Güralp 40TDE

PORTABLE BROADBAND DIGITAL SEISMOMETER

A rugged and robust three-component digitial 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 measureable 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 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

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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^{-1} (2 x 1600 V/ms^{-1}) differential standard output 1 s to 100 Hz option: 2000 V/ms^{-1} (2 x 1000 V/ms^{-1}) differential standard output Contact Güralp to discuss alternative high sensitvity (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	0.7 critical or 70% 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 wih different sample rates available)
Gain options	Unity (1×) 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

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	16 GB Flash memory with USB 2.0 port as standard with option to upgrade 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 16 or 64 GB USB armoured pod
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: https://www.guralp.com/documents/MAN-040-0004.pdf

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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.

DAS-040-0004 Issue G