

# MINIMUS<sub>2</sub>

PORTABLE SMART SEISMIC DIGITISER WITH ADVANCED COMMUNICATIONS AND STATE OF HEALTH



Compact and portable four-channel, ultra-low-power smart seismic digitiser.

## KEY FEATURES

- > Ultra-low-power < 0.8 W
- > 24-bit, 4-channel ADC
- > 142 dB dynamic range
- > Compact and lightweight
- > Bluetooth and Power-over-Ethernet
- > Dual-redundant microSD storage
- > Advanced State-of-Health capabilities
- > Utilises Güralp Discovery software interface providing access to a range of instrument and data management tools
- > Güralp Data Centre compatible

# Minimus<sub>2</sub>

The portable, ultra-low-power Güralp Minimus<sub>2</sub> offers advanced communication capabilities with rapid GNSS lock, making it ideal for rapid deployments.

ENCASED IN AN ENVIRONMENTALLY SEALED, HARD ANODISED ALUMINIUM CASING TO WITHSTAND THE HARSHTEST OF ENVIRONMENTS, THE MINIMUS<sub>2</sub> HAS AN INTERNAL THERMOMETER AND A HUMIDITY SENSOR TO ALERT YOU TO ANY MOISTURE INGRESS.

MINIMUS<sub>2</sub> DIMENSIONS:



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### Multidisciplinary functionality with simplified streaming and filtering options and advanced communications capabilities.

The four channel Minimus<sub>2</sub> is our lowest power digitiser and can accommodate any triaxial analogue seismic sensor plus an auxiliary input (e.g. for infrasound) and also incorporates its own internal MEMS accelerometer (4g).

The portable and ergonomic Minimus<sub>2</sub> features a rapid GNSS lock making it particularly suited for field applications where speed of deployment is of the utmost importance.

Integrated network connectivity enables the Minimus<sub>2</sub> to be controlled remotely using Güralp Discovery, our software platform, or via a standard web browser. Discovery allows the user to identify the instrument IP address via a Cloud registry server or data centre, eliminating the need for static IP addresses.

Discovery also provides simple and streamlined instrument and data management for arrays of any scale, with access to hardware State-of-Health (SoH); data streaming; GNSS location; instrument response and calibration values.

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

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## Key features

24-bit, four channel digitiser

Compatible with any analogue seismic sensor

Rapid GNSS lock with accuracy of  $\pm 50$  ns once locked

Industry standard triggering algorithms for EEW (STA/LTA and Threshold)

Common Alert Protocol (CAP) enabled for automated emergency warning

Identification of IP address via Discovery and Cloud registry server

Remote instrument and data management via easy-to-use Discovery software

Scream!<sup>TM</sup> compatible

GüVü Bluetooth App for installation integrity checking available (Android and iOS)

Dual redundant 128 GB microSD cards

Select from GNSS (GPS and GLONASS, BeiDou optional)

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### Versatile streaming options.

Users can select sample rates of up to 4000 samples per second with the option to simultaneously stream multiple sample rates in addition to two recording rates.

Data are locally recorded in miniSEED (with metadata stored in dataless SEED format) and can be streamed in realtime using GCF (Scream!), GDI-link and SEEDlink. Whilst traditional 'Nominal Response' files are supported, the system also provides 'machine generated Response files' to faithfully represent the exact configuration of the station and sensors.

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## Applications

- > Temporary seismic stations
  - > Earthquake Early Warning
  - > Rapid deployment arrays
  - > Volcanology
  - > Multi-discipline seismic observatories
  - > Structural health monitoring
  - > Induced seismicity detection
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# Minimus<sub>2</sub> Tools: Güralp Discovery Software\*

\*See Discovery datasheet for more details

Discovery dramatically simplifies instrument and data management and gives users powerful tools via a web interface:

- > Identify instrument IP address
- > Analysis of hardware State of Health
- > Data streaming control
- > Remotely upgrade digitiser firmware
- > Upload configuration to multiple units simultaneously
- > Advanced analysis on waveform data such as PSD and spectrogram

Status	Label	System	Name	Serial#	Firmware Ver	WAN Address	LAN Address	Uptime	Last Contact	Latit
24	DEMO 83	Minimus	MIN-C456	50262	1.1-1022	89.213.16.113	10.10.0.36	1 days 18 Hrs	Just Now	0.00C
25	NO LABEL	Minimus	MIN-D956	55638	1.1-1022	89.213.16.113	10.30.0.81	16:57:58	Just Now	0.00C
26	NO LABEL	Minimus	MIN-1F58	8024	1.1-1022	89.213.16.113	10.20.0.168	23:40:08	Just Now	51.3C
27	NO LABEL	Minimus	MIN-2B57	11095	1.1-1022	89.213.16.113	10.30.0.87	6 days 17 Hrs	Just Now	0.00C
28	NO LABEL	Minimus	MIN-2A58	10840	1.1-1022	89.213.16.113	10.20.0.50	17:48:29	Just Now	51.3C
29	NO LABEL	Minimus	MIN-2B58	11096	1.1-1022	89.213.16.113	10.20.0.64	17:34:48	Just Now	51.3C
30	NO LABEL	Minimus	MIN-2C58	11352	1.1-1022	89.213.16.113	10.20.0.67	17:36:48	Just Now	51.3C
31	NO LABEL	Minimus	MIN-2D58	11608	1.1-1022	89.213.16.113	10.20.0.67	17:36:48	Just Now	51.3C

NETWORK OVERVIEW

DIGITISER WEB INTERFACE

**System Status**

Host name	MIN-C555	Host label	Support	System type	Minimus	Product type	Minimus
Serial number	4555	Firmware version	5.1-1022	IP-v4 address	10.10.0.13	IEEE network and station	DG-FLS17
Digitiser temperature	38.1 °C	Digitiser humidity	25%	Input voltage	12.755 V	Power over Ethernet voltage	3.735 V

**GNSS Status**

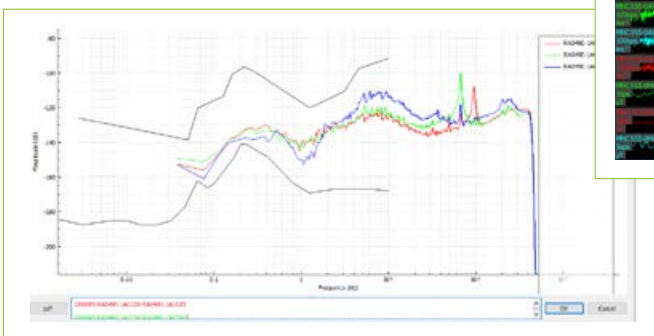
GNSS connection status	Connected	Last timestamp	2017-11-29 19:22:38
Lead lock time	2017-11-29 07:00:48	GNSS stability	GOOD
Latitude	51.3667	Longitude	-1.9331
Altitude	121.50 m	Horizontal dilution of precision	0.78
GNSS PPS status	Tracked	GNSS NMEA stream	Input OK
GNSS Lock state	3D locked	Number of satellites	Used: 12 In view: 13

**Storage**

MicroSD status	Recording	MicroSD total	68817.408 KiB	MicroSD used	5726540 KiB	MicroSD free	63090.868 KiB				
Number of sensors detected	1	Serial number (ID)	4555	Firmware ver (ID)	3.11	Serial number (ID)	22759	MicroSD ver (ID)	4958	Serial number (ID)	10945

DIGITISER CONFIGURATION

REAL-TIME VIEWER



INSTRUMENT POWER SPECTRAL DENSITY (PSD) GRAPHS

# Minimus<sub>2</sub> Tools:

## GüVü Bluetooth App

Check the integrity of your installation instantaneously

GüVü displays a range of instrument data such as waveforms, orientation, temperature and humidity data. Additionally you can lock/unlock and centre the masses of analogue sensors, reboot Minimus<sub>2</sub> and alter sample rates without instrument disturbance. GüVü can also format replacement SD cards. A deployment status report can then be emailed for a detailed record of the installation.

Connected to:  
MIN-C555  
DC:49:25:8E:2B:CC

**Instrument 1 of 2**

35.24°C  
24%  
12.0V/1.0V(PoE)  
SD memory card  
used: 5.64 GB  
size: 58.0 GB  
90% free

Recording  
Latitude: 51.3608°  
Longitude: -1.16306°  
Altitude: 117m  
Horizontal dilution of precision: 0.86  
Last GPS update time: 2017/12/04 15:35:54  
GPS time lock quality: 100%  
Last lock time: 2017/12/04 13:39:35

**Mass positions**

**Velocity channels**

Z  
N  
E

INSTRUMENT ORIENTATION

- UNIQUE INSTRUMENT SERIAL NUMBER
- MEDIA ACCESS CONTROL (MAC) ADDRESS
- INSTRUMENT TEMPERATURE
- INSTRUMENT INTERNAL HUMIDITY
- POWER SUPPLY
- MICROSD CARD STATUS
- DATA RECORDING STATUS
- GNSS RECEIVER LOCATION
- GNSS TIME-LOCK STATUS
- SENSOR MASS POSITIONS
- MAIN SENSOR OUTPUTS

## SPECIFICATIONS

SENSOR INPUTS	
Primary digitisation channels	Four at 24 bits  Differential input: 40 V peak-to-peak ( $\pm 20$ V). Also compatible with single-ended inputs: 20 V peak-to-peak ( $\pm 10$ V)
Secondary channels	Three analogue channels for sensor mass positions, one internal calibration channel
Internal environmental channels	Humidity Temperature Supply voltage/Power consumption MEMS accelerometer (three component)
Input impedance	50 k $\Omega$

PERFORMANCE	
ADC converter type	Delta-sigma
ADC conversion delay	6 $\mu$ s
Output format	32-bit
Dynamic Range	>142 dB at 100 samples per second
Gain drift	3 ppm / $^{\circ}$ C
Common-mode rejection	>110 dB

DATA PROCESSING	
Output rates available	1 sample per hour up to 4000 samples per second for primary channels, user-selectable  Multiple independent data streams at different sample rates for all channels (transmission and recording)  Up to 500 samples per second for environmental channels
Decimation filters	$\pm 2$ , $\pm 3$ , $\pm 4$ , $\pm 5$ decimation (Causal / Acausal)
Out-of-band rejection	>167 dB
Data transmission mode	Continuous and trigger modes
Triggered data	Retrievable using event table in digitiser's web page. User selectable pre and post event time.
Trigger modes	STA/LTA, Threshold
Selectable gain	Unity $\times 1$ , $\times 2$ , $\times 4$ , $\times 8$ , $\times 12$

TIMING AND CALIBRATION	
Timing source precision	Accuracy when GNSS locked $\pm 50$ ns. Typical drift when unsynchronised (without GNSS) <1 ms per day once temperature trained
Timing sources	GNSS (GPS and GLONASS, BeiDou optional)
Calibration signal generator	Broadband noise and Sinewave

OPERATION AND POWER USAGE	
Operating temperature	-20 to +60 $^{\circ}$ C
Relative humidity range	zero to 100 %
Power supply	5 - 36 V DC* (2S lithium compatible)
Power consumption at 12 V DC	< 0.8 W in power save mode with no GNSS or Ethernet  < 1.3 W in standard mode with constant GNSS and 10 Mb/s Ethernet output

\*Power voltage for operation of this unit only. Connection to additional instrumentation or use of longer cables may result in a higher input voltage requirement.

SOFTWARE	
Operating system	Windows, Linux and macOS compatible
Communication technologies supported	Ethernet (10/100BASE-T)  Power over Ethernet (IEEE 802.3af compliant)

USER INTERFACE	
Configuration and control	(Ethernet) Güralp Discovery - free download, web browser interface. GüVü app (Bluetooth) available for both Android and iOS devices

DATA COMMUNICATION	
Data recording formats	miniSEED (metadata stored in dataless SEED format)
Data streaming protocols (via Ethernet)	GCF (Scream!), GDI-link <sup>1</sup> and SEEDlink <sup>1</sup> ( <sup>1</sup> metadata sent in RESP, StationXML and dataless SEED file formats)
Memory and storage	Dual redundant 128 GB microSD cards (1 fixed, 1 hot-swappable)

PHYSICAL CHARACTERISTICS	
Casing type	Environmentally sealed, hard anodised aluminium on a stainless steel base
Environmental sensor	Humidity and temperature
Weight	600 g (disconnected)
Dimensions	98 mm $\times$ 108 mm $\times$ 40 mm
Connector type	MIL-DTL-26482 Series 1: Analogue - 26 way Power - 4 pin  SURE-SEAL IPMODM: Waterproof Ethernet  LEMO : GNSS/serial - 14 pin
Global navigation satellite system (GNSS)	Compact, encapsulated, waterproof, precision timing GPS/GLONASS (BeiDou optional) receiver
Environmental protection	IP68 - protection against effects of prolonged immersion at 3 m depth for 72 hours

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In the interests of continual improvement with respect to design, reliability, function or otherwise, all product specifications and data are subject to change without prior notice.



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