CENTAUR

AN ALL-IN-ONE HIGH-FIDELITY NETWORKING DIGITAL RECORDER

Featuring high-performance capabilities for digitizing, recording, data processing, and streaming, the Centaur is a best-in-class instrument thanks to efficient, easy-to-use workflows, high fidelity and reliability, adaptable interfaces, the ability to withstand harsh environmental conditions, and low power consumption.

Exceptional Performance

- High-performance digitizing with a resolution up to 31 bits, dynamic range up to 142 dB @ 100sps, sample rates up to 5000 sps, gain up to 40x for standard-gain models or 160x for high-gain models, and an accuracy within ±0.5%
- Low latency streaming protocol selection (SeedLink, NP, or CD-1.1) with user-defined backfill period and priority in the event of telemetry outages
- Recording redundancy with dual recording media capacity up to 256 GB providing both a data recording buffer and a field-swappable archive capable of storing years of data
- Built-in data processing capabilities for real-time azimuth or tilt orientation correction, STA/LTA event detection, and QSCD20 data product calculation
- High accuracy sensor calibration with voltage or current source and user-selectable signal type (user-defined waveform playback or built-in sine, step, or pseudo random binary generated waveform signal)

Easy to use & Highly adaptable

- Centaur has broad sensor support for single or mixed sensor acquisition, including seismometers, geophones, microbarometers, and digital weather stations
- A web interface provides extensive configurability in addition to viewing waveform data, state-of-health information, and Nanometrics smart sensor virtual levelling bubble
- Easy integration of state-of-health information into existing tools using low bandwidth SNMP communications (Simple Network Management Protocol)

Secure & Environmentally Robust

- Site-to-site encrypted virtual private networks using OpenVPN®
- Elliptic curve digital signature algorithm (ECDSA) for CD-1.1 streaming on Authenticating models
- Rugged, waterproof enclosure for harsh environments rated for continuous immersion (IP68). Models designed for polar environments are also available
- High protection from electrostatic discharge and lightning surges
- User configurable onboard 3-D data rotation for orientation correction of Azimuth and tilt rotation

Centaur

CTR4 series

Model Selection

Models available with:

- 3 or 6 analog sensor channels
- Standard or high gain preamps
- Optional authentication function
- Optional polar temperature certification

Target Markets

The Centaur is an ideal instrument to meet the needs of the most demanding real-time networks.

- Hazard monitoring such as earthquake early warning (EEW)
- Global seismic networks (GSN)
- Strong motion networks
- Ocean bottom cabled arrays
- Nuclear test ban monitoring
- Seismic and geodetic science facilities
- Multidisciplinary science including atmospheric monitoring.

Polar Certified Model available for operating temperatures down to -45°C

nanometrics

nanometrics.ca

TECHNICAL SPECIFICATIONS CENTAUR (CTR4 SERIES)

Specifications subject to change without notice

SENSOR INPUTS

Channels: Available with 3 or 6 channel inputs
Input voltage range (Peak-to-peak differential):
- 40 V, 20 V, 10 V, 4 V, 2 V, 1 V (standard)
- 10 V, 5 V, 2.5 V, 1 V, 0.5 V, 0.25 V (high-gain)

Also compatible with single-ended inputs:
Up to 20 V peak-to-peak (±10 V)
Input Impedance: 40 kΩ (standard digitizer)
1.7 MΩ (high-gain digitizer)

SENSOR COMPATIBILITY

Sensor Types: Broadband seismometers, short period geophones, and microbarometers
Control Lines: 6 sensor inputs – typically used for calibration enable, mass center, mass lock/unlock, XYZ/UVW select
Sensor Power:
- Supply power pass-through to sensor (9-36 VDC, 1A)
- Over-current and surge protected

Auto Mass Centering: Configurable thresholds, intervals, retries
Serial Interface: Supports digital management of Nanometrics sensors and connectivity to weather stations

DIGITIZER PERFORMANCE & CAPABILITIES

Sampling: Simultaneous on all 3 or 6 channels
Dynamic Range: 142 dB @ 100 sps, 135 dB @ 500 sps (full-scale peak to RMS shorted-input noise)
Resolution: User selectable bit-depth from 24 to 31 bits per sample, 32-bit ADC sample architecture
Accuracy: Nominal gain accuracy within ±0.5%
Preamp Gain:
- Standard: 1x, 2x, 4x, 10x, 20x, 40x
- High Gain: 4x, 8x, 16x, 40x, 80x, 160x

Digital Gain: 0.001 to 100 high precision DSP gain permits choice of any digitizer gain
Sample Rates: 1, 2, 5, 10, 20, 40, 50, 80, 100, 125, 200, 250, 500, 1000, 2000, 5000 sps
Dual Sample Rates: A second sample rate can be selected from the sample rates above
Decimation Anti-Aliasing Filter:
- Selectable linear phase (noncausal) or minimum phase (causal)
- -140 dB (linear phase) or -120 dB (minimum phase) at Nyquist frequency, 0 dB at 80% Nyquist

Digital Filters:
- User-configurable low-pass and high-pass
- 1st to 5th order, 0.1 mHz to Nyquist
- Different filters may be configured for primary and secondary sample rates and Sensor A and B

Orientation Correction: User configurable onboard 3-D data rotation for correcting azimuth and tilt

AVAILABLE MODELS

CTR4-3S: 3 standard channels
CTR4-3H: 3 high gain channels
CTR4-3A: 3 standard channels, Authenticating
CTR4-6S: 6 standard channels
CTR4-6H: 6 high gain channels
CTR4-6A/S: 6 standard channels, Authenticating
CTR4-6S/H: 3 standard & 3 high gain channels
CTR4-6AS/H: 3 standard & 3 high gain channels, Authenticating
CTR4-3S-XC: 3 standard channels, Polar Certified
CTR4-6S-XC: 6 standard channels, Polar Certified

RECORDING (CONTINUOUS)

Formats: MiniSEED
Internal Memory: 8 GB internal memory (32, 64, 128 or 256 GB options available)
Removable Media: SD Card up to 256 GB

RECORDING (EVENTS)

Triggers: Bandpassed STA/LTA, threshold
Captured Data: MiniSEED, ASCII
Data Products: Peak Ground Motion (i.e PGA, PGV, PGD) statistics calculated on the instrument

CALIBRATION

Signal Source: 16-bit DAC with 30 ksps output
Calibration Mode
- Voltage source, 1% accuracy from ±10V to ±5mV
- Current source, 1% accuracy from ±30mA to ±30µA

Calibration Signal and Response Recording
- Calibration signal digitized as a fourth 24-bit channel available to be downloaded from the Store using the Web Service data download interface (FDSN-WS) API
- Calibration signal and the sensor response can be archived together as an event file

Waveforms:
- Synthesized sine, step, PRB signals
- Playback user defined calibration files
- User controllable amplitude, frequency, pulse width, duration, lead-in and lead-out silence

STATE-OF-HEALTH INPUTS

Channels: 3 single-ended inputs, ±5 V range, 50 kΩ input impedance
Sampling Interval: Configurable from 1 to 3600 seconds
Accuracy: 18 bits effective resolution

DATA RETRIEVAL

File Transfer: Via Ethernet, optional WiFi or Ethernet-connected DSL, VSAT, cellular, radio
Media Exchange: SD card field-swappable during continuous recording with no loss of data
Response Metadata: Generate and download full digitizer/sensor response files in RESP, Dataless SEED or StationXML format, or access from the SD Archive Media in StationXML format.

DATA STREAMING

Continuous: Seismic data, data products and State-of-Health data
Formats: SeedLink (not available when authenticating), Nanometrics NP, QSCD20, CD1.1 (Authenticating Models)
Events: Triggered event data: email, secure file transfer, other options available

TIMING - GNSS & PRECISION NETWORK TIMING

Timing System: Internal DCXO clock disciplined to selectable timing source
Timing Source: Select from GNSS, PTP (Precision Timing Protocol), NTP or free-running
Timing Server: Serve PTP or NTP time to other Centaur, Titan SMA/EA or Meridian
Timing Accuracy:
<5 µsec (GNSS Always on or PTP)
<100 µsec (GNSS duty cycled or local NTP)
GNSS Receiver: Internal 32 channel GNSS receiver
GNSS Constellations: GPS + select one of Beidou, Glonass, Galileo, QZSS
GNSS Power: Selectable: always on, duty cycled or off

LOCAL USER INTERFACE

Removable Media: SD card protected in waterproof media bay
External LEDs: System status, Ethernet link, time quality, media card status, sensor A & B
Buttons: WiFi wakeup, media eject, system shutdown

COMMUNICATIONS

Web-based Graphical UI: Supports standard PC, tablet and mobile devices. Used for waveform and state-of-health monitoring, configuration, maintenance, sensor management and calibration, downloading data and events.
Interfaces: 10/100 Base-T Ethernet, WiFi (optional), Serial via USB (USB unavailable on Authenticating models)
IP Addressing: Static, dynamic (DHCP) or link-local IP
Protocols: WebSocket, UDP/IP unicast/multicast, HTTP data streaming, and Simple Network Management Protocol (SNMPv2c) for state-of-health monitoring
VPN: OpenVPN®

POWER

Power Supply: 9-36 VDC isolated input
Protection: Electronic resettable fuse design, lightning surge, reverse battery and short circuit protection
Battery Manager: User-configurable low voltage shutdown and restart thresholds

POWER USAGE (TYPICAL)

3 chan. (standard): 850 mW
6 chan. (standard): 1.2 W
Ethernet: Add 0.2 W for 10 Base-T, 0.3 W for 100 Base-T
High Gain: Add 0.2 W for every 3 high-gain channels
Authentication: Authenticating models add 1.2 W if enabled

CONNECTORS

Sensor: 26-pin Mil. circular, shell size 16, female
Power: 3-pin Mil. circular, shell size 8, male
Ethernet: Watertight RJ-45
USB: 2.0 Type A receptacle behind media bay door (USB unavailable on Authenticating models)
GNSS Antenna: TNC (female) with 3.3V supply for active antenna
State-of-Health: 4-pin Mil. circular, shell size 8, female

PHYSICAL CHARACTERISTICS

Housing: Aluminum
Ingress Protection: Rated to IP68 at 2 m for 72 hours when connectors mated or capped
Humidity: 0 to 100%
Operating Temperature:
–20°C to 60°C (Standard Model)
–45°C to 60°C (Polar Certified Model)
Storage Temperature:
–40°C to +70°C (Standard Model)
–60°C to +70°C (Polar Certified Model)
Weight: 2.4 kg (models CTR4-6A/S, CTR4-6AS/H); 2.1 kg (models CTR4-3S, CTR4-3H, CTR4-3S-XC); 2.2 kg (all other models)
Size: 196 mm (L) x 137 mm (W) x 88 mm (H)

CENTAUR WITH AUTHENTICATION MODELS: CTR4-3A, 6A/S, 6AS/H

Streaming: CD-1.1 format
Digital Signature:
Hardware authentication provides Elliptic Curve Digital Signature Algorithm (ECDSA P-256, SHA -256)
Tamper Detection: Authenticating models have case tamper switch or 3 external switches via SOH connector

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Listening to the Earth

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