güralp

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 (GPS, GLONASS, BeiDou) or PTP timing sources

NEW

> Enhanced features with firmware release 2.0 see page 3

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 ALUMINUM CASING TO WITHSTAND THE HARSHEST 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:

Multidisciplinary functionality with simple instrument and data management.

The four channel Minimus can simultaneously accommodate a triaxial analogue sensor, an auxillary 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 auxilary input.

Integrated network connectivity allows 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 allows for simpler 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, GüVü, a Bluetooth App, displays waveforms, orientation, temperature and humidity data, for instant checking of installation integrity.

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.

NEW

The latest firmware update also delivers enhanced 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.

Key features

- 24-bit, four channel (Minimus) or eight channel (Minimus+) digitiser
- Compatible with any analogue seismic sensor
- Ultra-low-latency mode for Earthquake Early Warning - when used with GDI protocol, transmission can be achieved in 40 ms
- Industry standard triggering algorithms for EEW (STA/LTA and Threshold)
- Multi-instrument voting for mitigating false positive alerts
- NEW Powerful real-time data Transforms: mathematical operations applied to real-time and recorded data e.g. integration; differentiation; high and low-pass filters
- NEW Quick Seismic Characteristic Data (QSCD) protocol and Maximum, Minimus and Average (MMA) calculated on selected time window.
- Seismic event table displaying events detetected using trigger algorithms with links to download event data (pre and post event time is user-configurable)
- 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!™ compatible
- GüVü Bluetooth App for installation integrity checking available for both Android and iOS devices
- Dual redundant 64 GB microSD cards (1 fixed, 1 hot-swappable)
- Select from GNSS (GPS, GLONASS or BeiDou) or PTP (Precision Time Protocol) timing sources
- Minimus+ supports Power Over Ethernet (POE) which significantly reduces complexity when installing local arrays

Applications

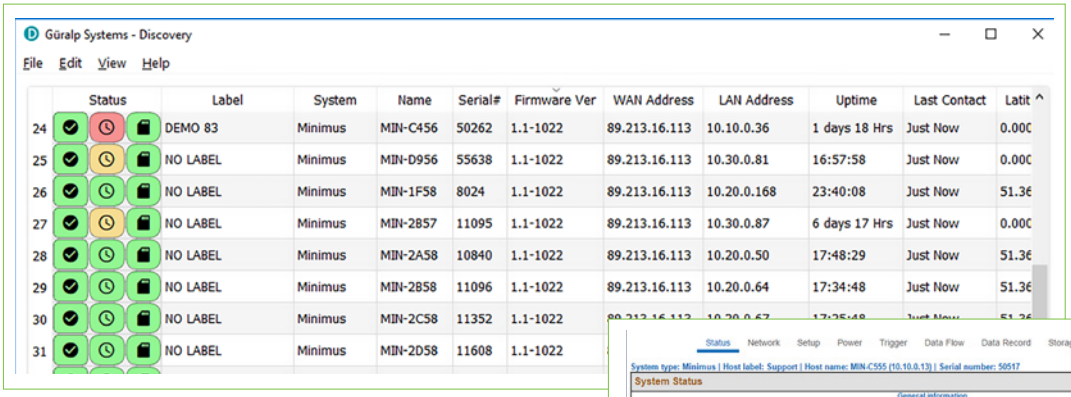
> Earthquake Early Warning Systems
> Volcanology
> Multi-scale seismic networks
> Structural health monitoring
> Hydrocarbon exploration
> Permanent reservoir monitoring
> Induced seismicity detection
> Explosion monitoring

Minimus:
Güralp Discovery Software*

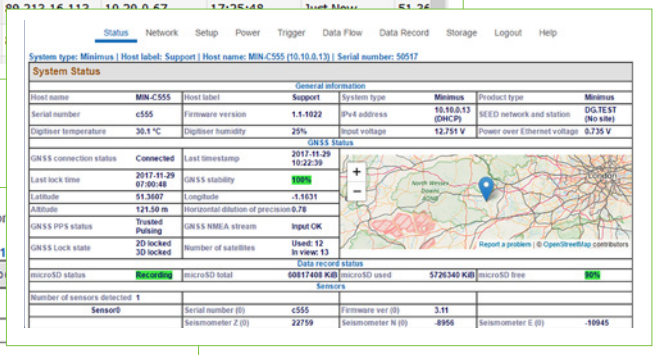
*See Discovery datasheet for more details

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

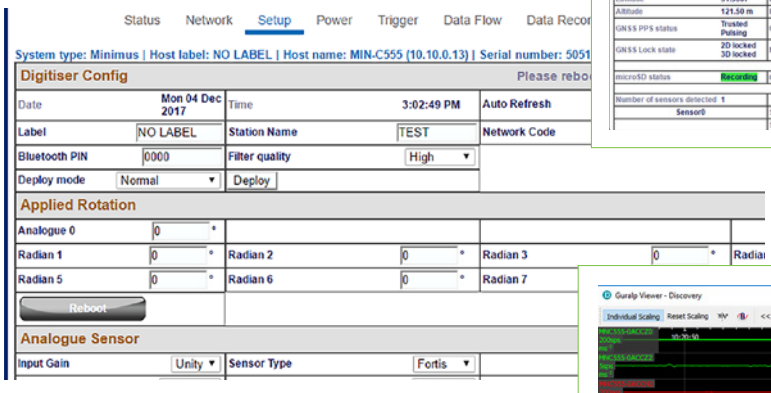
- > Identify instrument IP address
- > Analysis of hardware State of Health
- > Data streaming control
- > Remotely upgrade digitiser firmware
- > Upload configuration to multiple units simultaensouly
- > Advanced analysis on waveform data such as PSD and spectogram



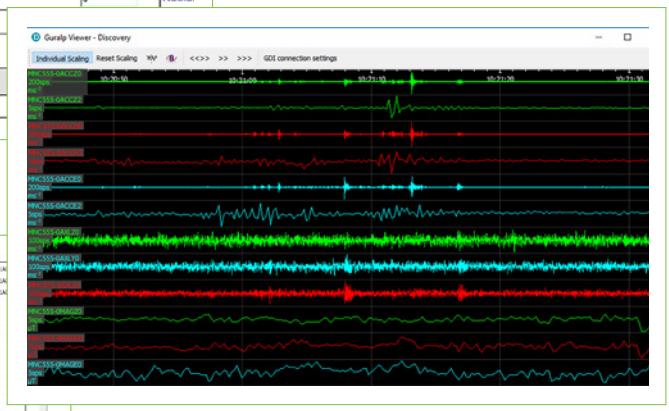
NETWORK OVERVIEW



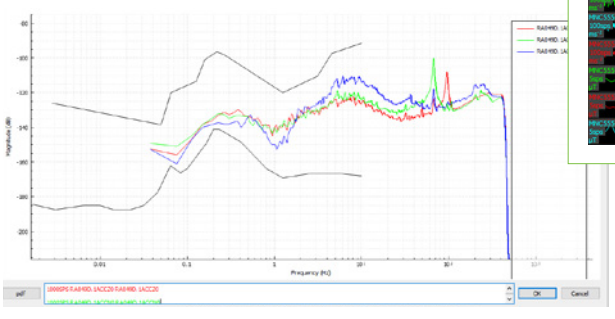
DIGITISER WEB INTERFACE



DIGITISER CONFIGURATION



REAL-TIME VIEWER

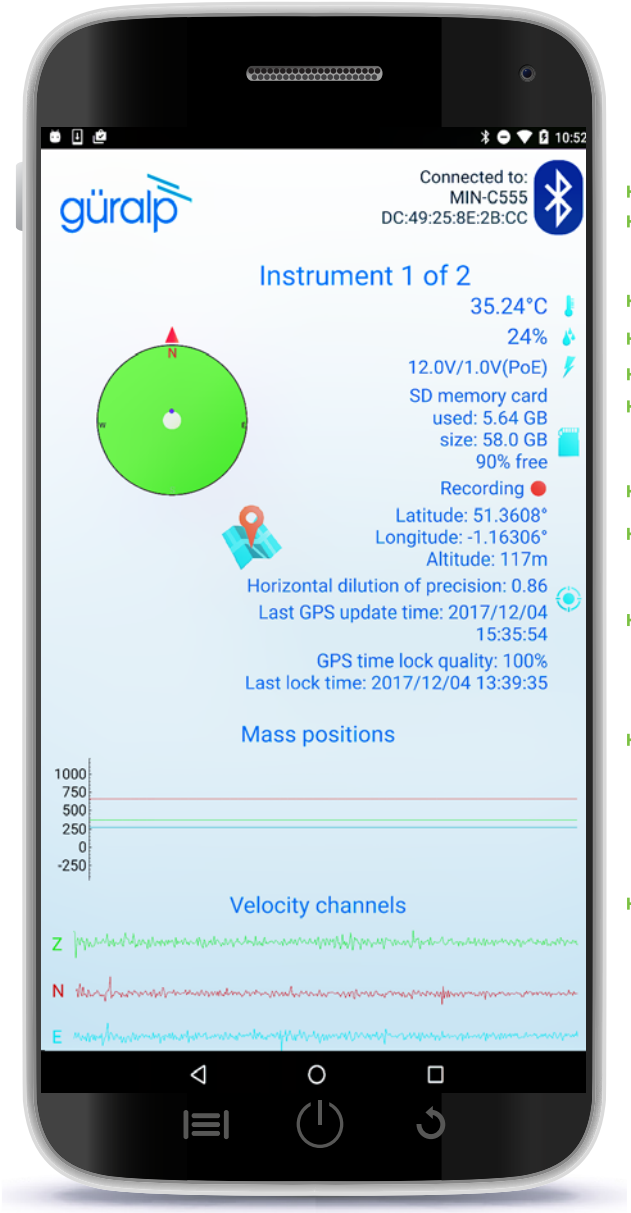


INSTRUMENT POWER SPECTRAL DENSITY (PSD) GRAPHS

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.



- 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
- INSTRUMENT ORIENTATION (RADIAN/FORTIMUS)

Minimus
Minimus+

SPECIFICATIONS

SENSOR INPUTS	
Primary digitisation channels	Minimus: four at 24 bits Minimus+: eight at 24 bits Differential input: 40 V peak-to-peak (± 20 V). Also compatible with single-ended inputs: 20 V peak-to-peak (± 10 V)
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
Internal environmental channels	Humidity Temperature Supply voltage MEMS accelerometer (three component) Magnetometer (three component)
Input impedence	50 kΩ
PERFORMANCE	
ADC converter type	Delta-sigma
ADC conversion delay	6 µs
Output format	32-bit
Dynamic Range	>136.5 dB at 100 samples per second
Gain drift	3 ppm / °C
Common-mode rejection	>110 dB
DATA PROCESSING	
Output rates available	1 sample per hour up to 5000 samples per second for primary channels, user-selectable Up to 500 samples per second for environmental channels
Decimation filters	÷2, ÷3, ÷4, ÷5 decimation (Causal / Acausal)
Out-of-band rejection	>194 dB
Data transmission mode	Continuous
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, ×2, ×4, ×8, ×12
TIMING AND CALIBRATION	
Timing source precision	Accuracy when GNSS locked ±50 ns. Typical drift when unsynchronised (without GNSS) <1 ms per day
Timing sources	GNSS (GPS, GLONASS, BeiDou), PTP (Precision Time Protocol)
Calibration signal generator	Triangle, Step or Broadband noise with adjustable amplitude.

OPERATION AND POWER USAGE	
Operating temperature	-20 to +60 °C
Relative humidity range	zero to 100 %
Power supply	10 - 36 V DC* Optional 9 V DC available
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
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

**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 Minimus and Minimus+:	Ethernet (10/100/1000BASE-T)
Minimus+ only:	Power over Ethernet (PoE)
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!) and GDI-link (metadata sent in RESP / dataless SEED file formats), SEEDlink
Memory and storage	Dual redundant 64 GB microSD cards (1 fixed, 1 hot-swappable)
PHYSICAL CHARACTERISTICS	
Casing type	Environmentally sealed, hard anodised aluminium
Environmental sensor	Humidity and temperature
Weight	Minimus: 674 g (disconnected) Minimus+: 782 g (disconnected)
Dimensions	Minimus: 134 mm × 99 mm × 45 mm Minimus+: 134 mm × 139 mm × 45 mm
Connector type	MIL-DTL-26482 Series 1: Analogue - 26 way (Minimus ×1; Minimus+ ×2) Ethernet - 8P8C (RJ45) Power - 4 pin Digital - 10 pin LEMO : GNSS/serial - 14 pin
Global navigation satellite system (GNSS)	Compact, encapsulated, waterproof, precision timing GPS/GLONASS/BeiDou receiver
Environmental protection	IP68 - protection against effects of prolonged immersion at 3 m depth for 72 hours

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