

# Güralp 40TDE



PORTABLE BROADBAND DIGITAL SEISMOMETER



## A rugged and robust three-component digital broadband seismometer

The Güralp 40TDE is a true broadband, force-feedback seismometer. The 40TDE is ideally suited for semi-permanent installations. The integrated digitiser and embedded communications module provide on-board and external storage options, a convenient web-based user interface and multi-protocol communications over serial and Ethernet connections. The stainless steel casing protects the instrument in some of the harshest deployment environments.

## Applications

- > Rapid temporary seismic deployments e.g. aftershock and volcanic unrest monitoring
- > Post-hole and direct burial installations
- > Regional and national seismic networks
- > Microseismic monitoring
- > Passive seismic imaging

Images: Guralp 40TDE digital seismometer

## Key features

Self-contained broadband triaxial seismometer (40T) with digitiser and data-logger (DM24S3EAM) in a single waterproof stainless steel case with fully adjustable levelling feet

Flat frequency response from 60 s (0.017 Hz) to 100 Hz with other response options available.

No mass locking required - plug in and go

The high-gain feedback loop eliminates mechanical nonlinearity (the overall measured linearity exceeds 90 dB) and minimises resonance in the spring system

Low-frequency vibration modes are carefully avoided in the design. The lowest spurious vibration mode of the 40T sensor is a barely measurable resonance at 450 Hz

Low self noise results in over 145 dB dynamic range across a wide frequency band

Cross axis rejection over 62 dB; sensor axes orthogonal to within +/- 0.05°

Supplied with 16 GB of on-board Flash memory storage, with option to increase up to 64 GB

Communication includes Ethernet and Serial with a host of options such as GSM or VSAT

Fast data download over Ethernet or USB

Real-time data streaming protocols include: SEEDlink, CD1.1, GCF (SCREAM!) - fully compatible with SeisComp3, Earthworm, Antelope analysis packages

## SPECIFICATIONS

### SENSOR: GÜRALP 40T BROADBAND SEISMOMETER

SENSOR SYSTEM	
Technology	Force feedback (force balance) velocity sensor
Configuration / Topology	Triaxial orthogonal (ZNE)
SENSOR PERFORMANCE	
Velocity output band (flat response within -3 dB crossing points)	60 s (0.017 Hz) to 100 Hz standard 30 s (0.03 Hz) or 1 s to 100 Hz options available
	Contact Güralp to discuss other frequency response options
Sensitivity	60 s and 30 s to 100 Hz: 3200 V/ms <sup>-1</sup> (2 x 1600 V/ms <sup>-1</sup> ) differential standard output  1 s to 100 Hz option: 2000 V/ms <sup>-1</sup> (2 x 1000 V/ms <sup>-1</sup> ) differential standard output  Contact Güralp to discuss alternative high sensitivity (high gain) options
Self-noise of sensor below NLNM (New Low Noise Model; Peterson; 1993, USGS)	7 s (0.15 Hz) to 4 Hz* *Independently tested value - see Tasic & Runovc (2012), Journal of Seismology
Sensor dynamic range (at standard output sensitivity)	148 dB @ 1 Hz 151 dB @ 5 Hz
Cross axis rejection	65 dB
Linearity	>90 dB
Lowest spurious resonance	450 Hz
Damping	70% of critical
Operating tilt range	±2.5°
SENSOR MASS CONTROL	
Sensor mass positions	Three independent outputs (single-ended)
Mass locking	No mass locking required
CALIBRATION CONTROLS	
Calibration signal types	Sine, step or broadband (adjustable amplitude and frequency)
DIGITISER PERFORMANCE	
Digitiser type	Fourth-order sigma-delta
Digitiser resolution	24-bit
Dynamic range	140 dB at 20 sps 136 dB at 40 sps 135 dB at 80 sps
Sample rates	1 to 1000 sps (up to four simultaneous streams with different sample rates available)
Gain options	Unity (1x) only
Digital filter types	FIR (linear phase) and IIR options available
Decimation filters	÷2; ÷4; ÷5; ÷8; ÷10
Anti-aliasing filter at Nyquist	160 dB
Absolute accuracy	<0.15%
Input impedance	117 kΩ
Crosstalk (out of band rejection)	140 dB
Linearity	110 dB at 80 sps
Common-mode rejection ratio	80 dB

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### DIGITISER / DATA-LOGGER: GÜRALP DM24S3EAM

USER INTERFACE / SOFTWARE	
Digitiser control and configuration	Platinum software (via web browser) Güralp Scream! software (free download) Terminal window over SSH or serial link
Triggering modes	STA/LTA, level, per-channel & network voting
REAL-TIME DATA COMMUNICATION	
Protocols	Scream! (GCF); SEEDlink; CD1.1; GDI-link
Latency	0.38 s digitisation delay at 250 sps 1 s transmission delay at 250 sps (GCF protocol)
ON-BOARD DATA STORAGE	
Data storage file formats	GCF; miniSEED
Internal storage capacity	Flash memory storage options available up to 64 GB
Data retrieval interfaces	Storage accessible via GPIO port (appears as USB drive); or secure file transfer (e.g. sftp)
Expandable storage	Optional hot-swappable USB armoured canister (various sizes available)
TIMING	
Timing system	Internal VCXO clock
Timing sources	GNSS (GPS, GLONASS); NTP (Network time protocol)
Timing accuracy	GNSS unlocked: <100 µs drift per day at 40 sps
STATE-OF-HEALTH	
Parameters available	Sensor mass positions, digitiser temperature, digitiser voltage and current
CONNECTORS	
Connector types	Power/data: 10-pin military specification bayonet GNSS: 10-pin military specification bayonet USB: 6-pin military specification bayonet GPIO: 12-pin military specification bayonet Ethernet: 6-pin military specification bayonet
POWER	
Power supply voltage	11-30 V DC*
Power consumption (at 12 V DC)	Without GNSS and Ethernet: 2.7 W With GNSS or Ethernet: 3.0 W With GNSS and Ethernet: 3.2 W
*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.	
ENVIRONMENTAL / PHYSICAL	
Operating temperature range	-20° to +75°C
Operating humidity range	0-100% relative humidity
Enclosure ingress protection	IP68 - protection against effects of prolonged immersion under pressure at 3 m depth for 72 hours
Enclosure material	Stainless steel case; O-ring seals throughout
Height	With handle: 300 mm Without handle: 245 mm
Diameter	168 mm
Weight	9.2 kg
Alignment	Bubble level on lid; north arrow on handle and base; adjustable feet
SUPPORTING DOCUMENTATION	
Calibration values	Measured sensor sensitivity, frequency response, instrument poles & zeros, digitiser sensitivity and test results enclosed
Full user's guide	Available online at: <a href="https://www.guralp.com/documents/MAN-040-0004.pdf">https://www.guralp.com/documents/MAN-040-0004.pdf</a>

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.

DAS-040-0004 Issue G