis

The Güralp Fortis strong-motion accelerometer features a remotely-switchable gain option that can be controlled from inside Discovery. First, ensure that the physical gain switch on the underside of the Fortis is set to position "3" (as indicated by the engraving). See <u>MAN-FOR-0001</u> for more details.

To change the gain electronically, first, set the "Instrument Type" to "Güralp Fortis". Setting this option will then enable the "Instrument Gain" control. Under the "Instrument Gain", select a gain setting (options: ±0.5g; ±1g; ±2g; ±4g).

Setting the instrument type to "Fortis" will also change the miniSEED channel names to indicate that data are recorded from an accelerometer, *e.g.* "HNZ".

Analogue Sens	Analogue Sensors												
Analogue to Digital Converter													
Input gain	x1.0 ~	Input range	+/- 20.48 V	Input resolution	2.441 uV/count								
	Identification												
Sensor type Gural	Sensor type Guralp Fortis 🗸												
			R	esponse									
Fortis Range	-0.5g; +0.5g 🗸	Fortis Loop	Normal $\sim$										
	-0.5g; +0.5g		Mas	s Centring									
Centre Mass	-1.0g; +1.0g	Mass Readout Z	-0.00375 V	Mass Readout N	-0.00312 V	Mass Readout E	-0.00375 V						
	-2.0g; +2.0g		Ca	libration									
Calibration	-4.0g; +4.0g	Amplitude	100% ~	Channel	Normal ~								

# 5.12.3 Setting digitiser gain

The input gain can be controlled from the "Setup" tab of the web page using the "Input Gain" drop-down box. Digitiser gain options available are: Unity, ×2, ×4, ×8 and ×12.

Analogue Sens	nalogue Sensors												
Analogue to Digital Converter													
Input gain		x1.0	$\sim$	Input range	ut range +/- 20.48 V Input resolution 2.441 uV/count								
		x1.0			lde	ntification							
Sensor type Gura	lp Fortis	x2.0											
		x4.0			R	lesponse							
Fortis Range	-0.5g	x8.0		Fortis Loop	Normal 🗸								
		x12.0	)		Ma	ss Centring							
Centre Mass				Mass Readout Z	-0.00375 V	Mass Readout N	-0.00312 V	Mass Readout E	-0.00375 V				
	Calibration												
Calibration	Off		$\sim$	Amplitude	100% $\sim$	Channel	Normal ~						

The input range and resolution change automatically when the gain is selected and the gain in the RESP files and Dataless SEED is updated automatically.

# 5.12.4 Mass control

The Minimus can lock, unlock and centre the masses of connected instruments.

#### 5.12.4.1 Mass centring

Many broadband seismometers (*e.g.* Güralp 3T and 3ESPC) support remote/electronic mass centring. Change the polarity of the control signal using the drop-down menu if necessary.

						lder	ntification					
Sensor type	Generic	velocity	~	Status LED	Idle	Idle						
					Ν	las	s Centring					
Centre Mass	5			Mass Readout	Z -0.00375 V		Mass Readout N		-0.00312 V	Mass Readout E	-0.00375 V	
	Mass Locking											
Lock Mass	Lock Mass Unlock Mass											
						Са	libration					
Calibration		Off	$\sim$	Amplitude	100%	$\sim$	Channel	Norm	al >			
					C	onti	rol Polarity			_		
Mass Lock P	Iass Lock Polarity       Active Low       Mass Unlock       Active Low       Centring Polarity       Active Low       Cal Enable Polarity       Active Low											
Digital Se	nsors					Active Low Active High						
	Salection											

Mass centring can be controlled from the "Setup" tab of the web page using the <u>Centre Mass</u> button. Mass centring status and control can also be found in the Centring tab of the instrument Control Centre window.

#### 5.12.4.2 Mass locking

Some seismometers require their masses to be locked for transportation. Mass locking can be controlled from the "Setup" tab of the web page using the Lock Mass and Unlock Mass buttons. Change the polarity of the control signals using the drop-down menu, if necessary.

Analogue	Analogue Sensors												
	Analogue to Digital Converter												
Input gain	x1.0	$\sim$	Input range	+/- 20.48 V	Input resolution	2.441 uV/count							
Identification													
Sensor type	Generic velocity	$\sim$	Status LED	Idle									
Mass Centring													
Centre Mass         Mass Readout Z         -0.00375 V         Mass Readout N         -0.00312 V         Mass Readout E         -0.00375 V													
				Mas	s Locking								
Lock Mass			Unlock Mass										
				Ca	libration								
Calibration	Off	$\sim$	Amplitude	100% ~	Channel	Normal ~							
				Contr	ol Polarity		• •						
Mass Lock P	Mass Lock Polarity Active Low V Cal Enable Polarity Active Low V Cal Enable Polarity Active Low V												
Digital Se	Active Low Active High				-								
	a letter a high			Se	election								

**Note:** The mass lock control buttons are not displayed unless the selected sensor type has a mass-locking mechanism.

# 5.12.5 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 zeros for the transfer function that expresses the frequency response of the sensor. A full discussion of poles and zeros 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 Minimus is programmed at the factory so that it knows its own calibration values. Although the Minimus automatically receives calibration parameters from connected digital instruments (*e.g.* Güralp Radian), calibration values need to be entered manually for connected analogue sensors (*e.g.* Güralp Fortis).

To enter the calibration values for your analogue instruments, right-click the Minimus in Discovery's main window and select "Calibration"  $\rightarrow$  "Calibration Editor".

tings					
trument serial numbe	er:		TF064		
					Acceleromete
mponent Z Com	ponent N Componen	t E Compone	nt X Mass Z M	Mass N Mass E	Calibration chann
arameters					
Digitizer Volts	per Count (VPC) 2.4	398328e-6	V/co	ount	
🗹 Analogue Insti	rument Gain 0.52000	0004	V per n	ns <sup>-2</sup>	
ADC Offset	-938.7843		counts		
Coil constant	nan		A/m/s <sup>2</sup>		
Calibration res	istor nan		Ω		
	nan				
	nan				
lesponse					
	ctor 1.930001e+9				
Poles (Hz)	1.930001249				
Pole 0	-755.90002	+ i* 0		Hz	
Pole 1	-209.7	+ i* 0		Hz	
Pole 2	-63.790001		90.389999	Hz	
Pole 3	-63.790001		0.389999	Hz	
Pole 4	nan	+ i* r + i* r		Hz	
Pole 5	nan nan	+ 1* r + i* r		Hz	
Pole 7	nan	+ i* r		HZ	
Pole 8	nan	+ i* r		Hz	
Pole 9	nan	+ i* r		Hz	
Pole 10	nan	+ <b>i</b> * r		Hz	
Zeros (Hz)					
Zero 0	nan	+ i* r		Hz	
Zero 1	nan	+ i* r		Hz	
Zero 2	nan	+ i* r		Hz	
Zero 3	nan	+ i* r		Hz	
Zero 4	nan	+ i* r		Hz	
Zero 5	nan	+ <b>i</b> * r	dri	Hz	
Component configura	tion				
		٦.			
Copy: Poles and Zer	ros 🔻 to sensor 0 🖨	to component	ZNE V		Сору
					Send axis Z
					Sens and L
tem calibration value	s				
			Poles and Zer	os 🔻 Export to fil	e Import from file
				Send instrument	calibration to device

This form has one tab for each seismic component, for the mass positions and calibration channel. The instrument's response values should be entered in the here. These 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 Minimus.
- Analogue Instrument Gain this specifies the output voltage of the seismometer per unit of ground motion, as measured at 1 Hertz. This information is normally provided on a calibration document that is shipped with the instrument.
- 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 Minimus.
- The **Coil constant** is the coil constant for the component being calibrated, in A/ms<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 zeros) 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. This information is normally provided on a calibration document that is shipped with the instrument.

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

**Copy** button to copy and paste the selected values. Finally click on Send axis Z button to send the calibration values to the digitiser and save them permanently. Repeat this last step for the other axis. Note that Send axis Z only sends the calibration of the selected axis.

Component configuration	
Copy: Poles and Zeros 🔻 to sensor 0 🛓	to component ZNE 🔻 Copy
	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	nd instrument cal	ibration 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 dropdown 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 the 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 Stream" and "Data Record" tab of the Minimus web page.

		güralp   UN PRO	DERSTAND TIMISE DTECT								
Minimus Status Network Setup Trigger Data Stream Data Record Storage Logout Help											
System type: Minimus   Host label: SPRT-MIN   Host name: MIN-C555 (10.10.0.10)   Serial number: 00C555											
Disable All Stream	ns	The "Disable All" and "Restore default" button will ALSO affect settings of any other sensors	Reboot								
Copy to Data Reco		"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	s	Display On Page	Sensor 0 🗸						
Channels config	guration										
Channel san	npling rate	Data transform	SEED name - please use check-box to modify the default	RESPonse file - if	available						
Seismic channels											
0AUXX0	200 Hz 🗸	Transforms Disabled for this tap $$	DG.TEST.00 .HDF	<u>RESP_file</u>	5						
0VELZ0	200 Hz 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .HHZ	<u>RESP_file</u>	1						
OVELNO	200 Hz 🗸 🗸	Transforms Disabled for this tap $\!$	DG.TEST.00 .HHN	RESP_file_	.11						
0VELE0	200 Hz 🗸	Transforms Disabled for this tap $ \lor $	DG.TEST.00 .HHE	<u>RESP_file</u>	<u>15</u>						

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

# #	<< Gural	p SEED resp	oonse file bu	ilder v1.2-86	i15 >>		
±		CHANNEL RE	SPONSE DATA				
B050F03	Station:						
	Network:						
	Location:						
	Channel:						
	Start date:		1:26:48				
	End date:						
#		-					
#	+		+			+	+
÷	+		Channel	Sensitivity.	TEST ch HNZ	i.	+
#	+					-+	+
#							
B058F03	Stage seguen	ce number:		0			
B058F04	Sensitivity:			2.131148E	+05		
B058F05	Frequency of	sensitivit	y:	1.000000E	+00 HZ		
B058F06	Number of ca	librations:	-	0			
#							
#	+	+				+	+
#	+	1	Response (P	oles & Zeros)	, TEST ch HNZ	1	+
#	+	+				+	+
#							
B053F03	Transfer fun	ction type:		A [Laplac	e Transform (Ra	ad/sec)]	
B053F04	Stage sequen	ce number:		1			
B053F05	Response in t	units looku	up:	M/S**2 -	Acceleration in	n Metres Per	Second Squared
B053F06	Response out	units loob	cup:	V - Volta	1		
B053F07	A0 normaliza	tion factor	::	3.022955E	+12		
B053F08	Normalizatio	n frequency	/:	1.00000E	:+00		

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

MIN-C45	6 Discovery
# #	<< Güralp SEED response file buil
+	CUANNEL RESPONSE DATA
B050F03	Back T
B050F16	Forward
B052F03 B052F04	Reload
B052F22	View Page Source 8,045,14:56:59
B052F23	Enα αate:8,046,12:03:06
+	
+	+ +
	+ 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	<u>RESP_fil</u>	Follow Link
0K	<u>RESP_fil</u>	Save Link
0L	RESP file	Back 63
0 <b>K</b>	RESP file	Forward
0L	RESP file	Reload View Page Source
0K	RESP_file	Copy Link URL
0L	RESP file 1	<u>6</u>



**Note:** RESP files are not available for channels that have a transform enabled. For details about transforms, see section 5.15 on page 73.

# 5.13 Configuration and control of connected digital instruments

Please refer to <u>MAN-RAD-0001</u> for full details on configuring and controlling compatible digital instruments, such as the Güralp Radian, connected to the Minimus.

# 5.14 Setting sensor orientation and depth parameters

### 5.14.1 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 <u>https://www.guralp.com/howtos/determining-sensor-orientation</u>.

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

Digitizer Cont	trois								
Reboot			Reset All Set	Reset All Settings			The "Reset All Settings" button will ALSO affect settings on other pages		
Digitizer Conf	ig								
Auto Refresh	1	Auto Reboot	On Error V	Low Latency Mode	Balanced	$\sim$			
Host Label	SPRT-MIN	Station Code	TEST	Network Code	DG		Site Name	No site	е
Bluetooth PIN	0000	Bluetooth	Enabled $\sim$	Filter quality	High	~			
Deploy Mode	Power Save	Auto Center Disable	(hr) 12	Deploy					
Applied Rotat	ion								
Analogue 0	0	•							
Digital 1	0	° Digital 2	0 °	Digital 3	0	۰	Digital 4	0	۰
Digital 5	0	Digital 6	0 °	Digital 7	0	۰	Digital 8	0	۰

This feature can be applied to analogue seismometers and accelerometers and also to Borehole or Post-hole Radians, when installed with a vertical orientation.



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

# 5.14.2 Instrument installation parameters

The Dip (tilt angle from vertical), Azimuth (tilt direction from North) and Depth of analogue or digital sensors connected to the Minimus 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 dropdown menu.

Sensor Installation	n Parameter	'S					
Sensor	Sensor 0 🗸	Dip	0	Azimuth	0	Depth	0
Analogue Sensor	Sensor 0						
	Sensor 1		Analogue t	o Digital Converter			
Input gain	Sensor 2	Input range	+/- 20.48 V	Input resolution	2.441 uV/count		
	Sensor 3		lde	ntification		•	
Sensor Generic v	Sensor 4	Status LED	Idle				
type Content of	Sensor 5		Ma	ss Centring			
Centre Mass	Sensor 6	Mass Readout Z	-0.00375 V	Mass Readout N	-0.00312 V	Mass Readout E	-0.00375 V
	Sensor 7		Ma	ss Locking			
Lock Mass	Sensor 8	Unlock Mass					
			C.	libration			



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

### 5.14.3 Inject a calibration signal

To check whether the analogue sensor(s) connected to the Minimus is correctly calibrated, go to the Setup tab of the web page and use the drop-down menu to choose between Triangle, Square and White Noise signal to be injected into the sensor's feedback loop.

Analogue Sensors										
Analogue to Digital Converter										
Input gain		x	1.0 ~	Input range	+/- 20.48 V	Input resolution	2.441 uV/count			
Identification										
Sensor type	Guralp	3T	~	Status LED	Idle					
						Mass Centring				
Centre Mass				Mass Readout Z	-0.00375 V	Mass Readout N	-0.00312 V	Mass Readout E	-0.00375 V	
						Mass Locking				
Lock Mass				Unlock Mass						
						Calibration				
Calibration		Triangle	~	Amplitude	100% ~	Channel	Normal ~			
Digital Sens	ors	Off				•		•		
Digital Selis	5015	Triangle				Calaatlaa				
Initialia atian	_	Square				Selection				
Initialisation		White N	loise			ralp Systems Limited				

Adjust the calibration signal amplitude at 100%, 50%, 25% or 12.5% of the DAC full range.

Calibration									
Calibration	Triangle 🗸	Amplitude		Channel	Normal ~				
Digital Sensors			100%						
Digital belibbib			50%						
			50 /0	Selection					
Initialisation	Complete		25%						
			12.5%						

Finally, enable the calibration on all three components of the selected analogue sensor.



**Note:** The calibration channel, named *nVELC0* (or *nACCC0*), produces an output if and only if the calibration is in progress.

While the calibration is in progress, the webpage shows the warning message Calibration in progress and Discovery flags the status icon in yellow.



# 5.15 Transforms

The Minimus 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 ratio 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.

			güralp	UNDERSTAND OPTIMISE PROTECT				
							Reboot Re	q <i>uired</i> - <mark>Minimus</mark>
	Status	Netv	vork Setup Trigger	Data Stream	Data Reco	rd Storage	Logout Help	
System type: Minim	us   Host labe	el: SPR	T-MIN   Host name: MIN-C555	(10.10.0.10)   S	erial number: (	0C555		
Data Stream								
Disable All Streams Restore default The "Disable All" and "Restore default" Disable All Streams Disable All Streams Disable All" and "Restore default"							Reboot	
Copy to Data Reco	ord		"Copy to Data Record" will ap settings from this page to re configuration of all of the sen	cording				
Display Streams	All	~	Apply configuration for t	ap groups			Display On Page	Sensor 0 🗸
Channels config	guration							
Channel sar	npling rate		Data transform	SEED	) name - please modify th	use check-box to e default	RESPonse	file - if available
				Seismic chan	nels		1	
0AUXX0	200 Hz	. ~	Transforms Disabled for th	is tap 🗸 🗌	DG.TEST.00	.HDF	RE	<u>SP_file_5</u>
0VELZ0	200 Hz	· ~	Enable Transform (reboot	) 🗸 🗆	DG.TEST.00	.HHZ	RE	<u>SP_file_7</u>
OVELNO	200 Hz	· ~	Transforms Disabled for th	·	DG.TEST.00	.HHN	RES	<u>SP_file_11</u>
0VELE0	200 Hz	· ~	Enable Transform (reboot	:)	DG.TEST.00	HHE	RES	P file 15

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



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

The available transforms are:

- Pass-through see Section 5.15.1 on page 75;
- 2<sup>nd</sup> order bi-quadratic filter see Section 5.15.6 on page 78;
- 1<sup>st</sup> order low-pass filter see Section 5.15.3 on page 76;
- 1<sup>st</sup> order high-pass filter see Section 5.15.4 on page 76;
- 1<sup>st</sup> order band/Notch filter see Section 5.15.11 on page 84;
- STA/LTA ratio see Section 5.15.10 on page 83;
- Integration see Section 5.15.7 on page 79;
- Double integration see Section 5.15.8 on page 80;
- Three-dimensional rotation see Section 5.15.11 on page 84;
- EEW parameters Observer see Section 5.15.9 on page 81;
- Differentiation see Section 5.15.2 on page 75;
- QSCDx sender see Section 5.15.12 on page 86;
- MMA logger see Section 5.15.13 on page 87.

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.

# 5.15.1 Pass-through

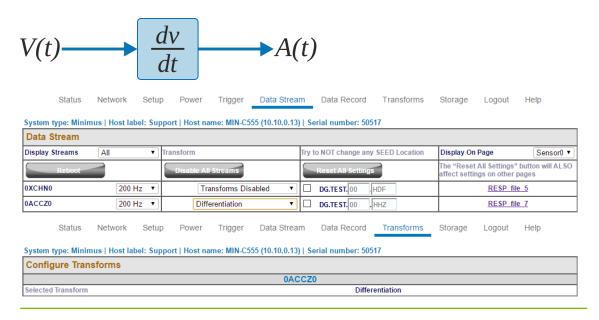
This null transform simply outputs a copy of the input data, without applying any transform. It has no configuration parameters.

Status	Network Setu	p Power Trigger	Data Stream	Data Record	Transforms	Storage	Logout	Help
System type: Minir	mus   Host label: Sup	oport   Host name: MIN-C	555 (10.10.0.13)	Serial number: 505	17			
Data Stream								
Display Streams	All 🔻	Transform	1	ry to NOT change any	SEED Location	Display On	Page	Sensor0 V
Reboot		Disable All Streams		Reset All Setting			All Settings" Igs on other p	button will ALSO ages
0XCHN0	200 Hz 🔻	Transforms D	isabled 🔻	DG.TEST.00	HDF		RESP file	<u>5</u>
0ACCZ0	200 Hz 🔻	Pass-through	•	DG.TEST. 00	HHZ		RESP file	<u>1</u>
Status	Network Setu	p Power Trigger	Data Stream	Data Record	Transforms	Storage	Logout	Help
System type: Minin	mus   Host label: Sup	oport   Host name: MIN₋C	555 (10.10.0.13)	Serial number: 505	i17			
Configure Trar	nsforms							
			0AC	CZ0				
Selected Transform				Pass	-through			

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

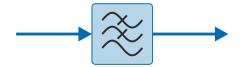
# 5.15.2 Differentiation

This transform differentiates the input data, *e.g.* if the input is a velocity (ms<sup>-1</sup>) channel, the output will be acceleration (ms<sup>-2</sup>). It has no configuration parameters.



# 5.15.3 1<sup>st</sup> order LPF

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

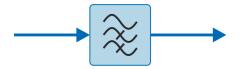


The single configurable parameter is "Corner Frequency": this specifies, in Hz, the frequency at which the output power is attenuated by -3 dB. Above this frequency, output power is attenuated by a further 6 dB per octave or 20 dB per decade.

Status	Network S	etup Powe	er Trigger	Data Stream	Data Record	Transforms	Storage	Logout Help
System type: Minim	us   Host label:	Support   Hos	t name: MIN-C555	(10.10.0.13)	Serial number: 5	0517		
Data Stream								
Display Streams	All	<ul> <li>Transform</li> </ul>		Tr	/ to NOT change a	ny SEED Location	Display On P	age Sensor0 ▼
Reboot		Disable	All Streams		Reset All Settin	igs		II Settings" button will ALSO s on other pages
0XCHN0	200 Hz	•	Transforms Disab	led 🔻 🗌	DG.TEST.00	HDF		RESP file 5
0ACCZ0	200 Hz	•	lst Order LPF	•	DG.TEST. 00	.HHZ		RESP file 7
Status System type: Minim Configure Trans	us   Host label:	etup Powe		Data Stream (10.10.0.13)	Data Record Serial number: 5		Storage	Logout Help
				0VEL	20			
Selected Transform	1st 0	rder LPF	Parameter Source	e	Def	ault Parameters	Save F	Parameters
Corner Frequency (Hz	L)	10						

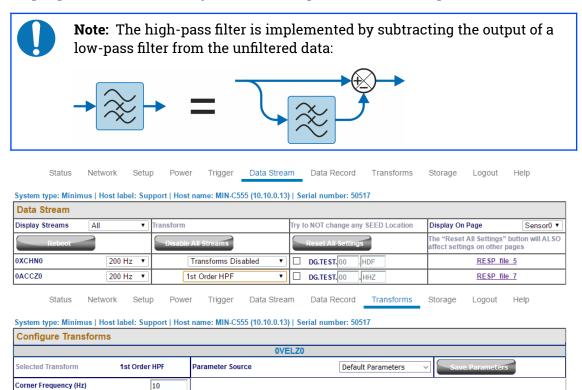
# 5.15.4 1<sup>st</sup> Order HPF

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.



# 5.15.5 1st 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:

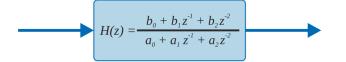
- A 1<sup>st</sup> order high pass filter (implemented using an LPF and a subtractor, as described in Section 5.15.4 on page 76), to gradually attenuate low-frequency integrator drift.
- A 1<sup>st</sup> order low pass filter (implemented as described in Section 5.15.3 on page 76).

The configurable parameters are the "High Pass Frequency" (HPF corner frequency as defined in Section 5.15.4 on page 76) and the "Low Pass Frequency" (LPF corner frequency as defined in Section 5.15.3 on page 76).

Status	Network Set	Ip Power Trigge	er Data Stream	n Data Record	Transforms	Storage Log	jout Help
System type: Minir	mus   Host label: Su	pport   Host name: MIN	-C555 (10.10.0.13)	Serial number: 5	0517		
Data Stream							
Display Streams	All 🔻	Transform		Try to NOT change a	ny SEED Location	Display On Page	Sensor0 V
Reboot		Disable All Streams		Reset All Settin	gs	The "Reset All Se affect settings on	ttings" button will ALSO other pages
0XCHN0	200 Hz 🔻	Transforms	Disabled 🔻	DG.TEST. 00	HDF	RE	SP file 5
0ACCZ0	200 Hz 🔻	Band/Notch Fi	lter (1st Order)▼	DG.TEST. 00	.HHZ	RE	SP file 7
Status System type: Minir	Network Setu mus   Host label: Su	ip Power Trigge pport   Host name: MIN				Storage Log	out Help
Configure Tran	nsforms						
			0VE	LZ0			
Selected Transform		Band/Notch Fil	ter (1st Order)	Parameter Source	Default Parar	meters 🗸	Save Parameters
High Pass Frequenc	y (Hz) 0.1	Low Pass Frequency (	lz) 50				

# 5.15.6 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.

Data Stream										
Display Streams	All 🔻	Transform		Try t	to NOT change a	ny SEED	Location	Display On	Page	Sensor0 •
Reboot		Disable All Stream	ns		Reset All Settin	Įs			All Settings" gs on other	' button will ALSC pages
0XCHN0	200 Hz 🔻	Transform	ns Disabled	•	DG.TEST.00	HDF			<u>RESP</u> fil	e <u>5</u>
0ACCZ0	200 Hz 🔻	2nd Order	Biquad	-	DG.TEST.00	.HHZ	1		<u>RESP</u> fil	e 7
	letwork Setu				Data Record		nsforms	Storage	Logout	Help
System type: Minimus	i   Host label: Su						nsforms	Storage	Logout	Help
	i   Host label: Su		IN-C555 (10.10.0.	13)   Se	erial number: 5		nsforms	Storage	Logout	Help
System type: Minimus	i   Host label: Su		IN-C555 (10.10.0. 0/	13)   Se ACCZO	erial number: 5	0517	nsforms ult Paramete		Logout Save Par	

# 5.15.7 Integration

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



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

- A DC filter (2<sup>nd</sup> order high-pass bi-quadratic) removes any DC component, which would cause the output to grow without limit;
- The integrator itself; and
- A 1<sup>st</sup> order high pass filter (implemented using an LPF and a sub-tractor, as described in Section 5.15.4 on page 76), to gradually attenuate low-frequency integrator drift.

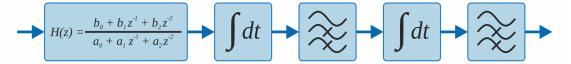
The configurable parameters are:

- "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.

System type: Minimus Data Stream	nost label: S	upport   nost name: M	(	- Serial Humber, Sost	, 		
	All	Transform		Try to NOT change any S	EED Location	Display On Page	e Sensor0 ▼
Reboot	)	Disable All Stream	ns	Reset All Settings		The "Reset All S affect settings o	ettings" button will ALSC n other pages
0XCHN0	200 Hz	Transform	ns Disabled 🔹 🔻	DG.TEST.00 H	DF	Ē	ESP file 5
0ACCZ0	200 Hz	Integration	•	DG.TEST.00 .H	HZ	B	ESP file 7
System type: Minimus		upport   Host name: M	IIN-C555 (10.10.0.13)	Serial number: 5051	7	-	- ·
Configure Transfo	rms						
Configure Transfo	rms		0AC	CZ0			
Configure Transfo Selected Transform	orms	Integration	0AC	CZ0 Parameter Source	Default P	arameters 🔻	Save Parameters

# 5.15.8 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 5.15.4 on page 76.

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.

Display Streams	All	Transform	Try to NOT change any SEED Location	n Display On Page Sensor0 🔻
Reboot		Disable All Streams	Reset All Settings	The "Reset All Settings" button will ALSC affect settings on other pages
0XCHN0	200 Hz 🔻	Transforms Disabled	DG.TEST.00 HDF	RESP file 5
0ACCZ0	200 Hz 🔻	Double Integration	DG.TEST.00 .HHZ	RESP file 7
Configure Transf	forms		ACCZ0	
		Devible late anotice	Parameter Source Default Param	
Selected Transform		Double Integration	Parameter Source Default Param	eters   Save Parameters

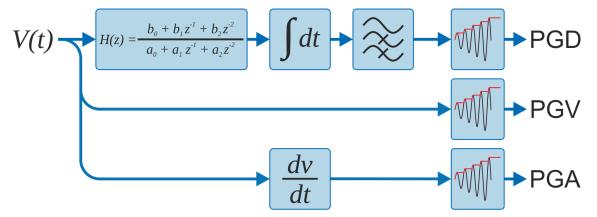
#### 5.15.9 EEW Parameters – Observer

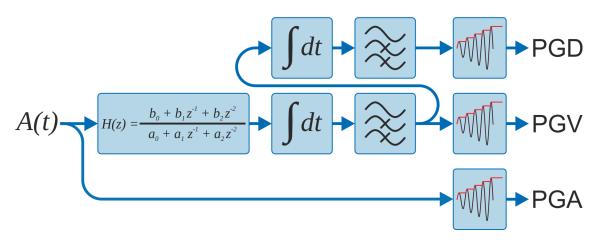
When an EEW trigger occurs (or is simulated – see below), the peak ground motion values (Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV) and Peak Ground Displacement (PGD)) are calculated and automatically recorded over the selected time-window and subsequently transmitted as a CAP message (see Section 5.16 on page 88 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.



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

The implementation of the transform differs, depending on whether the input stream represents velocity or acceleration data.





The high-pass filters are implemented using an LPF and a subtracter, as described in Section 5.15.4 on page 76.

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;
- "Preview Mode": the values to be shown in the output stream:
  - unmodified original stream (acceleration or velocity);
  - acceleration;
  - velocity; or
  - displacement.

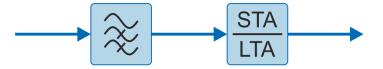
Note: Güralp recommend using the integration (section 5.15.7 on page 79) and double integration (section 5.15.8 on page 80) transforms to test the filter parameters, because the effect of the parameters will then be clearly visible in the transformed streams. Once suitable parameters have been determined, they can be copied to the EEW Parameter - Observer transform.

Display Streams	All	▼ Trans	form		fry t	o NOT change any	SEED Loca		isplay On Page	Sensor0 •
Reboot			isable All Streams			Reset All Settings			he "Reset All Settin ffect settings on oth	gs" button will ALSC ter pages
0XCHN0	200 Hz	•	Transforms Disa	bled 🔹		DG.TEST.00	HDF		RESP	file 5
0ACCZ0	200 Hz	•	EEW Parameters	Observer 🔻		DG.TEST.00	HHZ		RESP	file 7
				0ACC	:ZO					
Selected Transform		r	EEW Parameters - Obse	erver Paran	nete	r Source Default	: Paramete	rs v	Save Parame	ters
selected fraiisionn						4 - # F	[			
DC Cut-off Frequency	0.5 li	nterstage	Cut-off Frequency 0.00	)3 Outpu	It CL	ut-off Frequency		0.0015	Window Time (se	econds) 3

# 5.15.10 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 5.16 on page 88.

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 5.15.4 on page 76.

Status	Network	Setup	Power	Trigger	Data Strear	n	Data Record	Tra	nsforms	Storage	Logout	Help
System type: Minim	nus   Host lab	el: SUP	RT-MIN   Host	name: MIN	-C555 (10.10.0	13)	Serial numbe	r: 50517				
Data Stream												
Display Streams	All	~	Transform			Try to	o NOT change ar	y SEED I	ocation	Display O	n Page	Sensor0 ~
Reboot			Disable All	Streams			Reset All Settin	igs			et All Settings" tings on other	' button will ALSO pages
0AUXX0	200 H	z v	Tra	nsforms Disa	bled ~		DG.TEST.00	.HDF	HDF		<u>RESP fil</u>	<u>e 5</u>
0ACCZ0	200 H	Iz 🗸	STA	/LTA Ratio	<		DG.TEST.00	.HHZ	HNZ		<u>RESP</u> fil	<u>e 7</u>
Status	Network	Setup	Power	Trigger	Data Strea	n	Data Record	Tra	nsforms	Storage	Logout	Help
System type: Minim	nus   Host lab	el: SUP	RT-MIN   Host	name: MIN	-C555 (10.10.0	.13)	Serial numbe	r: 50517				
Configure Trans	sforms											
					0AC	CZO	)					
Selected Transform			STA/LTA Ratio		Parameter S	ourc	e	Defaul	t Paramete	rs 🗸	Save Para	imeters
DC coefficient	0.001	LTA coe	efficient	0.005	STA coefficie	ent			C	).1		

### 5.15.11 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 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  $\vec{u}$  as [u,v,w] and use Pauli's extension to Euler's formula:

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

to form a quaternion:  $\mathbf{q} \equiv [a, b, c, d]$  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:

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

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** 
$$\Rightarrow \operatorname{COS}\left(\frac{\theta}{2}\right)$$
,  $\mathbf{X} \Rightarrow 0$ ,  $\mathbf{Y} \Rightarrow 0$  and  $\mathbf{Z} \Rightarrow \operatorname{Sin}\left(\frac{\theta}{2}\right)$ 

Data Stream						
Display Streams	All 🔻	Transform	Try to NOT change any SE	ED Location Disp	olay On Page	Sensor0 •
Reboot		Disable All Streams	Reset All Settings		"Reset All Settings" b ct settings on other pa	
0AUXX0	200 Hz 🔻	Transforms Disabled	DG.TEST.00 .HD	F	RESP file	5
0ACCZ0	200 Hz 🔻	Rotation (Triplet)	DG.TEST.00 .HD	F	RESP file	7
0ACCN0	200 Hz 🔻	Rotation (Triplet)	DG.TEST.00 .HD	F	RESP file	8
0ACCE0	200 Hz 🔻	Rotation (Triplet)	DG.TEST.00 .HD	F	RESP file 1	1
		p Power Trigger Data Stropport   Host name: MIN-C555 (10.10.0.	_	Transforms Stor	age Logout	Help
	nus   Host label: Sup	oport   Host name: MIN-C555 (10.10.0.	_	Fransforms Stor	age Logout	Help

# 5.15.12 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 Minimus 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.)

				Minimus						
Status Ne	etwork Setu	p Power Trigger Data Stream	m Data Record Transforms	Storage Logout Help						
System type: Minimus	Host label: SU	PRT-MIN   Host name: MIN-C555 (10.10.0	.13)   Serial number: 50517							
Data Stream										
Display Streams	dl 🗸 🗸	Transform	Try to NOT change any SEED Location	Display On Page Sensor0 ~						
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						
0VELZ0	20 Hz 🗸 🗸	QSCDx Sender (Triplet) ~	DG.TEST.00 .BHZ	RESP_file_7						
OVELNO	20 Hz 🗸 🗸	QSCDx Sender (Triplet) 🗸 🗸	DG.TEST.00 .BHN	RESP file 8						
0VELE0	20 Hz 🗸 🗸	QSCDx Sender (Triplet) 🗸	DG.TEST. 00 .BHE	RESP file 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.

#### System configuration

		Mmmm	gürc	UNDERSTAND OPTIMISE PROTECT
				Minimus
Status Network	Setup Power Trigger	Data Stream Data Record	d Transforms Storage	Logout Help
	el: SUPRT-MIN   Host name: MIN	I-C555 (10.10.0.13)   Serial numbe	er: 50517	
Configure Transforms	0	ACCZ0 / 0ACCN0 / 0ACCE0		
Selected Transform	QSCDx Sender (Triplet)	Parameter Source	Default Parameters	Save Parameters
Period length 20		•	· · ·	
Manual Reset	Manual Reset	]		

#### 5.15.13 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.

Status	Network	Setup	Power Trigger	Data Stream	Data Record	Transforms	Storage Logou	it Help
ystem type: Minin	nus   Host lab	el: SUPR	T-MIN   Host name: MII	N-C555 (10.10.0.13)	Serial number:	50517		
Data Stream								
)isplay Streams	All	✓ Tre	ansform	Try	to NOT change any	SEED Location	Display On Page	Sensor0
Reboot			Disable All Streams		Reset All Setting	IS	The "Reset All Settin affect settings on ot	
OXXUAC	200 H	lz 🗸	Transforms Dis	abled 🗸 🗆	DG.TEST.00	HDF HDF	RESI	<u>p file 5</u>
DACCZ0	200 H	lz ∨	MMA Logger	~ [	DG.TEST. 00	.HHZ HNZ	RESI	file 7
Status	Network	Setup	Power Trigger	Data Stream	Data Record	Transforms	Storage Logo	ut Help

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

Configure Transforms		
	(	0ACCZ0
Selected Transform	MMA Logger	Parameter Source Default Parameters  V Save Parameters
Short Period Length 1000	Window Length in Short Periods 5	

# 5.16 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.

#### 5.16.1 Trigger sources

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

1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup>/4<sup>th</sup> **Remote Source**: This setting is used for multiple-source triggering networks. The sources specified here are other Minimus digitisers or Minimus based instruments, specified by the I.P. addresses configured in the "Remote Inputs" section:

Triggers	s configuration				
Source	1st Remote Source V	Score	100	Destination	Disabled $\vee$

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 5.16.2 on page 91 for more information.

• *n*<sup>th</sup> Address: is the I.P. address of the remote source, *e.g.* another Minimus.

Sources	
	Remote Inputs
1st Address	

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

Triggers	s configuration				
Source	1st I/O Expander Input $\sim$	Score	100	Destination	Disabled ~

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 5.16.2 on page 91 for more information.
- **Tap Trigger** *N*:: seismic or environmental Minimus channels selectable among any of the active taps in the "Data Stream" and "Data Record" tabs.

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

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 5.16.2 on page 91 for more information.
- Sensor number: this drop-down menu selects what sensor's streams to use as input of the trigger algorithm.
- Tap: this drop-down menu select the stream to use as input of the trigger algorithm. The choice is between single taps, *e.g. 0VELZ0*, or triplets, *e.g. First Seismo Triplet*.
- Trigger type: this drop-down menu chooses to use either STA/LTA or threshold algorithm.

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

Sources									
	Remote Inputs								
			1	lap Triggers					
Tap Trigger	A	Se	ensor 0 🗸 🗸	0ACCZ0	~	STA/LTA Trigger 🗸			
DC Frequency (Hz)	0.04	LTA Period (Seconds)	12	STA Period (Seconds)	0.5	Trigger Threshold 12			
Event Window (Seconds)	5	Initial Timeout (Seconds)	10	Preview in Stream					

- "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.

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

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

- "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/s<sup>2</sup>;
- "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.
- 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:

Sources							
		Local Ta	ap Triggers				
Tap Trigger A	4		Sensor 0 v		First Seismo Triplet	~	STA/LTA Trigger 🗸
DC Frequency (Hz)	0.04	LTA Period (Seconds)	12	STA Per	iod (Seconds)	0.5	Trigger Threshold
Event Window (Seconds)	5	Initial Timeout (Seconds)	10	3D or Z 8	& NE	1	Preview in Stream
				E togeth 0 = Trigg	ger off of the 3D resul her. ger off of the Z compo esultant of the horizo	onent and	

- 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.

For Threshold trigger algorithm:

Sources								
		Loca	al Tap Triggers					
Tap Trigger	А		Sensor 0 🗸	First S	eismo Triplet	$\sim$	Threshold	Trigger $\lor$
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 together. 0 = Trigger off of the Z c resultant of the horizon separately.	omponent and the 2D					

- 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.

# 5.16.2 Trigger destinations

The options available form the various Destination fields are:

1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup>/4<sup>th</sup> 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 <u>http://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html</u>). This field selects to which of the four available CAP receivers the trigger information should be sent to.

Triggers configuratio	n					
Source 1st Remote Source	ce 🗸 Score	100	Destination	1st CA	P receiver	~
Destinations						
	Сог	mmon Alerting Protoco	l Messaging			
1st CAP Address 52.34.40.123	1st CAP Port	11789	Total Score	300	1st CAP Threshold	200
1st CAP Msg scope Restricted	/ 1st CAP Recipient	eew@guralp.com	1st CAP Inhibit Timeout	10	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 Minimus 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 https://cap-validator.appspot.com 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 Minimus 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 5.15.9 on page 81).

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

Triggers config	guration					
Source Tap Trigge	r A [OVELZ	)] 🗸 Score		100	Destination 1st I/(	O Expander Output 🗸 🗸
Destinations						
			Relay Outputs			
1st Hold Time	1			1st Total Score	300	1st Score Threshold 200
1st Inhibit 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 Minimus 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.
- 1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup>/4<sup>th</sup> Remote Source: This setting is used for multiple-destination triggering networks. The destinations specified here are other Minimus digitisers or Minimus based instruments, specified by the I.P. addresses configured in the "Remote Outputs" section:

Triggers configuration					
Source Tap Trigger A [0VELZ0] 🗸	Score	100	Destination	1st Remote receiver	$\sim$

Destinations											
Remote Outputs											
1st Address	1st Total Score	300	1st Score Threshold		1st Inhibit Timeout	10					
1st Acceptance Window 1											

- *n*<sup>th</sup> Address: the I.P. address of the remote Minimus;
- 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 Minimus 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.

### 5.16.3 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 Minimus. 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 ⇒ optimal;
- Minimum latency ⇒ fast processing / lower latency.

		M	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	····			INDERSTAND OPTIMISE ROTECT
Status	Network Set		Data Stream		Transform Parameters	Storage Logout	<b>Minimus</b> Help
Digitizer Cont Reboot	mus   Host label: SF rols	rt-Min   Host na	ame: MIN-C555 (10	Reset All S		The "Reset All Setting ALSO affect settings	
Digitizer Conf	ig	_					
Auto Refresh Host Label	1 SPRT-MIN	Auto Reboot Station Code	On Error TEST	Low Latency Mode	Balanced v Minimum Power	Site Name	No site
Bluetooth PIN Deploy Mode	0000 Normal V	Bluetooth Deploy	Enabled	✓ Filter quality	Balanced Minimum Latency		

### 5.16.4 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 5.17 on page 99 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:

🕽 Güralp Systems -	Discovery										-		$\times$
ile Edit View	Help												
CAP Rec Add Der 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
00	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	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	
c													
Scan Locally	Registry	5	2.34.40.123								aü		-

The CAP receiver window allows specification of the listening port. Each Minimus from which messages should be received must have this value specified as the "CAP Port" in its triggering settings (see Section 5.16.2 on page 91). The value should be between 1025 and 65535. You should avoid numbers in the list at <a href="https://en.wikipedia.org/wiki/List\_of\_TCP\_and\_UDP\_port\_numbers">https://en.wikipedia.org/wiki/List\_of\_TCP\_and\_UDP\_port\_numbers</a>.

CAP Receiver - Discovery		– 🗆 X
Port 11789		Start
Log events	Browse	Load from logfile
Use forw	arding server	
+ -	Sverige	
<b>.</b>		
	the all the	
	United Kingdom Deutschland	
	France	
	Italia	
	Espana © OpenStreetMap nontributor	Sec. 1
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 I.P. address into the field and tick the check-box named "Use forwarding server". An error message is displayed if the entered I.P. address is not valid.

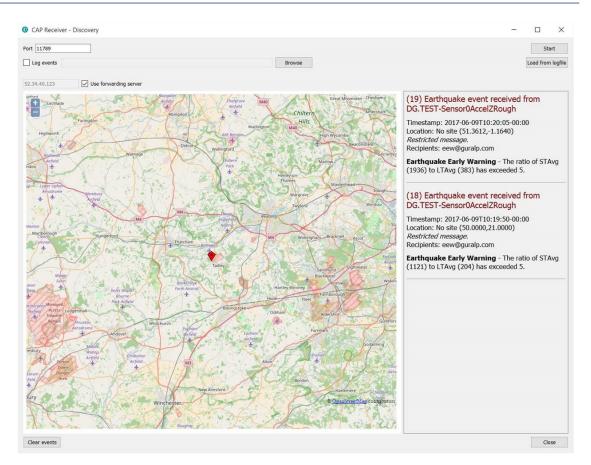
D CAP Receiver - Discovery		– 🗆 X
Port 11789		Start
Log events	Browse	Load from logfile
52, 34, 40, 123 Use forwarding server		

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

CAP Receiver - Discovery	_		×
Port 11789		Star	rt
Log events Browse	[	Load 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.

#### System configuration



When an event is detected and a CAP message is received, the location of the Minimus 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.

# 5.16.5 Seismic Event Table

The Minimus 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 Minimus web page.

Seismic Events Table									
Download Settings:	Seconds Pre 10	Seconds Post 10	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	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 V	Request Event Data						

The Minimus 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.

Do	wnload Settings:	Seconds Pre	10	Seconds Post	10	Download Z,N,E Triplet
	<b>Note</b> : Use the recent data i	e Flush data nto the microS			5	to copy most page 42).

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

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.

# 5.17 Using a Registry

Discovery can maintain a list of Minimus digitisers in a local or cloud-based registry, simplifying management of medium to large networks and removing the need for static I.P. 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.

Administrators can create their own registry servers by installing a simple program on a server (contact <u>support@guralp.com</u> for more details). The server itself must have a static I.P. address and be accessible to all connected Minimus 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:

- 1. 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 I.P. address.
- 2. Choose one or more Group IDs for your digitisers.
- 3. Set the Registry server address and Group ID in each Minimus.
- 4. Set the Registry server address and Group ID in each instance of Discovery.

#### 5.17.1 Configuring a Minimus for use with a registry

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

To do this, first connect the Minimus to the same network as a PC running Discovery and click the Scan Locally button, so that the Minimus 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#	Firmw	are Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude			
1		NO LA <mark>BEL</mark>	Minimus		4438	1.1-10	22	0.0.0.0	10.10.0.45	00:04:49	51.3607	-1.1630			
2		DEMO	Control Ce Live View	entre		•	22	0.0.0.0	10.10.0.36	19:49:55	0.0000	0.0000			
3		Suppo	Firmware l	Jpdate			31	0.0.0.0	10.10.0.13	19:24:21	51.3608	-1.1628			
4	Active	FishAf	System Co	nfiguration			628	0.0.0.0	10.10.0.22	22 days 20	0.0000	0.0000			
5	Active	fishyN	GDI Config File Exchan Edit Netwo				667	0.0.0.0	10.10.0.1	8 days 23 Hrs	0.0000	0.0000			
Sc	can Locally	Registr	Show On N View Web			N								_	
	al Systems			Page (in sys	tem brows	ser)							gür	alþ	5
LUCC	ai systems		Calibration	n		•							-	1	
of	5 systems respon	iding	CAP Receiv 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 Rebooted button.

# 5.17.2 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:

Status	Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Latitude	Longitude	
<u> (0)</u>	NO LABEL	Minimus	MIN-1156	4438	1.1-1022	0.0.00	10.10.0.45	00:04:49	51.3607	-1.1630	
0 0	DEMO 83	Minimus	MIN-C456	50262	1.1-1022	0.0.0.0	10.10.0.36	21:18:15	0.0000	0.0000	
0 0 🖆	Support	Minimus	MIN-C555	50517	1.1-1031	0.0.0.0	10.10.0.13	20:52:41	51.3607	-1.1629	
an Locally	Registry	_	34.40.123	_							

To set the Group ID in Discovery:

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

D	Güralp System	s - Dis	scovery						
<u>F</u> ile	<u>E</u> dit <u>V</u> iew	H	elp						
	Settings		Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Add
_	Exit		NO LABEL	Minimus	MIN-1156	4438	1.1-1022	0.0.0.0	10.10.0.4
2	00		DEMO 83	Minimus	MIN-C456	50262	1.1-1022	0.0.0.0	<b>10.10.0</b> .3
3	00		Support	Minimus	MIN-C555	50517	1.1-1031	0.0.0.0	<b>10.10.0</b> .1

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

Application configuration -	Discovery		-		Х
General					
Cloud registry group identifier	NorthernArray				
Default HTTP connection port	80				
		Г			
Restore defaults		L	Cancel	Appl	у

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

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

#### 5.17.3 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
58	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
55	0	C		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
53	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
56	0	C		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
54   <	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
	an Lo terec	cally I Syste		Registry 52	2.34.40.123	]						güra	n)

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

	System	Name	Serial#	Firmware Ver	WAN Address	LAN A	ddress	Uptime	Latitude	Longi ^
	Minimus	MIN-FD57	64855	1.2-8572	192.0.2.157	10.0.1.6	4	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	1.1.0
	Minimus Plus	MINP-DC58	56408	1.2-8572	192.0.2.201	10.	Live Viev			
	Minimus Plus	MINP-DD58	56664	1.2-8572	192.0.2.201	10.	Firmware	e Update (using LA	N address)	
	Minimus Plus	MINP-DE58	56920	1.2-8572	192.0.2.201	10.	-	Configuration (usin	-	ss)
	Minimus Plus	MINP-DF58	57176	1.2-8572	192.0.2.201	10.		figuration (using L/ work Address	AN address)	
	Minimus Plus	MINP-E058	57432	1.2-8572	192.0.2.201	10.	Show Or	n Map		
		_				-	View We	b Page (using LAN	address)	
52.	34.40.123						View We	b Page (in system l	browser) (usi	ng LAN addre
							Calibrati	on		

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:

sı idl#	Firmware Ver	WAN Address	LAN	Address	Uptime	Latitude	Longi	^		
855	1.2-8572	192.0.2.157	10.0.1	64	30 days 4 Hrs	35.4279	-98.02			
920	1.3-2713	192.0.2.35	10.00	Control	Centre	C1 0(10				1
408	1.2-8572	192.0.2.201	10.	Live Viev					×	GDI (using LAN address)
6 <b>64</b>	1.2-8572	192.0.2.201	10.	Firmware	යි e Update (using LA	N address)				GCF (using LAN address)
920	1.2-8572	192.0.2.201	10.	· ·	Configuration (usir	-				GDI and GCF (using LAN a
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.	Show Or						
					b Page (using LAN b Page (in system		ing LAN	addre	ess)	_

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

WAN Address	LAI	Address	Uptime	Latitude	Longi ^				
92.0.2.157	10.0.	1.64	30 days 4 Hrs	35.4279	-98.02				
92.0 <b>.2.35</b>	10.~	Control	Centre	F1 0640					
92.0.2.201	10.	Live Viev				•			
92.0.2.201	10.	Firmware	e Update (using LA	N address)					
92.0.2.201	10.	System (	Configuration (usin	ng LAN addre	ess)				
92.0.2.201	10.		figuration (using L vork Address	AN address)					
92.0.2.201	10.	Show Or							
			b Page (using LAN	l address)					
			b Page (in system		ing LAN ad	dress)			
		Calibrati	on			×	Calibrate	Accelerometer of S	ensor1
						<b>—</b>	Calibrate	Magnetometer of S	ensor1 (Wit
							Calibratic	on Page Editor (usin	g LAN addr

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

# 5.18 Updating Minimus firmware

The firmware of the Minimus is upgradeable. New releases appear regularly – mostly to add new features but, occasionally, to fix problems. Güralp recommends that the Minimus 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 Minimus digitiser. See section 12.5 on page 149 for more details.

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

- 1. Unplug the external microSD card from your Minimus.
- 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 Minimus.

Once this is complete, to upgrade the Minimus:

- 1. Run Discovery.
- 2. Right-click on the Minimus in Discovery main window and select "Firmware Update".
- 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 connection. Click Get from server and update

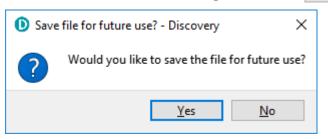
D MIN-C456 - Firmware Update - Discovery		-		×
Host name: MIN-C456 IP address: 10.10.0.17 MAC address: 00:50:C2:40:56:C4 Configuration				
Automatically download/upload configuration				
Reset configuration     Apply configuration from file			Browse	
Firmware Current firmware date: 13-Nov-2019 Current firmware version: 2.0-7806				
Güralp server - stable (online version: 2.0-7856) <u>Release notes</u>	Get from serve	er and up	date	
O Güralp server - experimental (online version: 2.0-7856)	Get from serve	er and up	date	
O Local file	Browse	ι	Jpdate	
				0%
			Close	2



**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 <u>support@guralp.com</u>.

IP address: 10.10.0.6 MAC address: 00:50:C2:40:55:AF		
Configuration		
Automatically download/upload configuration		
Reset configuration		
O Apply configuration from file		Browse
Firmware		
Current firmware date: 29-Apr-2019 Current firmware version: 1.2-8707		
○ Güralp server - stable (online version: 1.2-8713) <u>Release notes</u>	Get from server	r and update
○ Güralp server - experimental (online version: 1.2-8713)	Get from server	r and update
🔿 Local file	Browse	Update
Güralp server - version 2.0-7856 (online)	Get from server	r and update
		Clos

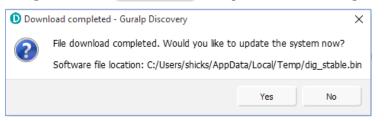
Discovery will ask you if you want to save the Firmware binary file for future use – click Yes for future use, *e.g.* update other systems offline using same firmware file. Otherwise, proceed with No



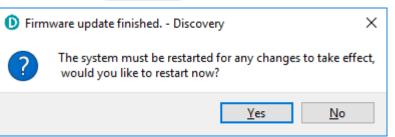
Discovery may ask to overwrite a temporary file on your PC – click
 Yes to allow it to do so.

File download - Guralp Discovery	—	×
File already exists Guralp Discovery X		
File already exists - overwrite? C:/Users/shicks/AppData/Local/Temp/dig_stable.bin		
Yes No		
Close this window automatically winen misned.		

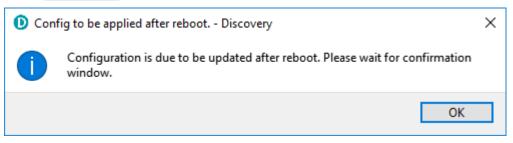
 Discovery will confirm through another dialogue box that the file download is complete. Click Yes to begin the firmware upload to the Minimus.



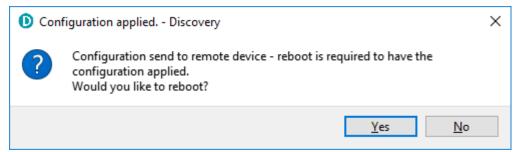
 At the end of the uploading process, the dialogue box will ask to restart the Minimus. Click Yes to finalise the process.



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



 When the configuration is uploaded, the Minimus needs to be restarted again. Confirm with Yes to the dialogue box.



- 10. The Minimus will re-boot and, during this process, the LED will rapidly flash white and power off for a few seconds.
- 11. Go to the "Storage" of the Minimus web page and Quick-format the microSD cards of your Minimus (for details, see Section 5.8.2.1 on page 41).
- 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 Minimus web page.
- 14. Check that your Minimus firmware version is as expected.
- 15. Check that nothing red or yellow shows up in the "Status" tab of the Minimus web page.

# 5.19 Import / Export an existing configuration

Updating the Minimus' 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:

	St	tatus	Label	System	Name	Serial#	Firmware Ve	er WAN Address	LAN Address		Uptime	Latitude	Longitude			
1		0	NO LABEL	Minimus	MIN-1156	4438	1.1-1022	0.0.0	10.10.0.45	00:	04:49	51.3607	-1.1630			
2	2	0	DEMO 83	Minimus	MIN-C456	50262	1.1-1022	Control Centre	l.		7:55	0.0000	0.0000			
3	9	0	Support	Minimus	MIN-C555	50517	1.1-1031	Live View		2:21	51.3607	-1.1630				
								Firmware Update								
						System Configura										
Scan Locally Registry 52.34.40.123					GDI Configuration											
					File Exchange Edit Network Address											
										guiup						
								Show On Map								
of 5 systems responding					View Web Page											
						View Web Page (in system browser)										
								Calibration		•						
								CAP Receiver								
								Add device								

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
O Use configuration from file:		Bro	owse	
Devices				
Select devices for configuration upload				
MIN-9555 (10.10.0.18)				
Select All				
Upload				
		Upload	configura	tion
		Ret	oot seled	: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
Use 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.

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.

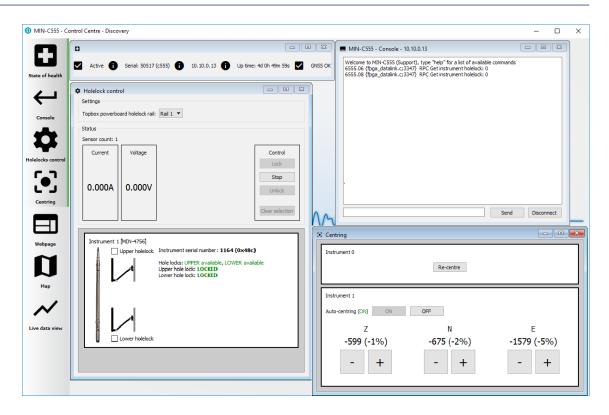
### 5.20 Control Centre

Several actions can be taken from within Discovery to control any of the instruments connected to the Minimus as well as the digitiser itself.

This operation can be done 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 digitiser, 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 Minimus. 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 Minimus in the Discovery main window.
Мар	This button is equivalent to the "Show on Map" entry in the context (right-click) menu of the Minimus 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 Minimus in the Discovery main window.
Holelocks control	Hole-lock control for attached Radian instruments. Please refer to <u>MAN-RAD-0001</u> for full details.
Centring	This tab allows manual centring of connected analogue and digital ( <i>e.g.</i> Radian) instruments. Please refer to <u>MAN-RAD-0001</u> for details about centring Radian instruments.

#### System configuration



## 6 GüVü app

The GüVü app provides monitoring and control of near-by Minimus digitisers 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

### 6.1 Getting stated

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

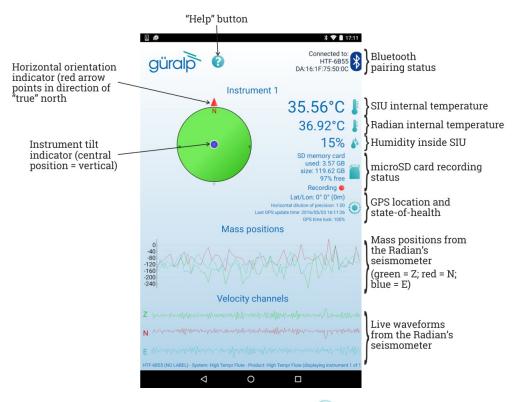


Steps for launching the GüVü App:

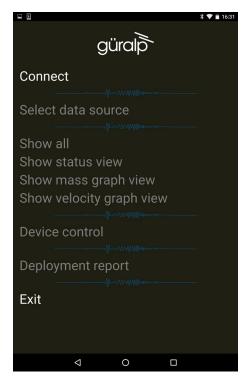
- 1. Launch by clicking on the GüVü icon from either the Apps Menu or from the Home Screen.
- 2. Wait a few seconds for the app splash screen.
- 4. Select the appropriate Minimus device from the list to pair. Wait a few seconds for the main viewer screen to show.

The instrument connection screen can also be accessed by pressing the menu icon (IIII) 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 Minimus and connected sensors. These features are summarised in the figure below:



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



### 6.2 Selecting data sources

Güralp view can provide status information about all connected sensors, including digital instruments (*e.g.* Güralp Radian) and analogue instruments.

To select the instrument source that provides information to the main status screen of GüVü, tap the menu icon ()) on the main instrument status window, and then tap the "Select data source" option.

The data source selection screen shows a list of connected instruments. Select an instrument name: this is now the instrument that will be displayed on the main instrument status window.



### 6.3 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:

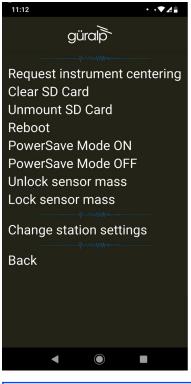
- **Show all** the default view setting; show state-of-health status, mass positions, and sensor traces on a single screen;
- Show status view show state-of-health on the main screen only;
- Show mass graph view show mass position traces on the main screen only; and
- Show velocity graph view show sensor traces on the main screen only.

### 6.4 Instrument control

Several features of the Minimus and connected instruments can be controlled and configured remotely over Bluetooth using GüVü:

- Analogue instrument centring
- Clearing and un-mounting SD card
- Rebooting the Minimus
- Enable/disable power-saving mode
- Lock/unlock sensor masses
- Station meta-data (User Label, Station Name, Network Code, Site Name)
- Network setting (I.P., Netmask, Gateway)
- Changing 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 channels' sampling rates, the Minimus must be rebooted before the changes will take effect.

These options can be accessed by tapping the menu icon (IIII) and choosing the

"Device control" option. To access the instrument control and configuration submenu, a PIN code has to be entered by selecting the text entry box and tapping OK.

	g	üra	alp	i.		DA:1		necte MIN-6 7:75:5	5B55	5 <b>X</b>
		5	STA	Instr	ume	ent 2	of	2		
							36	5.95	5°C	
		N						0.0	0°0	
								3	35%	6 🍐
w		•	E			16	.1V/	1.0V	(PoE	) 📕
		e T		Enter 0000	PIN nur	nber	ised	mory d: 69. : 14.6	3 ME 2 GE	3
					ОК	Cance	Re	cordi	6 free ng <b>(</b>	
								atitud	-	
										Ŷ
1	2	3	4	5	6	7	8	9	0	⊠
@	#	£	-	&	-	+	(	)	/	Ø
=/<	١	%	*	п	1	:	;	ļ	?	=\<
ABC	,	12 34						:		ABC
		7	$\checkmark$		0		C	]		

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.

#### 6.4.1 Setting the PIN code

The PIN code for accessing the instrument control menu of GüVü can be changed from the "Setup" tab of the web page. The new four-digit PIN code should be entered into the "Bluetooth PIN" field. The new value is applied by keying []; or clicking the left mouse button in any other setting box.

Digitizer Config	3						
Auto Refresh	1	Auto Reboot		Low Latency Mode	Balanced ~	]	
Host Label	SPRT-MIN	Station Code	TEST	Network Code	DG	Site Name	No site
Bluetooth PIN	0000	Bluetooth	Enabled $\sim$	Filter quality	High $\sim$	]	
Deploy Mode	Normal ~	Deploy					

### 6.5 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;
- 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 ()) 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.

#### Güralp Minimus and Minimus+

<b>∲</b>	*	* *	4% 🖻 1	7:4	0
÷	Compose	e	>	:	
	From deployment.team@example.com				
	То		~		
	MIN-C555 report				
	MIN-C555 system report * GENERAL * Hostname: MIN-C555 User label: Support SEED Station name: TEST SEED Network name: DG SEED Site name: No site Digitizer relative humidity: 23% Digitizer temperature: 39°C Digital instrument temperature: 4.4°C Power supply voltage: 13V Power over ethernet voltage: 1.5V Analogue instrument type: Fortis Guralp product name: Minimus * NETWORK * IP address: 10.10.0.13 Netmask: 255.255.0.0 Default gateway: 10.10.255.1 Mode: Automatic IP (DHCP) * STORAGE * Primary microSD card space: 1.51GB/58.0GB (97% free Primary microSD card status: Recording Secondary microSD card status: Recording External microSD: Usable / SECONDARY * GPS * GPS Quality: 100% Latitude: 51.3608° Longitude: -1.16284° Altitude: 106m Horizontal dilution of precision: 0.98 Time: 2017/09/04 17:33:04 Last lock time: 2017/09/04 16:39:43 (local device time)	ee)			

# 7 Advanced troubleshooting

In the unlikely event of the user experiencing problems with the operation of the Minimus, a diagnostics tool is available via the GNSS connector. This connector provides a serial console which can be accessed using a terminal emulator.

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 as the "Serial line", and the "Speed" should be set to 115200.

🕵 PuTTY Configuration		? ×
Category: Session Conservation Conservation Connection Connection Connection Proxy Telnet Rlogin Serial	Basic options for your PuTTY ses         Specify the destination you want to connect         Serial line         COM1         Connection type:         O Raw       Ielnet         Raw       Ielnet         Raw       Ielnet         Saved Sessions         Default Settings         Web Mirror         Close window on exit:         Always         Never	t to Speed 115200  Serjal  Load Save Delete ean exit
<u>A</u> bout <u>H</u> elp	<u>O</u> pen	<u>C</u> ancel

Next, select "Serial" from the bottom of the Category menu in the left-hand pane and check that the settings match those shown in the screen-shot below.

RuTTY Configuration		? ×
Cate <u>q</u> ory:		
Session     Logging     Terminal     Keyboard     Bell     Features     Window     Appearance     Behaviour     Translation     Selection     Colours     Connection     Data     Proxy     Telnet     Rlogin     SSH     Serial	Options controlling loc Select a serial line Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity Flow control	COM1 115200 8 1 None ~ None ~
About Help	Oper	n Cancel

Finally click the **Open** button and a terminal window will open, connected to the console of the Minimus.

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.

### 7.1 Reset all settings during boot phase

The Minimus 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 Minimus via a network connection, where the unit is not responsive, or where it 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 7 on page 118). 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 Minimus 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 Minimus to reset and re-boot.

Do not press any buttons during the first phase of boot-up:

```
Rebooting system, please wait...
00000101
0000clc1 RomBOOT
SCKC CR = 0xA, CKGR MOR = 0x100FF0A, CKGR PLLAR = 0x20FDD101, PMC MCKR =
0 \times 11\overline{2}2, PIO PDSR = \overline{0} \times F13F7C65
SCKC CR = 0xA, CKGR MOR = 0x100FF0A, CKGR PLLAR = 0x21403F01, PMC MCKR =
0x1302, PIO PDSR = 0xF13F7C65
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
NAND: Done to load image
SCKC CR = 0xA, CKGR MOR = 0x100FF02, CKGR_PLLAR = 0x21403F01, PMC_MCKR =
0 \times 1302, PIO PDSR = 0 \times F23F7C65
U-Boot v2019.10-1.guralp
CPU:
      SAMA5D36
External clock: 12.288 MHz
             497.664 MHz
CPU clock:
Master clock:
                165.888 MHz
DRAM: 256 MiB
NAND: 256 MiB
MMC ·
     Atmel mci: 0, Atmel mci: 1
Loading Environment from NAND... OK
In: serial
Out:
      serial
Err:
      serial
      eth0: ethernet@f0028000
Net:
word at 0xffffea20 (0x06) != word at 0x23000008 (0x07)
Total of 0 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: 5008508 = 0x4C6C7C
crc32 for 21000000 ... 214c6c7b ==> 6f7d4b5e
Total of 2 word(s) were the same
word at 0xffffea20 (0x06) != word at 0x23000008 (0x07)
Total of 0 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
Board type set to: Minimus
Recognised external clock: 12288000 Hz
SCKC CR = 0xA, CKGR MOR = 0x100FF02, CKGR_PLLAR = 0x21403F01, PMC_MCKR =
0x1302, MCK = 165888000 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 Minimus to reboot.

```
v2.0-7548 by teamcity on 14:28:48 07-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: 2019-11-08T14:23:11 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
    0.01 | -> rpc_init
    0.01 | -> ram init
    0.01 | -> ram_exchange_init
    0.01 | -> 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:

```
C0.01 | -> i2c_init
i2c_configure( 0, 100000Hz )
Using pclk 41472000, cdiv 203, shift 0 => 100173
i2c configure( 1, 100000Hz )
Using pclk 41472000, cdiv 203, shift 0 => 100173
i2c configure( 2, 100000Hz )
Using pclk 41472000, cdiv 203, shift 0 => 100173
    0.01 | -> i2c dac init
Ctrl+R
<mark>Ctrl+R</mark>
Ctrl+R
Ctrl+R
<mark>Ctrl+R</mark>
Ctrl+R
Ctrl+R
    0.01 | -> i2c_dac_init
    0.01 | -> i2c_humid_init
Humidity sensor test SUCCESS
    0.01 | -> fram init
Installing NVR device. size 12640
    0.04 | -> net sockets init
    0.06 | -> newtask init
USE ADC MINIMUS
    0.07 | -> init_whalesong
    0.07 | -> analog232_init
    0.07 | -> start timers
```

```
Warning non-integer microsecond divisor from 82944000
    0.08 | -> spi datalink init semaphores
    0.09 | -> chain init
Using 251 coefficients.
    0.15 | -> var user init
[SD log not available!] User variable "last_loc_lat" modified (called
from load from fram)
[SD log not available!] User variable "last loc lon" modified (called
from load from fram)
[SD log not available!] User variable "station start t" modified (called
from load from fram)
[SD log not available!] User variable "DHCP" modified (called from
load from fram)
[SD log not available!] User variable "Static IP addr" modified (called
from load from fram)
[SD log not available!] User variable "Net Mask" modified (called from
load from fram)
[SD log not available!] User variable "Gateway" modified (called from
load_from_fram)
[SD log not available!] User variable "DNS1" modified (called from
load from fram)
[SD log not available!] User variable "DNS2" modified (called from
load from fram)
[SD log not available!] User variable "Username" modified (called from
load from fram)
[SD log not available!] User variable "Password" modified (called from
load from fram)
[SD log not available!] User variable "tunnel password" modified (called
from load from fram)
[SD log not available!] User variable "tunnel username" modified (called
from load from fram)
[SD log not available!] User variable "tunnel connection" modified
(called from load_from_fram)
[SD log not available!] User variable "Host Label" modified (called from
load from fram)
[SD log not available!] User variable "Station Code" modified (called
from load from fram)
[SD log not available!] User variable "Network Code" modified (called
from load from fram)
[SD log not available!] User variable "Site Name" modified (called from
load from fram)
[SD log not available!] User variable "Bluetooth PIN" modified (called
from load from fram)
[SD log not available!] User variable "Filter quality" modified (called
from load from fram)
[SD log not available!] User variable "CAP Msg HMAC Key" modified (called
from load from fram)
[SD log not available!] User variable "Registry Address" modified (called
from load from fram)
[SD log not available!] User variable "tunnel_url" modified (called from
load from fram)
[SD log not available!] User variable "Password (Normal)" modified
(called from load from fram)
[SD log not available!] User variable "Username (Admin)" modified (called
from load_from_fram)
[SD log not available!] User variable "Password (Admin)" modified (called
from load from fram)
[SD log not available!] User variable "Username (Normal)" modified
(called from load from fram)
[SD log not available!] User variable "Group ID" modified (called from
load from fram)
    0.45 | -> calibration init
    1.91 | -> gcftx_init
    1.92 | -> spi datalink chains init
```

```
Sensor0 is velocimeter
Sensor1 is accelerometer
Sensor2 is velocimeter
Sensor3 is velocimeter
Sensor4 is velocimeter
Sensor5 is velocimeter
Sensor6 is velocimeter
Sensor7 is velocimeter
Sensor8 is velocimeter
    3.33 | -> init nand
    4.17 | -> adc12_init
    4.18 | -> init_random
    4.18 | -> ltc4151 vc monitor init
Voltage/Current readings are not provided by LTC4151 chip.
    4.19 | -> voltage sniffer init
    4.20 | -> init_lut
    4.28 | -> i2c_humid_init_ui
    4.30 | -> sd init
    4.31 | -> sd_file_init
    4.31 | -> sd log init
    4.31 | -> streaming client init
2019-11-08T14:23:15.000Z Retime Request Waiting (35s/3600s/Boot delay)
   4.33 | -> xtaltable init
No XTAL table found.
   4.40 | -> gps_pps_init
Chain 54 already set.
MIN-C555->
              4.44 | -> init var debug
    4.44 | -> tcpdump_init
    4.45 | -> var html init
    4.45 | -> init http server
    4.46 | -> sd_init_var
    4.46 | -> gps_pps_ui_init
    4.46 | -> xtaltable ui init
checking for xtaltable.txt
   4.47 | -> init fpga datalink
    4.47 | -> init auto center
   4.48 | -> init_embedded_fs
    4.48 | -> status txt init
    4.49 | -> lan init web
#####tx lock:
majic:f710f7f7
Call_lock value:-1
                      4.50 | -> init_responder_ui
    4.51 | -> init tunnel ui
    4.52 | -> quasar_init
Quasar Serial Isolated Input/Output Module support is disabled.
    4.53 | -> quasar_init_ui
    4.53 | -> applied_rot_init_web
    4.54 | -> installation parameters init web
    4.55 | -> init_fpga_web
    4.62 | -> analog232 init web
    4.73 | -> init transforms
   4.74 | -> triggers_init_ui
    5.02 | -> chain init web
   10.52 | -> transform init web
   13.14 | -> storage init web
   13.19 | -> spi datalink ui init
```

13.32 | -> gps\_init\_ui 13.33 | -> gps\_init

Once the boot-up reaches this stage, pressing Ctrl + R will have no effect.

If Ctrl + R was recognised during the second stage of boot-up, then the Minimus 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: 0x01010101 [GPS:1 PTP:1 RTC:1 TABLE:1]
Ctrl+R
Ctrl+R
Ctrl+R
sd manager: probed both microSD card slots
11.58 {calibration.c;1142} calibration_write_to_fram: successfully wrote
calib to FRAM
                       'sd format time' $20301021 --> $0000000
11.60 {var nvr.c;773}
                       'sd unmount time' $22647008 --> $0000000
11.61 {var_nvr.c;773}
11.62 {var_nvr.c;773}
                       'pps_src_table' 168 --> 1
                       'pps_src_gps' 0 --> 1
'pps_src_ptp' 69 --> 1
11.63 {var nvr.c;773}
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
                       'rtcSavedOffsetNano_nv' 402788896 --> 0
11.65 {var_nvr.c;773}
                       'rtcSavedFreqErrorPPB nv' -2129883872 --> 1000000
11.66 {var_nvr.c;773}
11.67 {var_nvr.c;773}
                       'rtcSavedOffsetTime nv' $52080158 --> $0000000
11.68 {var nvr.c;773} 'xtaltable offset' 610275339 --> 0
:
```

# 8 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.

**Note:** Throughout this section, the letter *n* in italic script is used to indicate the Instrument number, which is a small integer used to identify the signal source. This is always zero ('0') for the Minimus' own internal sensors and for the first analogue instrument.

For Minimus units, Instruments 1, 2, ... 8 are external Radian instruments in a string sharing a digital connection. Instrument 1 is the digital instrument closest to the Minimus.

A For Minimus+ units, Instrument 1 is the second analogue sensor. Instruments 2, 3, ... 9 are external Radian instruments in a string sharing a digital connection. Instrument 2 is the digital instrument closest to the Minimus+.

### 8.1 Minimus' internal sensors

			Data streaming	Data recording		
Sensor	Comp.	Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code
		Acausal	S0AccZ	0AXL10	S0AccZA	xN1
	1	Acausai			S0AccZB	xN1
		Causal	S0AccelZLowLat	0AXL1C		xN1
		Acausal	SOAccN	0AXL20	SOAccNA	xN2
MEMS accelerometer	2	Acausai			SOAccNB	xN2
		Causal	S0AccelNLowLat	0AXL2C		xN2
		Acausal	S0AccE	0AXL30	SOAccEA	xN3
	3	Acausai			S0AccEB	xN3
		Causal	S0AccelELowLat	0AXL3C		xN3
	1	Acausal	S0MagZ	0MAG10	S0MagZ	xF1
Magnetometer	2	Acausal	S0MagN	0MAG20	S0MagN	xF2
	3	Acausal	S0MagE	0MAG30	S0MagE	xF3
Input voltage		Acausal	S0Voltage	0VINP0	S0Voltage	xYV
Power						
Humidity within the Minimus		Acausal	S0HumidA	0HUMA0	S0HumidA	xIO
Tomporatura	Precision temperature	Acausal	S0TemprA	0TMPA0	S0TemprA	хКО
Temperature	First derivative of temperature	Acausal	S0TemprD	0TMPD0		xKD
	Internal clock offset from GNSS	Acausal	ClkGpsOffset	0CGPSO	ClkGpsOffset	BEO
Internal Clock	Internal clock period difference from GNSS	Acausal	ClkGpsPeriod	0CGPSP	ClkGpsPeriod	BEF
	Internal clock DAC frequency pulling	Acausal	ClkDacFreqPull	0CVDAC	ClkDacFreqPull	BED
	Test internal clock drift	Acausal	ClkTestPbpS	0CTSTB	ClkTestPpbS	BEB
	Internal clock	Acausal	ClkPtpOffset	0CPTPO	ClkPtpOffset	BEP

#### Güralp Minimus and Minimus+

			Data streaming	Data recording		
Sensor	Comp.	Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code
	offset from PTP					
	Delay MS	Acausal	ClkPtpDelayMS	0CPDMS	ClkPtpDelayMS	BEA
	Delay SM	Acausal	ClkPtpDelaySM	0CPDSM	ClkPtpDelaySM	BEB
	Mean path delay	Acausal	ClkPtpMeanPathDelay	0CPMPD	ClkPtpMeanPathDelay	BEC

### 8.2 Analogue Instruments

The italicised n in the codes is always set to zero ('0') for the first analogue instrument. A For Minimus+ units, it is set to 1 for the second analogue sensor. There is an Auxiliary input on each of the analogue sensor inputs on a Minimus+ and the streams from these are similarly identified by a 0 or 1.

			Data streaming	Data recording		
Sensor	Comp.	Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code
		Accurat	S <b>n</b> SeisZ	nVELZ0 or nACCZ0	S <b>n</b> SeisZA	xHZ or xNZ
	Vertical	Acausal al	S <b>n</b> SeisZ	nVELZ2 or nACCZ2	S <b>n</b> SeisZB	xHZ or xNZ
		Causal	S <b>n</b> SeisZLowLat	<i>n</i> VELZC <i>or</i> <i>n</i> ACCZC	Se <b>n</b> SeisZLowLat	xHZ or xNZ
Analogue seismic sensor	North	Acausal Iorth Causal	S <b>n</b> SeisN	nVELN0 or nACCN0	S <b>n</b> SeisNA	xHN or xNN
(velocimeter or accelerometer)			S <b>n</b> SeisN	nVELN2 or nACCN2	S <b>n</b> SeisNB	xHN or xNN
			S <b>n</b> SeisNLowLat	<i>n</i> VELNC or <i>n</i> ACCNC	S <b>n</b> SeisNLowLat	xHN or xNN
	East	ast Acausal	S <i>n</i> SeisE	nVELE0 or nACCE0	S <b>n</b> SeisEA	xHE or xNE
			S <i>n</i> SeisE	<b>n</b> VELE2 or	S <i>n</i> SeisEB	xHE or

#### Güralp Minimus and Minimus+

#### Appendix 1 – Instrument/channel names

			Data streaming	Data recording	Data recording		
Sensor	Comp.	Digital filter mode	Live stream name	Live Stream code	Data record name	Mini SEED channel code	
				<i>n</i> ACCE2		xNE	
		Causal	S <b>n</b> SeisELowLat	<i>n</i> VELEC or <i>n</i> ACCEC	S <b>n</b> SeisELowLat	xHE or xNE	
Auxiliary input		Acausal	S <b>n</b> SeisX	<b>n</b> AUXX0	S <b>n</b> SeisX	xDF	
Analogue	Vertical	Acausal	S <b>n</b> IntZ	<i>n</i> VELM8	S <b>n</b> IntZ	xMZ	
seismic sensor	North	Acausal	S <b>n</b> IntN	<i>n</i> VELM9	S <b>n</b> IntN	xMN	
mass positions	East	Acausal	S <b>n</b> IntE	<b>n</b> VELMA	S <b>n</b> IntE	xME	
Calibration Channel		Acausal	S <i>n</i> Calib	<i>n</i> VELC (or <i>n</i> ACCC)	S <b>n</b> Calib	xCA	
Humidity within sensor enclosure		Acausal	S <b>n</b> HumidB	<i>n</i> HUMB0	S <b>n</b> HumidB	xIO	
Pressure	Within sensor enclosur e	Acausal	S <b>n</b> Pressure	<i>n</i> PRSR0	S <b>n</b> Pressure	xDI	
	External	Acausal	S <b>n</b> ExtPressure	<i>n</i> PRSR1	S <b>n</b> ExtPressure	xDO	
PLL clock offset		Acausal	S <b>n</b> PLLOffset	<i>n</i> PLLO0	S <b>n</b> PLLOffset	xYO	

### 8.3 Digital Instruments

Digital instruments can be attached to the Minimus in a chain. The lowest number instrument is the one which is closest to the Minimus. On a Minimus, this is Instrument 1. A For Minimus+ units, it is Instrument 2.

			Data streaming	Data recording		
Sensor	Comp	Digital filter mode	Live stream name	Live stream code	Data record name	MiniSEED channel code
			S <b>n</b> SeisZ	<i>n</i> VELZ0 <i>or</i> <i>n</i> ACCZ0	S <b>n</b> SeisZA	xHZ or xNZ
	Vertical	Acausal	S <b>n</b> SeisZ	nVELZ2 or nACCZ2	S <b>n</b> SeisZB	xHZ or xNZ
		Causal	S <b>n</b> SeisZLowLat	<i>n</i> VELZC <i>or</i> <i>n</i> ACCZC	S <b>n</b> SeisZLowLat	xHZ or xNZ
			S <b>n</b> SeisN	nVELN0 or nACCN0	S <b>n</b> SeisNA	xHN or xNN
Seismometer (velocity or acceleration response)	North	Acausal	S <b>n</b> SeisN	<i>n</i> VELN2 <i>or</i> <i>n</i> ACCN2	S <b>n</b> SeisNB	xHN <i>or</i> xNN
response)		Causal	S <b>n</b> SeisNLowLat	<i>n</i> VELNC <i>or</i> <i>n</i> ACCNC	S <b>n</b> SeisNLowLat	xHN <i>or</i> xNN
	East	Acausal	S <b>n</b> SeisE	<i>n</i> VELE0 <i>or</i> <i>n</i> ACCE0	S <b>n</b> SeisEA	xHE or xNE
			S <b>n</b> SeisE	<i>n</i> VELE2 <i>or</i> <i>n</i> ACCE2	S <b>n</b> SeisEB	xHE or xNE
		Causal	S <b>n</b> SeisELowLat	<i>n</i> VELEC or <i>n</i> ACCEC	S <b>n</b> SeisELowLat	xHE or xNE
Digital seismic	Vertical	Acausal	S <b>n</b> IntZ	<i>n</i> INTZ0	S <b>n</b> IntZ	xMZ
sensor mass	North	Acausal	S <b>n</b> IntN	<i>n</i> INTN0	S <b>n</b> IntN	xMN
position	East	Acausal	S <b>n</b> IntE	<i>n</i> INTE0	S <b>n</b> IntE	xME
		Acausal	S <b>n</b> AccZ	<b>n</b> AXLZ0	S <b>n</b> AccZA	xNZ
MEMS	Vertical	Acausal			S <b>n</b> AccZB	xNZ
accelerometer		Causal	S <b>n</b> AccZLowLat	<b>n</b> AXLZC		xNZ
	North	Acausal	S <b>n</b> AccN	<b>n</b> AXLN0	S <b>n</b> AccNA	xNN

#### Güralp Minimus and Minimus+

#### Appendix 1 – Instrument/channel names

			Data streaming		Data recording			
Sensor	Comp	Digital filter mode	filter Live stream name stream		Data record name	MiniSEED channel code		
					S <b>n</b> AccNB	xNN		
		Causal	S <b>n</b> AccNLowLat	<b>n</b> AXLNC		xNN		
		Acausal	S <b>n</b> AccE	<b>n</b> AXLE0	S <b>n</b> AccEA	xNE		
	East				S <b>n</b> AccEB	xNE		
		Causal	S <b>n</b> AccELowLat	<b>n</b> AXLEC		xNE		
	Z	Acausal	S <b>n</b> MagZ	<i>n</i> MAGZ0	S <b>n</b> MagZ	xFZ		
	Ν	Acausal	S <b>n</b> MagN	<i>n</i> MAGN0	S <b>n</b> MagN	xFN		
Magnetemeter	E	Acausal	S <b>n</b> MagE	<b>n</b> MAGE0	S <b>n</b> MagE	xFE		
Magnetometer	Yaw	Acausal	S <b>n</b> RotYaw	<i>n</i> ROTY0	S <b>n</b> RotYaw	хҮҮ		
	Pitch	Acausal	S <b>n</b> RotPitch	<b>n</b> ROTP0	S <b>n</b> RotPitch	хYР		
	Roll	Acausal	S <b>n</b> RotRoll	<i>n</i> ROTR0	S <b>n</b> RotRoll	XYR		
Temperature		Acausal	S <b>n</b> TemprB	<b><i>n</i></b> TMPB0	Sensor <b>n</b> TemprBRough	хКО		
Humidity within sensor enclosure		Acausal	S <b>n</b> HumidB	<i>n</i> HUMB0	S <b>n</b> HumidB	xIO		
Pressure	Within sensor enclosur e	Acausal	S <b>n</b> Pressure	<i>n</i> PRSR0	S <b>n</b> Pressure	xDI		
	External	Acausal	S <b>n</b> ExtPressure	<b>n</b> PRSR1	S <b>n</b> ExtPressure	xDO		
PLL clock offset		Acausal	S <b>n</b> PLLOffset	<i>n</i> PLLO0	S <b>n</b> PLLOffset	хҮО		
Sensor power		Acausal	S <b>n</b> Power	<i>n</i> PWR0	S <b>n</b> Power	xE0		
Sensor input voltage		Acausal	S <b>n</b> Voltage	<i>n</i> VOLT0	S <b>n</b> Voltage	xE1		

## 9

# Appendix 2 – Minimus network ports

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	SEEDlink transmission protocol

The following network ports are used by the Minimus:

# 10 Appendix 3 – Connector pin-outs

### 10.1 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).



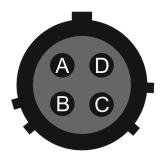
When used in hostile environments, a standard Ethernet cable can have a mating environmental shield (Amphenol part number RJF6MN) fitted.

### 10.2 Power

This is a standard 4-pin military-specification bayonet plug, conforming to MIL-DTL-26482 (formerly MIL-C-26482).



Pin	Function
A	Ground
В	10-36 V DC input
С	not connected
D	not connected



Wiring details for the compatible socket as seen from the cable end (*i.e.* when assembling).



**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 digitiser, the power supply and any connected instruments.



**Caution:** We recommend fitting an in-line 3.5 A anti-surge fuse in the positive power lead to protect the external wiring of the installation.

#### **GNSS**/serial 10.3

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.



Pin	Function
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).

### 10.4 Digital

This is a standard 10-pin military-specification bayonet sockets, conforming to MIL-DTL-26482 (formerly MIL-C-26482).



Pin	Function
A	Ground
В	Power
С	RS422 serial transmit – positive
D	RS422 serial transmit – negative
Е	RS422 serial receive – negative
F	not connected
G	not connected
н	not connected
Ι	not connected
J	RS422 serial receive – positive



Wiring details for the compatible plug, \*\*\*-12-10P, as seen from the cable end (*i.e.* when assembling).

### 10.5 Analogue 1 and Analogue 2

These are standard 26-pin male military-specification bayonet plugs, conforming to MIL-DTL-26482 (formerly MIL-C-26482).



Pin	Function	Pin	Function
A	Vertical Acceleration/Velocity – differential non-inverting input	Р	Calibration signal (all channels)
В	Vertical Acceleration/Velocity – differential inverting input	R	Calibration enable – vertical channel
с	N/S Acceleration/Velocity – differential non-inverting input	s	Calibration enable – N/S channel
D	N/S Acceleration/Velocity – differential inverting input	Т	Calibration enable – E/W channel
Е	E/W Acceleration/Velocity – differential non-inverting input	U	Centre
F	E/W Acceleration/Velocity – differential inverting input	v	Aux sensor input – differential non-inverting (or single) input
G	Vertical mass positions	W	Unlock
н	not connected	х	Lock
J	N/S mass positions	Y	Logic – ground*
К	BUSY line	Z	Sensor RS232 transmit
L	E/W mass positions	а	Sensor RS232 receive
м	Auxiliary sensor input – differential inverting input	b	Power – ground*
N	Signal – ground*	с	Power – positive

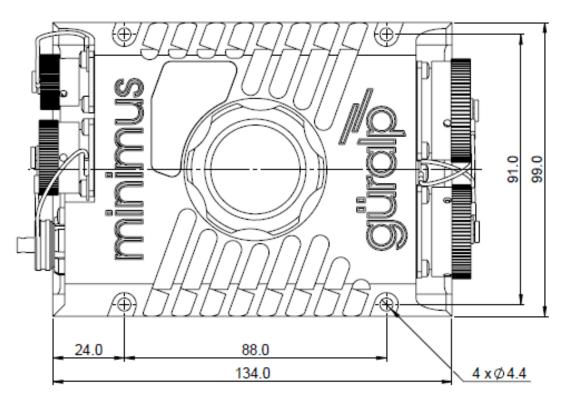
\* "Power – ground" and "Logic – ground" are connected together internally and also connected to the digitizer case.

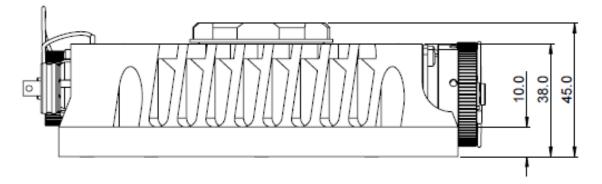


Wiring details for the compatible socket, \*\*\*-16-26S, as seen from the cable end (*i.e.* when assembling).

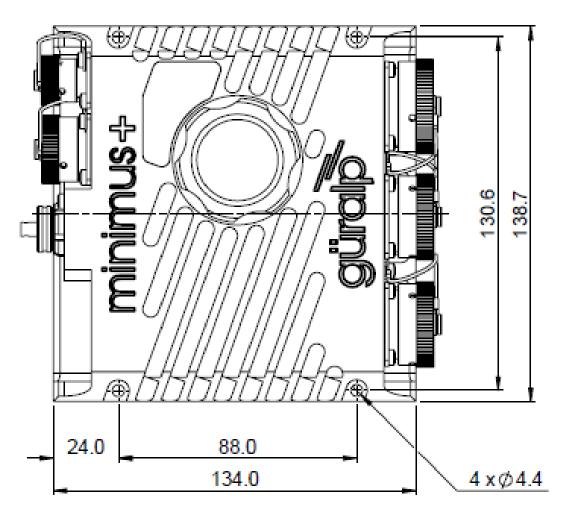
# 11 Appendix 4 – Dimensions and drawings

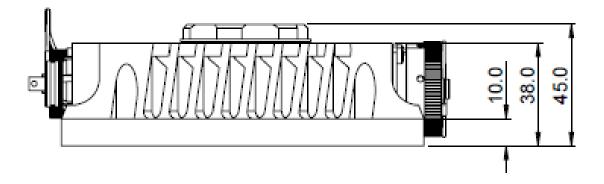
### 11.1 Minimus





### 11.2 Minimus+





# 12 Appendix 5 – 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→About menu.

### 12.1 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 <u>www.guralp.com/sw/download-discovery.shtml</u> 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
```

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.

### 12.2 Installation in Mac

To install Güralp Discovery in a macOS machine:

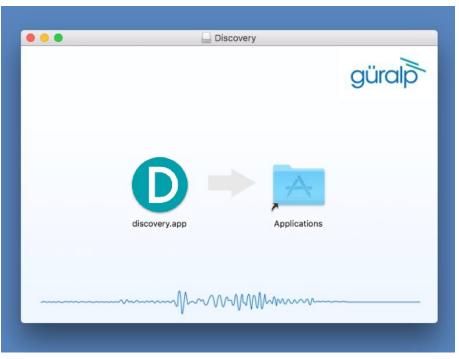
1. Open Safari, visit <u>www.guralp.com/sw/download-discovery.shtml</u> and download the appropriate disk-image file.

www.guralp.com/download/discovery/Di	scovery.dmg		V > Q Search		☆ 自 ♥	<b>+</b> ^	4	•
güral								
aurar	2							
Sarah								
HOME ABOU	IT US APPLICATIONS	PRODUCTS SYST	EMS SERVICES	SUPPORT	CONTACT US			
Discovery	Download Pa	age						
To download a copy of G	üralp's Discovery software, please	select a link from the list below:			Ľ			
Microsoft Windows     http://www.gurglo.	- 32-bit versions: .com/download/discovery/Discover	vinctall v96 ava						
		ymatan_x00.6x6						
<ul> <li>Microsoft Windows</li> </ul>	: - 64-bit versions: .com/download/discovery/Discover	yInstall.exe						
http://www.guralp.								
MacOS X - 64-bit:								
• MacOS X - 64-bit:	.com/download/discovery/Discover	y.dmg						
MacOS X - 64-bit:     http://www.guralp     Linux - 64-bit versis	ons:							
MacOS X - 64-bit:     http://www.guralp.     Linux - 64-bit versis								
MacOS X - 64-bit:     http://www.guralp.     Linux - 64-bit versis	ons: .com/download/discovery/discover		s Contact Local Dist	ibutor				
MacOS X - 64-bit:     http://www.guralp     Linux - 64-bit versis	ons: .com/download/discovery/discover	y_linux_x64.tar.gz	s Contact Local Dist	ibutor				
<ul> <li>MacOS X - 64-bit: http://www.guralp.</li> <li>Linux - 64-bit versis</li> </ul>	ons: com/download/discovery/discover Email Us Sub	y_linux_x64.tar.gz						
<ul> <li>MacOS X - 64-bit:</li> <li>http://www.guralp.</li> <li>Linux - 64-bit versis</li> </ul>	ons: com/download/discovery/discover Email Us Sub	y_linux_x64.tar.gz						
<ul> <li>MacOS X - 64-bit:</li> <li>http://www.guralp.</li> <li>Linux - 64-bit versis</li> </ul>	ons: com/download/discovery/discover Email Us Sub	y_linux_x64.tar.gz						
<ul> <li>MacOS X - 64-bit: http://www.guralp.</li> <li>Linux - 64-bit versis</li> </ul>	ons: com/download/discovery/discover Email Us Sub	y_linux_x64.tar.gz						

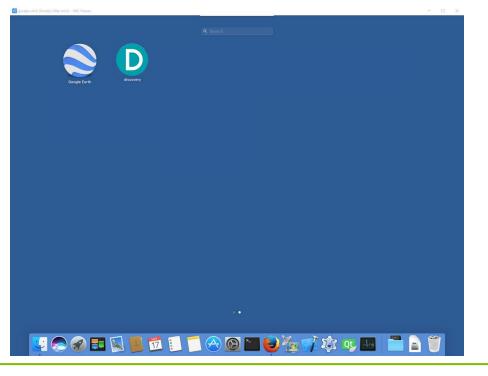
2. Either save the downloaded file on a local drive, or automatically open it with DiskImageMounter.

www.guralp.com/download/discovery/Discovery.dmg	V 🗦 🔍 Search		습	d C	1	1	î -	-
güralþ								
HOME ABOUT US APP Discovery Down To download a copy of Girlary's Discovery Market Windows - 32-bit version http://www.gurab.com/download.id Marcol X - 46-bit http://www.gurab.com/download.id Marcol X - 46-bit http://www.gurab.com/download.id	Opening Discovery.dmg       SUPPORT         You have chosen to open:          Discovery.dmg          which is: Document (B4 (M8))          from: http://www.guralp.com          What should Fields do with this file?          Open with Disk/mageMounter (default)          Save File          Do this automatically for files like this from now on.          Cancel       OK         convy/stoovery.fince.vit/Larget	col	NTAGT	ſ	•			
Email t	Je Submit Enquiry Contact Us Contact Local Distributor 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 Discovery drag and drop installation window



- 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.



### 12.3 Installation in Windows

To install Güralp Discovery on a Windows machine:

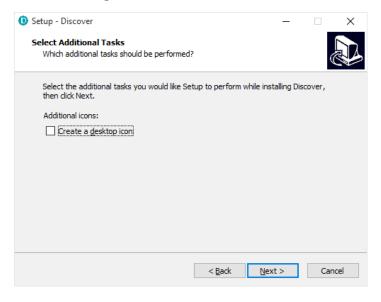
1. Download the appropriate installer – 32-bit or 64-bit – from

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	– 🗆 X
Select Start Menu Folder Where should Setup place the program's shortcuts?	
Setup will create the program's shortcuts in the following Sta	rt Menu folder.
To continue, click Next. If you would like to select a different folder, c	lick Browse.
Guralp Systems\Discover	Browse
< <u>B</u> ack <u>N</u> ext	> Cancel
Click Next > , key 🕶 or key Alt 🕂	N to continue.

4. The next screen asks whether you would like to place an icon for Discovery on the desktop:



6.

Tick the check-box if you wish and then click  $\underline{Next} > 1$ , key  $\underline{\leftarrow}$  or key

t + N to continue.

5. The installer then offers a last chance to change any of your decisions:

🛈 Se	Setup - Discover — 🗌 🗙	
	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 to review or change any settings.	
	Destination location: C:\Program Files (x86)\Guralp Systems\Discover Start Menu folder: Guralp Systems\Discover 	
	< Back Install Cancel	
ther Onc	pices or click < Back (or key Alt + B) if you wish to revise	sit any of
	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:

	📵 Setup - 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.	
		Einish	
	Press <u>Finish</u> Discovery.	, key 🗲 or key Alt 🕂 두 to close	the installer and launch
0		ofor Windows 64-bit requires Micro ask to install it if it is not installed y	

## 12.4 Configuring Windows Firewall

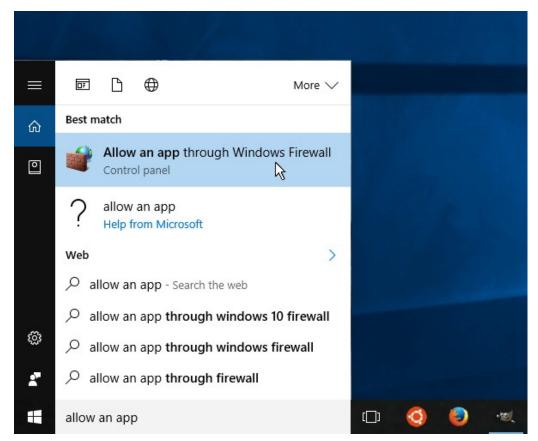
Windows Firewall can interfere with Discovery's ability to send information to instruments and/or receive information from instruments over the network. If you use Windows Firewall, you should make special provision for allowing Discovery to communicate, as described in this section.

1. Click in the "Ask me anything" search box at the bottom left of your Windows screen:



145

2. Type "allow an app"



- 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			_		>
→	<b>∨ Ö</b> S	earch Con	trol Panel		۶
Allow apps to communicate through Windows Firewal To add, change or remove allowed apps and ports, click Change setting 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					
✓ Cortana	$\checkmark$		<b>~</b>		
Delivery Optimization	$\checkmark$		<b>~</b>		
☑ DiagTrack	$\checkmark$				
☑ DIAL protocol server		V			
discovery	✓			>	
Distributed transaction Co-ordinator					
✓ Dropbox	$\checkmark$	$\checkmark$	✓		
Email and accounts	$\checkmark$	$\checkmark$	$\checkmark$		
Feedback Hub	✓	<b>~</b>	<b>~</b>		
✓ File and Printer Sharing					
✓ Films & TV	✓	✓	✓	~	
	Deta	ails	Remove	2	
		Allow an	iother app	)	
		ОК	Canc	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 Wi-Fi hotspots at coffee shops, airports, and other locations.

For a more complete discussion of this topic, please see <u>http://www.tenforums.com/tutorials/6815-network-location-set-private-public-windows-10-a.html</u> 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:

Edit an app	×
	communication with this app from any computer, including nternet or just from computers on your network.
Name:	() discovery
<u>P</u> ath:	C:\program files\guralp systems\discovery\discovery.exe
What are the r	isks of unblocking an app?
You can choose	which network types to add this app to.
<u>N</u> etwork t	ypes OK Cancel

7. Click the <u>Network types...</u> button. The "Choose network types" window is shown:

Allowed applications		- 🗆 X
← → ✓ ↑ 🔗 ≪ Windows F	irewall > Allowed applications 🗸 🗸	Search Control Panel 🔎
To add, change or remove What are the risks of allowi	nunicate through Windows Firewall allowed apps and ports, click Change settings. ing an app to communicate? Choose Network Types	Change settings
	Now this app or port to communicate through Windows	ate Public ^
<ul> <li>✓ Core Network You tho</li> <li>✓ Cortana</li> <li>✓ Delivery Optin DiagTrack</li> <li>✓ DIAL protoco</li> <li>✓ discovery</li> <li>✓ Distributed Tr</li> <li>✓ Dropbox</li> <li>✓ Email and acc</li> <li>✓ Feedback Hub</li> <li>✓ Films &amp; TV</li> </ul>	Domain: Networks at a workplace that are attached to a domain  Private: Networks at home or work where you know and trust the people and devices on the network  Public: Networks in public places such as airports or cafés  OK Cancel	g       2       V         2       V       2         2       V       2         3       V       2         3       V       2         3       V       2         3       V       2         3       V       2         4       V       2         5       V       2         6       V       V         7       V       V         Petails       Remove
	E	Allow another app
		OK Cancel

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.

## 12.5 Update

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 Alt + H followed by A:

<b>D</b> G	iüralp S	ystems	- Disc	overy				
File	Edit	View	Hel	р				
		Statu	s	About	System	Name	Firmware Ver	WAN Address
1	0	O	?	Help	Minimus	MIN-B056	1.0-1271	95.6.57.152
2		O		SalesDEMO	Minimus	MIN-8256	1.1-1022	89.213.16.117
3	Activ	e		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		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, the screen will say Up to date and the Update button will be disabled, as shown above. If a newer version is available, the screen will look like this:

Discovery About - Guralp Disco	very – 🗆 X
	Discovery application is provided by Guralp Systems Limited.
güralþ	Head office: Gurajo Systems Limited, Midas House, Calleva Park, Aldermaston, Reading. RG7 8EA, United Kingdom Tel: +441 13 961 9056 E-Mail: sales@guralp.com
	Discovery version: Experimental 0.1.351 Update to version 0.1.669 is available online. Please use "Update" button to download the installer. Update
	Ok

If you with to proceed with downloading the newer version, click the Update button. This does not commit to an immediate upgrade: it just downloads the installer. If you do not wish to download the installer, click Ok 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 download - Guralp	Discovery	-		
	File already exists Guralp Discovery     X		taller.	-
	File already exists - overwrite?		te	
	C:/Users/fish.GURALP/AppData/Local/Temp/DiscoveryInstall.exe			s Netmask
				255.255.0
	Yes No			255.255.0
Close this window automa	tically when finished.			255.255.0
	Cancel Ok			255.255.0
	Contex OK			255.255.0
gürc				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:

#### Appendix 5 – Güralp Discovery installation

	gü	'n	alþ	Midas Aldern	Systems Limite House, Calleva haston, Readin EA, United King 44 118 981 90 sales@guralp	a Park, g. gdom 56					
p Digit it Vie			<ul> <li>Dowr</li> <li>Oracle</li> </ul>	This will close Di	ompleted. Wo scovery appli tion: C:/Users/	very uld you like to upd cation and run inst /fish.GURALP/App	aller. Data/Loc	al/Temp/	X wnload	the installer. Update	s Netm 255.255 255.255 255.255
						Ok					255.255 255.255
		12	Active	NO LABEL	Minimus	MIN-6655	26197	0.80-12885	81.150.35.105	10.30.0.45	255.255
		13	Active	NO LABEL	Minimus	MIN-7755	30549	0.80-12786	81.150.35.105	10.30.0.88	255.255
Scan Locally		14	Active	NO LABEL	Minimus	MIN-8555	34133	0.80-12786	81.150.35.105	10.30.0.8	255.255

If you wish to complete the installation immediately, click <u>Yes</u>. If you would rather defer the installation, click <u>No</u> 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 Sec	urity Alert		×
💮 Windo	ows Firewa	l 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	n these networks:	
🗹 Domain netv	vorks, such as a	a workplace network	
Private netv	vorks, such as n	iy home or work network	
Public netwo because the	orks, such as the se networks of	ose in airports and cafés (not recommended ten have little or no security)	
What are the risks	of allowing an a	app through a firewall?	
		Cance	el

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 Wi-Fi hotspots at coffee shops, airports, and other locations.

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

# 13 Appendix 6 – 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 I.P. address in the range 169.254.0.1 to 169.254.255.254. The default subnet mask is 255.255.0.0.

Connect the Minimus to the laptop or PC using the blue Ethernet cable and power it up.

## 13.1 On Linux

On your Linux computer, open the terminal and type the command

sudo bash



and provide the appropriate password. Then, enter the command

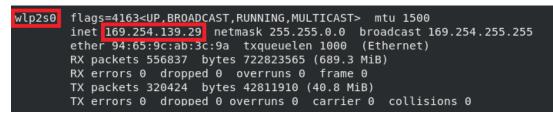
ifconfig

to identify the Ethernet network interface to which the Minimus is connected. Once you have identified the correct interface, connect the Minimus, 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.

## 13.2 On macOS

Click the Apple icon in the upper-left corner of the screen, and select "System Preferences."

1. Click the "Network" icon to open the Network Preferences pane and select "Ethernet" from the list on the left side of the window.

00	Network	
Show All	٩	l
	Location: Automatic	
<ul> <li>Ethernet Connected</li> <li>Bluetooth Not Connected</li> <li>FireWire Not Connected</li> <li>AirPort On</li> </ul>	Status:       Connected         Ethernet is currently active and has the IP address 192.0.2.143         Configure:       Using DHCP         IP Address:       192.0.2.143         Subnet Mask:       255.255.255.0         Router:       192.0.2.254         DNS Server:       Search Domains:	
+ - 0-	Advanced ?	
Click the lock to	prevent further changes. Assist me Revert Apply	

- 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 Minimus connected and powered up, click the state 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:

Ethernet Connected	$\langle \cdots \rangle$	Status: Connected
Bluetooth Not Connected	8	Ethernet is currently active and has the IP address 169.254.56.230
FireWire Not Connected	**	Configure: Using DHCP 🛟
On AirPort		IP Address: 169.254.56.230 Subnet Mask: 255.255.0.0

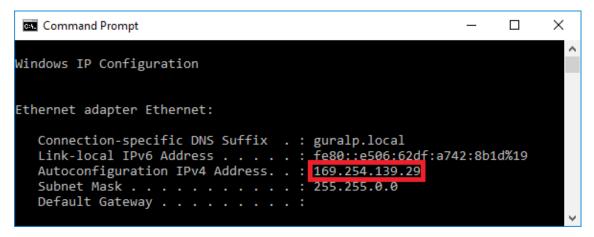
In the example above, the interface has been allocated address 169.254.56.230, which is in the correct network.

## 13.3 On Windows

On a Windows computer, key + R to open the "Run" dialogue, enter ncpa.cpl and key + R.

Right-click on the network adapter which is connected to the Minimus and select "Disable" from the context menu. Right-click on the same adapter again and select "Enable". Close the network settings window.

Key **I** + **R** and type **cmd**., then **<sup>I</sup>**. 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.

## 14 EU Declaration of Conformity

CE

We

Guralp Systems Ltd Midas House, Calleva Park, Aldermaston READING, RG7 8EA.

Tel: +44 118 981 9056 E-mail: technical@guralp.com

#### Declare under our sole responsibility that the following product

Equipment name: Minimus and Minimus+ with GPS Model Number: MI-2407SA0V20124 and MI-2414SA0V20643 and appropriate variants

#### Is in conformity with the

Radio Equipment Directive 2014/53/EU Electromagnetic Compatibility Directive 2014/30/EU Low Voltage Directive 2014/35/EU Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU

#### by applying the following harmonised standards and technical specifications:

EN 55011, EN 55016:2009 +A1:2010 – Conducted Emissions EN 55011, EN 55032 :2009 +A1:2010 – Radiated Emissions EN 61000-4-2:2009 – Electrostatic Discharge Immunity EN 61000-4-3:2006 +A1:2008 +A2:2010 – Radiated RF Immunity EN 61000-4-4:2012 – Electrical Fast Transients Immunity EN 61000-4-5:2014 – Voltage Surge Immunity EN 61000-4-6:2014 – Conducted RF Immunity EN 61000-4-8:2010 – Power Frequency Magnetic Field Immunity IEC 61010-1 3rd Edition - Low voltage Safety 2011/65/EU – RoHS

Signed for and on behalf of Guralp Systems Ltd on 25 February 2020

Systems Director

15	Revision History				
	Q	2021-09-09	Added EU Declaration of Conformity		
	М	2019-12-02	Updated LED sequence. Updated web page screen-shots. Updated Data Stream and Data Storage. Updated stream and file names. Updated and added Transforms. Updated EEW and Triggering. Added back-fill from miscoSD card.		
	L	2018-09-02	Added details of new-style microSD card-holder Moved NTP to Network section and corrected description.		
	К	2018-08-14	Updated web page screen-shots Updated I.P. address section Added modified SEEDlink Added QSCD protocol and transform Added Seismic Events Table Added case drawings		
	J	2018-06-25	Updated Discovery screen-shots. Updated Scream file-name. Updated LiveView screen-shots. Updated Calibration Page Editor. Updated Setup tab. Updated Setup tab. Updated EEW settings. Updated LED behaviour. Updated storage tab. Updated formatting instructions. Updated formatting instructions. Updated firmware update procedure. Updated firmware update procedure. Updated troubleshooting. Added analogue sensor calibration. Added transforms. Added miniSEED extractor. Added note on non-recording status. Added minimus default static I.P. address info. Added instructions for setting PC I.P. address. Added local access from the Registry. Added recommendation on sensor grounding. Removed FPGA firmware update.		
	Н	2018-03-19	Added LEMO connector warning.		
	G	2018-02-16	Included Minimus+. Updated Discovery screen-shots. Updated Discovery software download instructions (incorporating new download page).		

		Updated SEEDlink server options. Updated STA/LTA Ratio threshold. Updated GDI channels name. Updated Minimus firmware upgrade procedure. Added column hide/show in Discovery. Added Control Centre. Added Deploy mode section. Added PTP.
F	2017-07-28	Updated EEW and triggering section. Updated calibration page editor. Added FPGA firmware update. Added GDI connection settings. Added network setting in Discovery. Added Power tab section. Added Minimus ports.
Е	2017-05-19	Updated Discovery and GüVü print screens. Updated Discovery and GüVü download links. Updated calibration section. Updated analogue pin-out. Added MEMS axis directions. Added download of data from web page. Added EEW and triggering section. Added GDI auto-connection section. Added installation instructions for MAC and Linux
D	2017-02-09	Updated Discovery print screens. Corrected Analogue and Digital pin-outs Corrected GDI channels name.
С	2016-11-15	Corrected power connector gender. Extra detail for Ethernet connector. Added Windows Firewall details. Added microSD-card removal details.
В	2016-09-20	Brought up-to-date with current firmware release. Updated stream names. Added SEED-link information. Added system reset function during boot.
А	2016-08-24	Initial release.