

# A complete seismograph you can hold in your hand

Taurus is a revolution in the integration of performance, capabilities and packaging of field portable seismographs. It is an all-in-one design that is small, lightweight and complete. This hand-held instrument can directly interface with almost any sensor, record continuous data for over 600 days, and operate using a mere 650 mW.

This next-generation portable combines all the attributes of a stand-alone recorder with the connectivity required to harness the benefits of today's Internet and wireless communications. Taurus incorporates a high resolution 24-bit ADC, a precision GPS clock and internal removable storage options with 1 to 30 Gbyte capacities. An integrated colour graphics display and five-button keypad provide instant access to real-time or recorded data.

## Applications

- ▶ Broadband seismic studies
- ▶ Emergency networks
- ▶ Aftershock studies
- ▶ Strong motion studies
- ▶ Seismic networking over the Internet
- ▶ Noise surveys
- ▶ Vibration monitoring
- ▶ Infrasound data acquisition
- ▶ Local site data storage in Libra networks

## Benefits

- ▶ Excellent quality data with 24-bit resolution and precise GPS timing
- ▶ Hand-held, all-in-one seismograph
- ▶ Long term deployments with over 600 day recording capacity
- ▶ Quick and convenient data retrieval using internal hot swap media
- ▶ Real-time data streaming for network applications
- ▶ Optional internet service provider dial-up
- ▶ Real-time, historic and calibration data review at-a-glance
- ▶ Data output directly in industry-standard formats

# Next Generation Hand-held Data Acquisition

Finally, a portable instrument that is truly compact and self-contained. Regardless of the application, you will appreciate how little equipment you will actually need to carry to the field. No laptop, PDA or break-out box, just a seismometer, cable, Taurus and battery.



## Taurus Technical Specifications

### ▶ Sensor inputs

Channels ..... 3 standard, field upgradeable to 6 or 9 with addition of external Trident digitisers  
 Sampling ..... Simultaneous  
 Input voltage range ..... 40 V peak-to-peak differential (at gain=0.4)  
 Nominal sensitivity ..... 1 count/ $\mu$ V (gain=1)  
 Hardware gain selection ..... Software configurable 0.4, 1, 2, 4, 8  
 Software gain ..... User configurable 0.001 to 100  
 High pass filter ..... User configurable in mHz

### ▶ Digitiser performance

Type ..... Proprietary high order sigma-delta  
 Digital filter ..... 140 dB attenuation at output Nyquist  
 Filter type ..... Linear phase (consult factory for other options)  
 Dynamic range ..... >138 dB @ 100 sps (max sine wave above shorted input)  
 Sample rates ..... 10, 20, 40, 50, 80, 100, 120, 200, 250, 500 sps

### ▶ Sensor support

Sensor types ..... Broadband active and short period passive  
 Control lines ..... 3; typically used for Cal enable, mass center and mass lock/unlock  
 Logic level configurable; High: 5V, 12V, open drain. Low: 0V, open drain  
 Sensor power ..... Supply power pass-through to sensor (9-36 VDC). Protected against short circuit. Sensor power can be switched on/off from user interface.  
 Auto mass centering ..... Configurable mass position threshold with auto-centering or centering scheduled with configurable repeat interval. In auto-centering mode, mass centering will be repeated until masses are within limits.  
 Sensor management ..... Supports digital interface to Nanometrics Trillium 120 seismometer

### ▶ Calibration output

Calibration signal ..... Ramped sine wave, configurable frequency and amplitude  
 Pseudo-random binary  
 Calibration initiation ..... User interface (local or remote)  
 Calibration mode ..... Voltage or current

### ▶ Timing

Timing system ..... Internal DCXO clock disciplined to GPS  
 GPS receiver ..... Internal 8 channel receiver  
 GPS antenna ..... External active antenna supplied with 5 meter cable  
 Duty cycle ..... Software configurable

### ▶ Instrument state-of-health

Taurus records continuous instrument state-of-health including:  
 Power supply voltage  
 Seismometer mass position  
 Calibration enabled bit for each channel  
 GPS state-of-health  
 Instrument temperature  
 Signal clip indication bit  
 User accessible SOH ..... 4 external SOH channels (12-bit)  
 Configuration ..... Complete configuration audit trail  
 Communications ..... Complete audit trail with cumulative good/bad packet counts  
 Log file ..... All software generated log messages are stored with the data

### ▶ Internal data storage

Standard ..... Single, 1.8" ATA disk drive slot  
 Single, Type I/II Compact Flash slot  
 Both storage options are removable. Storage media are accessed via the media door on the end of the unit.

The following media options are available:

Compact Flash ..... Standard and industrial grade Type I/II, 1 or 2 Gbyte; Contact factory for larger capacity options.  
 1.8" ATA disk drive ..... 10 or 30 Gbyte

Duration ..... >600 days continuous recording, 3-channels @ 100 sps on 30 GByte ATA drive (~40 days on 2 Gbyte Compact Flash)  
 Recording modes ..... Continuous; write once or ringbuffer (overwrites oldest data)  
 Continuous with STA/LTA trigger flags  
 File system ..... FAT32  
 Storage format ..... Nanometrics Store. Direct data output in MimiSEED and Nanometrics formats.

### ▶ Data retrieval

Media exchange ..... Compact Flash and ATA drives are field swappable  
 Download interfaces ..... 10/100 Base-T Ethernet

### ▶ Real-time data communications

Interfaces ..... 10/100 Base-T Ethernet, RS-232 serial  
 Protocols ..... UDP/IP unicast/multicast  
 HTTP (POST and GET)  
 RS-232 serial with IP drivers

### ▶ Integrated user interface

LCD display ..... 240\*320 colour graphics display with backlight  
 Interface ..... Web browser with five button navigation  
 LED ..... System status tri-colour LED, Ethernet communications LED, Media status LED.

### ▶ Configuration

Taurus is configurable locally via the colour LCD display and onboard browser or remotely using any web browser connected to the unit. Multiple unit configuration is achieved using an optional group configuration web server. Consult factory for further information.

### ▶ Software

Operating system ..... Linux  
 Applications software ..... Nanometrics next generation NAQS Server with web interface

### ▶ Connectors

Sensor connector ..... 26-pin mil circular. Primary data channels, sensor control lines, protected/switchable sensor power, digital serial sensor management interface  
 Serial/USB ..... 19-pin mil circular  
 Serial port 1; Rx, Tx, RTS, CTS, DTR, DSR, CD, RI  
 Serial port 2; Rx, Tx, RTS, CTS (data collection from serial devices)  
 USB master; Data, Pwr (5V, 100 mA)  
 Serial device power (pass through supply voltage)  
 GPS ..... TNC, active antenna connection (3.3V)  
 Ethernet ..... 4-pin mil circular, 10/100 Base-T  
 User SOH ..... 7-pin mil circular, 4 analog SOH inputs, SOH ref., 3.3V @ 10 mA power  
 NMXBus ..... 4-pin mil circular, NMXBus data and power  
 Power ..... 3-pin mil circular, 9-36 VDC  
 USB ..... USB master/slave accessible behind media door

### ▶ Power

Power system ..... Protected fuseless design with configurable low power disconnect, reverse protection and short circuit protection  
 Ultra-low power mode ..... 650 mW @ 12 Volts, 3-channel continuous recording @ 100 sps, <100  $\mu$ sec timing precision, Compact Flash recording  
 Low power ..... 1.1 Watt @ 12 Volts; 3-channel continuous recording @ 100 sps, continuous serial data acquisition (external geodetic GPS or equivalent), <100  $\mu$ sec timing precision, internal disk or Compact Flash recording.  
 Communications mode ..... 1.5 Watt typical; 3-channel continuous recording @ 100 sps, <100  $\mu$ sec timing precision, real-time Ethernet or serial communications  
 Configuration ..... <3.5 Watts. All systems operational including colour graphics display.  
 Low voltage disconnect ..... Software configurable

### ▶ Environmental

Operating temp. ..... -20°C to +60°C base unit using Compact Flash storage  
 +5°C to +55°C base unit using 1.8" ATA disk storage  
 Storage temp. ..... -40°C to +70°C  
 Humidity ..... 100%  
 Length ..... 264 mm  
 Width ..... 147 mm  
 Depth ..... 60 mm  
 Weight ..... 1.8 Kg



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## ▶ Class-leading dynamic range and 24-bit resolution

To excel in modern broadband data acquisition, a higher dynamic range is essential. Taurus is well-equipped with Nanometrics' proprietary sigma-delta digitizer providing 24 bits of resolution and a class-leading dynamic range of 138 dB. Sampling is simultaneous on all channels and timing accuracy is sub-millisecond with the GPS locked.



### ▶ Minimal power, maximum data availability

Taurus has an impressively low power consumption of just 650mW in a typical portable system configuration acquiring 3-channels at 100sps. This significantly reduces the size of the solar panels and batteries required at any site. Experienced users will appreciate the importance of low power consumption and the increased reliability that follows. It is not uncommon for the Taurus to operate continuously from a 10Ah battery and 20W solar panel.

### ▶ Integrated display provides clear concise feedback

Every Taurus includes a large colour graphics LCD display and five-button keypad providing direct access to the various acquisition, monitoring, configuration and instrument status web pages. There is no guesswork or interpretation of LED sequences, just concise, plain text messages and graphics informing the user of the instrument status.

### ▶ Familiar web browser interface for local or remote operation

No special software is required to configure the Taurus or to display real-time waveform or state-of-health information. A familiar web browser provides onboard and remote access to the many interactive web pages that make up the Taurus interface. Real-time and historic data, GPS status, instrument configuration and field procedures are all richly presented on the large colour graphics display. Many of the html pages can be translated into other languages or edited to include customer workflow requirements for configuration, monitoring and data retrieval.

### ▶ Connects directly to all modern seismometers with single cable

Taurus can interface directly with any of today's broadband or short period sensors without the need for external breakout boxes or power supplies. Hardware and software gain are user-configurable via the browser interface, as are the sensor control lines for mass centering, cal enable, and lock/unlock. Taurus will monitor the sensor mass position and center the masses as required, facilitating single visit deployments of broadband sensors. This is most important immediately after installation while the sensor is acclimatizing.

### ▶ Quick and convenient data retrieval using internal hot swap storage media

Compact Flash and 1.8" ATA drive slots are standard on every unit. A waterproof access door affords quick and easy access for fast media exchange in the field without interruption to data acquisition. Memory options can be selected as appropriate for environmental conditions and memory upgrades purchased directly from local suppliers.

### ▶ Data output directly in industry-standard formats

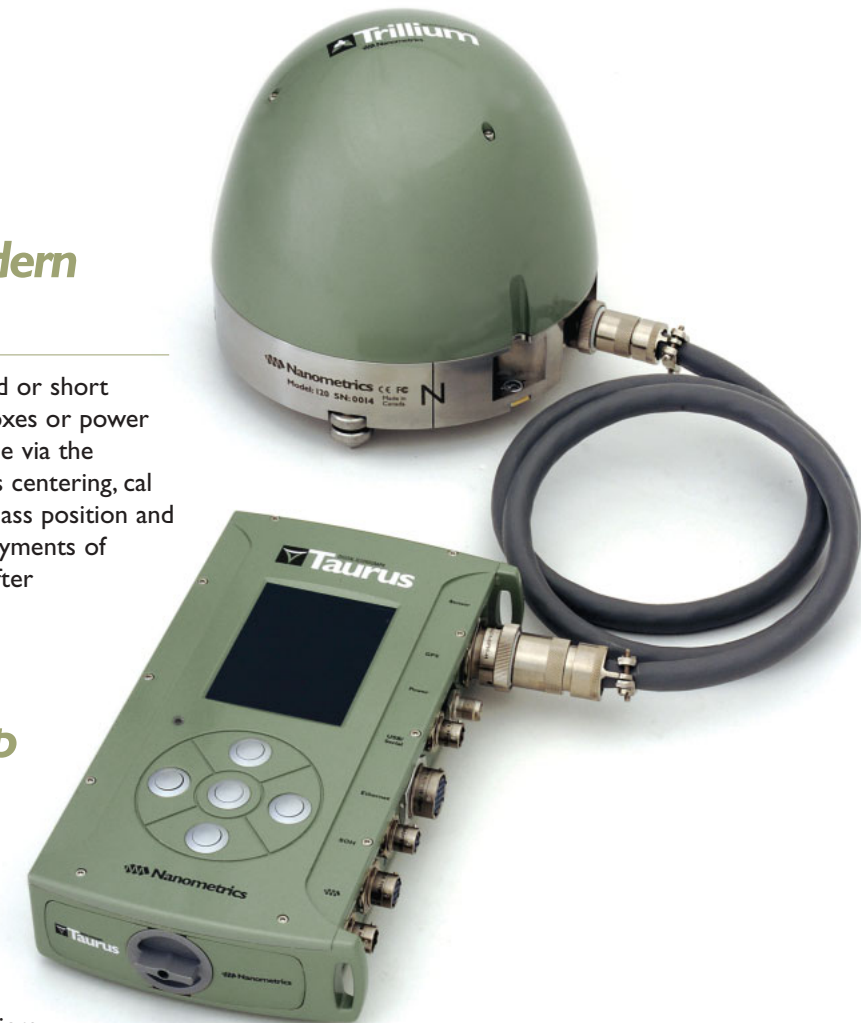
Taurus records in addition to the waveform data, the entire configuration history, all log file entries and status information data in a single project file or Store. Data are organized to facilitate the rapid review and retrieval of waveform, configuration and log file information. The Store contents can be reviewed using a web browser and data directly accessed in a number of international formats including MiniSEED.

### ▶ Real-time data streaming for network applications

Taurus includes a wide range of physical interfaces and software protocols to support continuous real-time data streaming. Where network connections exist, real-time data streaming is available via UDP/IP multicast and http over 10/100Base-T Ethernet or the serial data port (PPP). Optionally, Taurus can utilize low cost internet service provider connections in a dial-up mode.


### ▶ New capabilities readily incorporated into Linux & Java based architecture

Today's portable seismograph must operate unattended for long periods in remote areas. It must also integrate seamlessly into the rapidly developing world of internet and wireless communications. To meet these challenges the Taurus architecture combines the versatility of the Linux operating system with modern Java applications while interconnecting with standard IP protocols. It is a winning combination designed to keep Taurus on the cutting edge for years to come.



DIGITAL SEISMOGRAPH  
**Taurus**



 **Nanometrics**

Sensor

GPS

Power

USB/  
Serial

Ethernet

SOH



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- Aftershock studies
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 **Nanometrics**  
SEISMOLOGICAL INSTRUMENTS



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➤ **Minimal power, maximum data availability**

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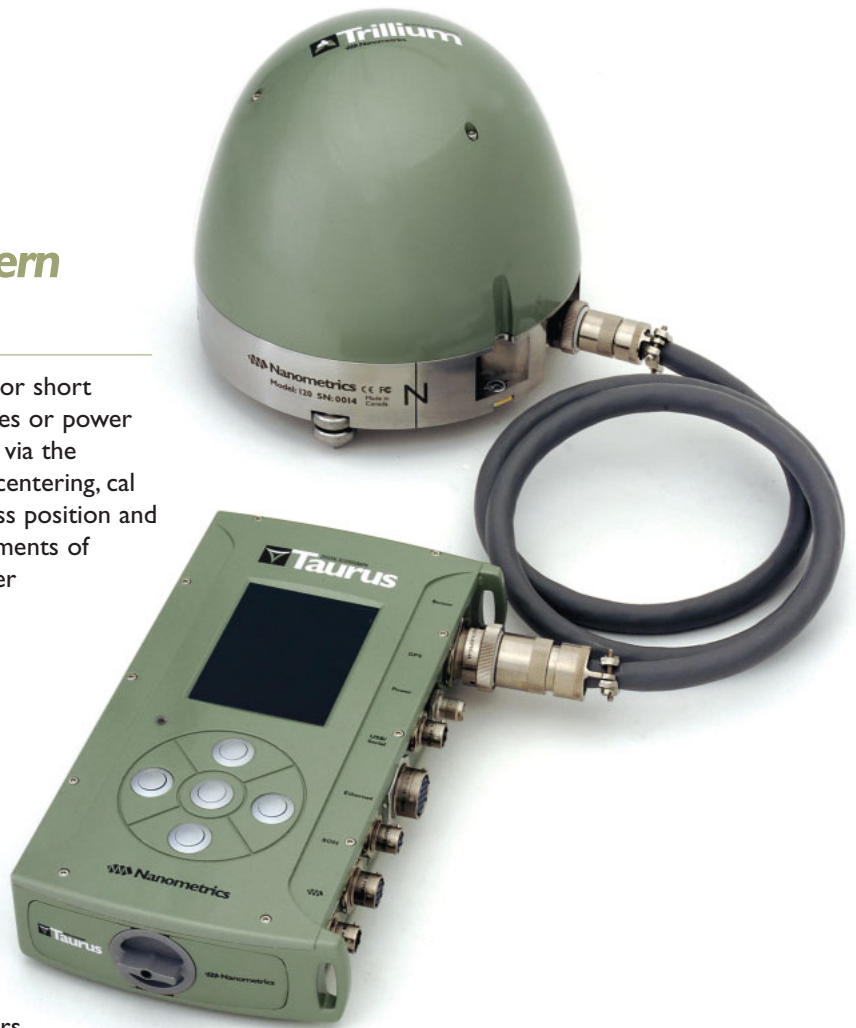
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# Taurus Technical Specifications



## ➤ Sensor inputs

Channels ..... 3 standard, field upgradeable to 6 or 9 with addition of external Trident digitisers  
 Sampling ..... Simultaneous  
 Input voltage range... 40 V peak-to-peak differential (at gain=0.4)  
 Nominal sensitivity... 1 count/μV (gain=1)  
 Hardware gain selection... Software configurable 0.4, 1, 2, 4, 8  
 Software gain ..... User configurable 0.001 to 100  
 High pass filter ..... User configurable in mHz

## ➤ Digitiser performance

Type ..... Proprietary high order sigma-delta  
 Digital filter ..... 140 dB attenuation at output Nyquist  
 Filter type ..... Linear phase (consult factory for other options)  
 Dynamic range ..... > 138 dB @ 100 sps (max sine wave above shorted input)  
 Sample rates ..... 10, 20, 40, 50, 80, 100, 120, 200, 250, 500 sps

## ➤ Sensor support

Sensor types ..... Broadband active and short period passive  
 Control lines ..... 3; typically used for Cal enable, mass center and mass lock/unlock Logic level configurable; High: 5V, 12 V, open drain. Low: 0V, open drain  
 Sensor power ..... Supply power pass-through to sensor (9-36 VDC). Protected against short circuit. Sensor power can be switched on/off from user interface.  
 Auto mass centering... Configurable mass position threshold with autocentering or centering scheduled with configurable repeat interval. In autocentering mode, mass centering will be repeated until masses are within limits.  
 Sensor management... Supports digital interface to Nanometrics Trillium 120 seismometer

## ➤ Calibration output

Calibration signal ..... Ramped sine wave, configurable frequency and amplitude  
 Pseudo-random binary  
 Calibration initiation... User interface (local or remote)  
 Calibration mode ..... Voltage or current

## ➤ Timing

Timing system ..... Internal DCXO clock disciplined to GPS  
 GPS receiver ..... Internal 8 channel receiver  
 GPS antenna ..... External active antenna supplied with 5 meter cable  
 Duty cycle ..... Software configurable

## ➤ Instrument state-of-health

Taurus records continuous instrument state-of-health including:  
 Power supply voltage  
 Seismometer mass position  
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 GPS state-of-health  
 Instrument temperature  
 Signal clip indication bit  
 User accessible SOH... 4 external SOH channels (12-bit)  
 Configuration ..... Complete configuration audit trail  
 Communications ..... Complete audit trail with cumulative good/bad packet counts  
 Log file ..... All software generated log messages are stored with the data

## ➤ Internal data storage

Standard ..... Single, 1.8" ATA disk drive slot  
 Single, Type I/II Compact Flash slot  
 Both storage options are removable. Storage media are accessed via the media door on the end of the unit.  
 The following media options are available:  
 Compact Flash ..... Standard and industrial grade Type I/II. 1 or 2 Gbyte; Contact factory for larger capacity options.  
 1.8" ATA disk drive... 10 or 30 Gbyte

Duration ..... > 600 days continuous recording, 3-channels @ 100 sps on 30 Gbyte ATA drive (~40 days on 2 Gbyte Compact Flash)  
 Recording modes ..... Continuous; write once or ringbuffer (overwrites oldest data)  
 Continuous with STA/LTA trigger flags  
 File system ..... FAT32  
 Storage format ..... Nanometrics Store. Direct data output in MiniSEED and Nanometrics formats.

## ➤ Data retrieval

Media exchange ..... Compact Flash and ATA drives are field swappable  
 Download interfaces ... 10/100 Base-T Ethernet

## ➤ Real-time data communications

Interfaces ..... 10/100 Base-T Ethernet, RS-232 serial  
 Protocols ..... UDP/IP unicast/multicast  
 HTTP (POST and GET)  
 RS-232 serial with IP drivers

## ➤ Integrated user interface

LCD display ..... 240\*320 colour graphics display with backlight  
 Interface ..... Web browser with five button navigation  
 LED ..... System status tri-colour LED, Ethernet communications LED, Media status LED.

## ➤ Configuration

Taurus is configurable locally via the colour LCD display and onboard browser or remotely using any web browser connected to the unit. Multiple unit configuration is achieved using an optional group configuration web server. Consult factory for further information.

## ➤ Software

Operating system ..... Linux  
 Applications software ... Nanometrics next generation NAQS Server with web interface

## ➤ Connectors

Sensor connector ..... 26-pin mil circular. Primary data channels, sensor control lines, protected/switchable sensor power, digital serial sensor management interface  
 Serial/USB ..... 19-pin mil circular  
 Serial port 1; Rx, Tx, RTS, CTS, DTR, DSR, CD, RI  
 Serial port 2; Rx, Tx, RTS, CTS (data collection from serial devices)  
 USB master; Data, Pwr (5 V, 100 mA)  
 Serial device power (pass through supply voltage)  
 GPS ..... TNC, active antenna connection (3.3 V)  
 Ethernet ..... 4-pin mil circular, 10/100 Base-T  
 User SOH ..... 7-pin mil circular, 4 analog SOH inputs, SOH ref., 3.3 V @ 10 mA power  
 NMXBus ..... 4-pin mil circular, NMXbus data and power  
 Power ..... 3-pin mil circular, 9-36 VDC  
 USB ..... USB master/slave accessible behind media door

## ➤ Power

Power system ..... Protected fuseless design with configurable low power disconnect, reverse protection and short circuit protection  
 Ultra-low power mode... 650 mW @ 12 Volts. 3-channel continuous recording @ 100 sps, < 100 μsec timing precision, Compact Flash recording  
 Low power ..... 1.1 Watt @ 12 Volts; 3-channel continuous recording @ 100 sps, continuous serial data acquisition (external geodetic GPS or equivalent), < 100 μsec timing precision, internal disk or Compact Flash recording.  
 Communications mode... 1.5 Watt typical; 3-channel continuous recording @ 100 sps, < 100 μsec timing precision, real-time Ethernet or serial communications  
 Configuration ..... < 3.5 Watts. All systems operational including colour graphics display.  
 Low voltage disconnect... Software configurable

## ➤ Environmental

Operating temp. .... -20°C to +60°C base unit using Compact Flash storage  
 +5°C to +55°C base unit using 1.8" ATA disk storage  
 Storage temp. .... -40°C to +70°C  
 Humidity ..... 100 %  
 Length ..... 264 mm  
 Width ..... 147 mm  
 Depth ..... 60 mm  
 Weight ..... 1.8 Kg



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