

# MINIMUS MINIMUS+

SMART SEISMIC DIGITISER WITH ADVANCED DATA-PROCESSING CAPABILITY AND SOFTWARE COMMUNICATIONS



Compact and low-power smart seismic digitiser with the option of four or eight primary digitisation channels.

## KEY FEATURES

- > Advanced software communications for quick and easy instrument and data management
- > Hot-swappable and dual-redundant microSD storage
- > Select from GNSS or PTP timing sources
- > Access real-time data manipulation tools such as Quick Seismic Characteristic Data protocol and Maximum, Minimum and Average calculations

## FOR EARLY WARNING APPLICATIONS:

- > Ultra low-latency capability
- > Multi-instrument voting for mitigating false-positive alerts
- > Reduce telemetry load by streaming only derived values at trigger
- > Common Alert Protocol (CAP) enabled for automated emergency warning

# Minimus

The Güralp Minimus (four channel) and Minimus+ (eight channel) are advanced 'smart' seismic digitisers, packed with a host of features that make them the ideal plug and play solution for rapid deployments and multi-scale networked arrays.

ENCASED IN AN ENVIRONMENTALLY SEALED, HARD ANODISED ALUMINIUM CASING TO WITHSTAND THE HARSHTEST OF ENVIRONMENTS, THE MINIMUS AND MINIMUS+ HAVE AN INTERNAL THERMOMETER AND A HUMIDITY SENSOR TO ALERT YOU TO ANY MOISTURE INGRESS.

MINIMUS DIMENSIONS:



MINIMUS+ DIMENSIONS:



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## Multidisciplinary functionality with simple instrument and data management.

The four channel Minimus can simultaneously accommodate a triaxial analogue sensor, an auxiliary input e.g. for infrasound; a Radian posthole; plus its own internal MEMS accelerometer (2g).

The eight channel Minimus+ accommodates all of the above plus an additional triaxial analogue seismic sensor and auxiliary input.

Integrated network connectivity enables the Minimus 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 instrument and data management with access to hardware State-of-Health (SoH); data streaming; GNSS location; instrument response and calibration values.

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

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## Key features

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24-bit, four channel (Minimus) or eight channel (Minimus+) digitiser

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Compatible with any analogue seismic sensor

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Ultra-low-latency mode for Earthquake Early Warning - when used with GDI protocol, transmission can be achieved in 40 ms

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

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Multi-instrument voting for mitigating false positive alerts

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Powerful real-time data Transforms: mathematical operations applied to real-time and recorded data e.g. integration; differentiation; high and low-pass filters

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Quick Seismic Characteristic Data (QSCD) protocol and Maximum, Minimum and Average (MMA) calculated on selected time window.

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Seismic event table displaying events detected using trigger algorithms with links to download event data (pre and post event time is user-configurable)

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Common Alert Protocol (CAP) enabled for automated emergency warning

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Identification of IP address via Discovery and Cloud registry server

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

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Scream!™ compatible

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GüVü Bluetooth App for installation integrity checking (Android)

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## Versatile streaming and filtering options.

Users can select sample rates of up to 5000 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.

Access real-time data manipulation tools such as Quick Seismic Characteristic Data (QSCD); Maximum, Minimum and Average (MMA) calculations and transforms such as integration, differentiation and low and high pass filters.

For Earthquake Early Warning applications, the Minimus has an ultra-low-latency mode running causal filters alongside traditional acausal filters. When used with our GDI protocol, this low-latency mode means network transmission can be achieved in 40 milliseconds (sample rate and network dependent). Other EEW features include industry standard triggering algorithms for EEW (STA/LTA and Threshold); multi-instrument voting for mitigating false positive alerts; and Common Alert Protocol (CAP) for automated emergency warning.

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Dual redundant 64 GB microSD cards (1 fixed, 1 hot-swappable)

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Select from GNSS (GPS and GLONASS, BeiDou optional) or PTP (Precision Time Protocol) timing sources

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Minimus+ supports Power Over Ethernet (POE) which significantly reduces complexity when installing local arrays

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## Applications

- > Earthquake Early Warning Systems
  - > Volcanology
  - > Multi-scale seismic networks
  - > Structural health monitoring
  - > Hydrocarbon exploration
  - > Permanent reservoir monitoring
  - > Induced seismicity detection
  - > Explosion monitoring
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# Minimus: 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	10.20.0.69	17:36:48	Just Now	51.3C

NETWORK OVERVIEW

DIGITISER WEB INTERFACE

System type: Minimus | Host label: NO LABEL | Host name: MIN-C555 (10.10.0.13) | Serial number: 5051

**Digitiser Config** Please reboot

Date: Mon 04 Dec 2017 Time: 3:02:49 PM Auto Refresh:

Label: NO LABEL Station Name: TEST Network Code:

Bluetooth PIN: 0000 Filter quality: High

Deploy mode: Normal Deploy

**Applied Rotation**

Analogue 0: 0 Radian 1: 0 Radian 2: 0 Radian 3: 0 Radian 4: 0 Radian 5: 0 Radian 6: 0 Radian 7: 0

Reboot

**Analogue Sensor**

Input Gain: Unity Sensor Type: Fortis

DIGITISER CONFIGURATION

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

**System Status**

General information

Host name	MIN-C555	Host label	Support	System type	Minimus	Product type	Minimus
Serial number	4555	Firmware version	1.1-1022	IPv4 address	10.10.0.13 (NIC:0)	IEEE network and station	DG-FLE57 (No site)
Digitiser temperature	38.1 °C	Digitiser humidity	25%	Input voltage	12.75V V	Power over Ethernet voltage	3.75V V

GNSS status

GNSS connection status: Connected Last timestamp: 2017-11-29 15:22:38

Lead lock time: 2017-11-29 07:00:48 GNSS stability: GOOD

Latitude: 51.3667 Longitude: -1.9333

Altitude: 121.50 m Horizontal dilution of precision: 0.78

GNSS PPS status: Tracked PPS: Input OK

GNSS Lock state: 3D locked Number of satellites: 12 In view: 13

MicroSD status: Recording MicroSD total: 68817.408 KiB MicroSD used: 5726540 KiB MicroSD free: YES

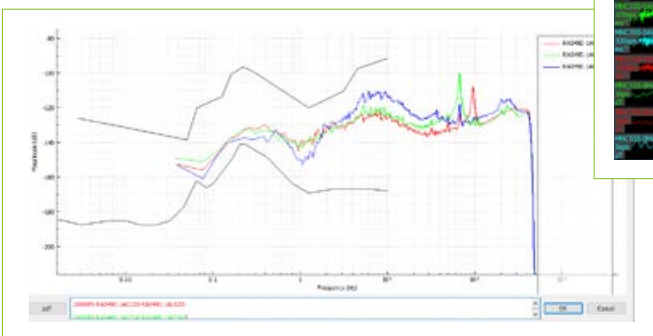
Number of sensors detected: 1

Sensor	Serial number (ID)	Firmware ver (ID)	Serial number (ID)	Serial number (ID)	Serial number (ID)
	4555	3.11	22759	4958	-10945

REAL-TIME VIEWER



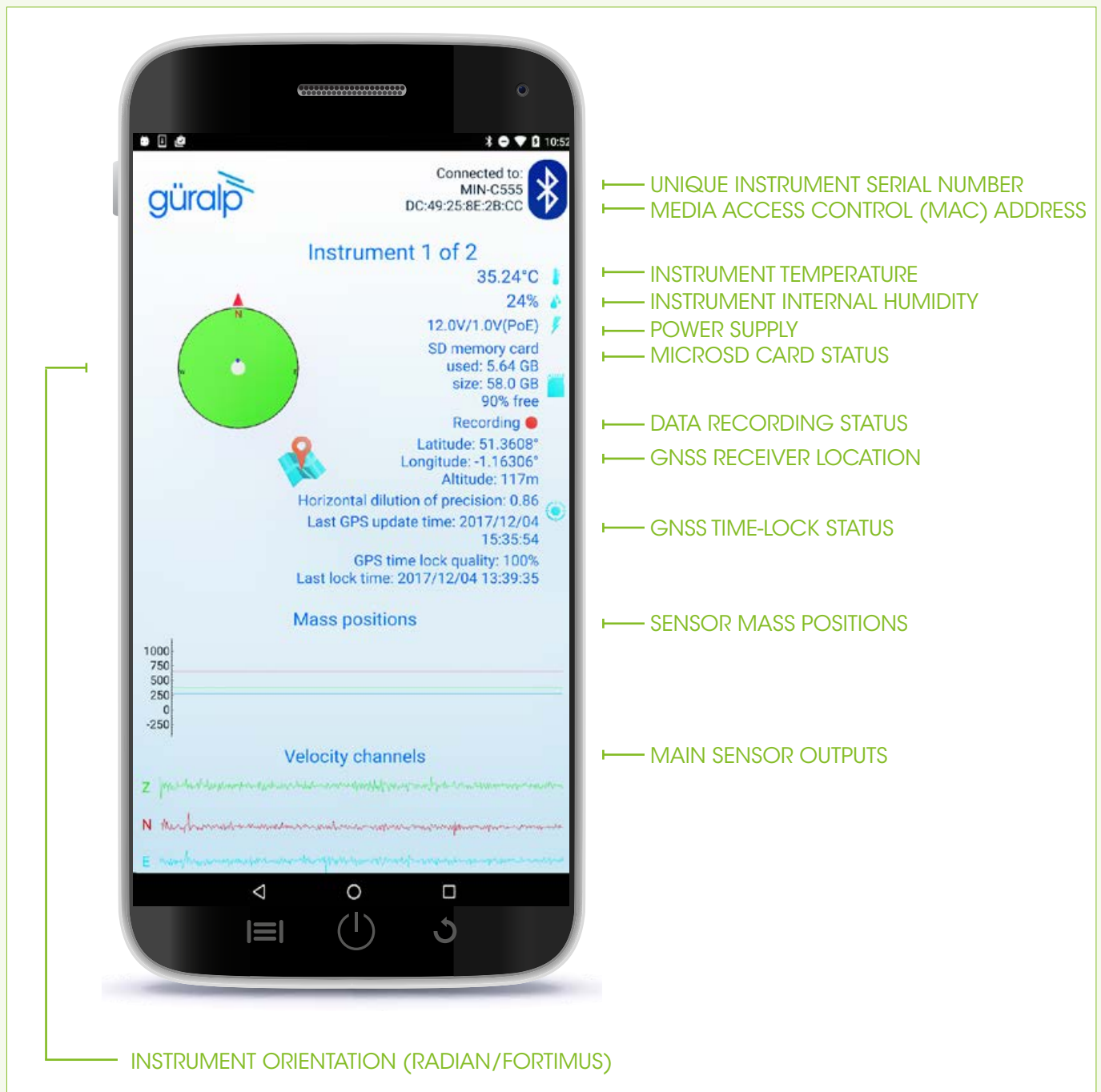
INSTRUMENT POWER SPECTRAL DENSITY (PSD) GRAPHS



# Minimus: 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 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.



# Minimus Minimus+



## SPECIFICATIONS

SENSOR INPUTS		OPERATION AND POWER USAGE	
Primary digitisation channels	Minimus: four at 24 bits Minimus+: eight 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)	Operating temperature	-20 to +60 °C
Secondary channels	Minimus: three analogue channels for sensor mass positions, one internal calibration channel Minimus+: six analogue channels for sensor mass positions, two internal calibration channels	Relative humidity range	zero to 100 %
Internal environmental channels	Humidity Temperature Supply voltage MEMS accelerometer (three component) Magnetometer (three component)	Power supply	10 - 36 V DC* Optional 9 V DC available
Input impedance	50 k $\Omega$	Power consumption at 12 V DC (Minimus)	< 1 W in power save mode with no GNSS or Ethernet  < 1.65 W in standard mode with GNSS and 10 Mb/s Ethernet output
<b>PERFORMANCE</b>		Power consumption at 12 V DC (Minimus+)	< 1.1 W in power save mode with no GNSS or Ethernet  < 1.75 W in standard mode with GNSS and 10 Mb/s Ethernet output
ADC converter type	Delta-sigma	<i>*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.</i>	
ADC conversion delay	6 $\mu$ s	<b>SOFTWARE</b>	
Output format	32-bit	Operating system	Windows, Linux and macOS compatible
Dynamic Range	>142 dB at 100 samples per second	Communication technologies supported Minimus and Minimus+:	Ethernet (10/100BASE-T)
Gain drift	3 ppm / °C	Minimus+ only:	Power over Ethernet (PoE)
Common-mode rejection	>110 dB	<b>USER INTERFACE</b>	
<b>DATA PROCESSING</b>		Configuration and control	(Ethernet) Güralp Discovery - free download, web browser interface. GüVü Bluetooth app (Android)
Output rates available	1 sample per hour up to 5000 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	<b>DATA COMMUNICATION</b>	
Decimation filters	$\pm 2$ , $\pm 3$ , $\pm 4$ , $\pm 5$ decimation (Causal / Acausal)	Data recording formats	miniSEED (metadata stored in dataless SEED format)
Out-of-band rejection	>194 dB	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)
Data transmission mode	Continuous and trigger modes	Memory and storage	Dual redundant 64 GB microSD cards (1 fixed, 1 hot-swappable)
Triggered data	Retrievable using event table in digitiser's web page. User selectable pre and post event time.	RAM	256 MB
Trigger modes	STA/LTA, Threshold	<b>PHYSICAL CHARACTERISTICS</b>	
Output streams	Direct output of PGA, PGV and PGD without external software	Casing type	Environmentally sealed, hard anodised aluminium
Selectable gain	Unity, $\times 2$ , $\times 4$ , $\times 8$ , $\times 12$ , $\times 64$	Environmental sensor	Humidity and temperature
<b>TIMING AND CALIBRATION</b>		Weight	Minimus: 674 g (disconnected) Minimus+: 782 g (disconnected)
Timing source precision	Accuracy when GNSS locked $\pm 50$ ns. Typical drift when unsynchronised (without GNSS) <1 ms per day	Dimensions	Minimus: 134 mm $\times$ 99 mm $\times$ 45 mm Minimus+: 134 mm $\times$ 139 mm $\times$ 45 mm
Timing sources	GNSS (GPS and GLONASS, BeiDou optional), PTP (Precision Time Protocol)	Connector type	MIL-DTL-26482 Series 1: Analogue - 26 way (Minimus $\times 1$ ; Minimus+ $\times 2$ ) Ethernet - 8P8C (RJ45) Power - 4 pin Digital - 10 pin
Calibration signal generator	Triangle, Step, Sinewave or Broadband noise with adjustable amplitude.	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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