### SPECIFICATIONS

Specifications are applicable to both TitanSMA and TitanEA unless otherwise stated.

#### ACCELEROMETER TECHNOLOGY AND PERFORMANCE

| Topology | Triaxial, horizontal-vertical |
| Feedback | Force balance with capacitive displacement transducer |
| Centering | Electronic offset zeroing via user interface |
| Full-scale Range | Electromechanically selectable range: 24 g, 42 g, 85 g, ±300 g, ±20 g, and ±200 g (normal) |
| Bandwidth | DC to 430 Hz (< 3 dB point) |
| Dynamic Range | 115 dB @ 1 Hz over 1 Hz bandwidth |
| Offset | Electromechanically zeroed to within ±0.005 g |
| Non-linearity | < 0.025% total non-linearity |
| Hysteresis | < 0.005% of full scale |
| Cross-axis Sensitivity | < 0.5% total |
| Offset Temperature | Selectable from 0.01% to 100% of full scale |
| Threshold Trigger | Dual Sample Rate |
| | A second sample rate can be selected from the sample rates above |
| | Configurable STA, LTA, LTA latching, trigger, and threshold values |
| | 0 to 100% of full scale |
| | True 24-bit ADC per channel, simultaneous sampling |

#### TIMING - GNSS & PRECISION NETWORK TIMING

| Timing System | Internal DCOX clock disciplined to selectable timing source |
| Timing Source | Select from GNSS (TitanSMA and TitanEA Master), PTP (Precision Timing Protocol), NTP or free-running |
| Timing Server | Can serve as PTP or NTP time source to other Centaur, Titan SMA/EA or Meridian |
| Timing Accuracy | < 5 ppm (GNSS Always on), < 100 ppm (GNSS duty cycled, PTP or local NTP) |
| GNSS Power | Selectable: Always on, Duty cycled, or off |

#### PHYSICAL AND ENVIRONMENTAL

| Housing | Aluminum, surface-resistant to corrosion, scratches, and chips |
| Mounting | Single bolt keyhole mount |
| Leveling | Integrated bubble level |
| | Adjustable leveling screws |
| Size | Length: 26 cm (10 in.) |
| | Width: 11.8 cm (4.6 in.) |
| | Height: 11.2 cm (4.4 in.) |
| Weight | 2.8 kg |
| Operating Temperature | -20°C to +40°C (TitanSMA: Ultra-low temperature option available. Please contact Nanometrics.) |
| Storage Temperature | -40°C to +50°C |
| Humidity | 0 to 100% |
| Weather Resistance | Rated to IP67 |

#### POWER - TitanSMA

| Supply Voltage | 9 to 36 V DC isolated input |
| Power Consumption | 2.8 W quiescent, Ethernet active (nominal) |
| Protection | Reverse-voltage and over-/under-voltage protected |
| Isolation | Self-resetting over-current protection |
| Grounding | Supply power is isolated from signal ground |
| Battery Manager | User-configurable low voltage shutdown and restart thresholds |

#### POWER-OVER-ETHERNET - TitanSMA (MASTER AND SLAVE)

| Voltage Range | 37 to 57 V DC |
| Supported Mode | Mode A and B |

#### INTERFACE

| Connectors | TitanSMA: Power (MIL-C-28432G Series 1), Ethernet (MIL-C-28432G Series 1), GPS (TNC female), USB 2.0 (type A, female) |
| | TitanEA Master: Ethernet (MIL-C-28432G Series 1), GPS (TNC female) |
| | TitanEA Slave: Ethernet (MIL-C-28432G Series 1) |
| Status LEDs | TitanSMA: Power, Ethernet, TIMING, Media, overall Status, Event notification |
| | TitanEA: Power, Ethernet, Timing, overall Status |
| | Provided via onboard web server |

#### EVENTS

| Trigger Selection | Bandpass 50 kHz to 10 MHz |
| STA/LTA Trigger | Configurable STA, LTA, LTA latching, triggering; and triggering thresholds |
| Trigger Votes | User set votes assigned by channel, transmitted via IP multicast |
| Threshold Selectable | Selectable from 0.01% to 100% of full scale |
| Event Statistics | Peak ground acceleration, velocity, displacement, 5a (3, 1, 1 Hz) |

#### COMMUNICATIONS

| Datapath | 10/100 Base-T Ethernet |
| IP Addressing | Static IP or DHCP |
| Protocols | UDP/IP (unicast/multicast), or HTTP-based (inbound or outbound streaming) |

*Specifications subject to change without notice.

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**Strong Motion Instrumentation**
TitanSMA

The TitanSMA is a strong motion accelerograph designed for high precision observational and structural engineering applications, where scientists and engineers require exceptional dynamic range over a wide frequency band.

The TitanSMA features the same sensor as the Titan Accelerometer with its low noise floor, exceptionally low hysteresis, and industry leading dynamic range. The integrated digitizer and recorder facilitate both standalone and networked free-field monitoring deployments.

EASE OF USE FEATURES INCLUDE:

- Convenient data retrieval via removable SD card or local Ethernet in MiniSEED or ASCII formats
- Continual streaming of data to a central server or retrieved on demand from the central site
- HTTP data communications, which requires only Internet website access from within the host IT network to stream continuous or event data
- Instrument configuration/control via browser interface with Ethernet connection
- LED indicators that provide quick visual instrument status
- GNSS, PTP or NTP timing

CIVIL DEFENSE APPLICATIONS

The TitanSMA provides all the necessary functionality to facilitate civil defense applications such as early warning systems and shake maps:

- Ultra-low latency configurations as low as 25 seconds
- Local real-time processing and transmission of PGA, PGV, and PGD data
- Ability to recognize P-wave events and broadcast warnings
- Network integration of multiple sensors for event triggers and voting

TitanEA

The TitanEA is a strong motion Ethernet accelerograph specifically designed for networked deployments on or in large civil structures such as nuclear reactors, multi-story buildings, bridges, and hydro-electric dams. The TitanEA features the same Titan triaxial sensor and digitizer/recorder technology as the TitanSMA.

SINGLE CABLE ETHERNET CONNECTIVITY

Deploy the TitanEA in any structure with only a single Ethernet CAT5 cable for all functions:

- Power
- Precision timing
- Data

Ethernet connectivity eliminates the need to reroute expensive analogue cables throughout a structure and provides maximum flexibility in sensor placement.

PRECISION TIME PROTOCOL (PTP TIMING)

Precision Time Protocol (PTP) provides timing accuracy of <100µs:

- No need for GNSS antennas at every sensor
- Place the accelerograph anywhere in the structure
- Time inputs provided through the single Ethernet connection

STRUCTURAL MONITORING

The TitanEA facilitates central control room monitoring of a structure, allowing operators to monitor the PGA, PGV, PGD, and SA of all sensors in the network, in real-time, on a convenient display.

Each sensor in the network can be accessed independently using any mobile device with Internet access. Structural engineers can quickly view instrument status and events anywhere, anytime.
The TitanSMA is a strong motion accelerograph designed for high precision observational and structural engineering applications, where scientists and engineers require exceptional dynamic range over a wide frequency band.

The TitanSMA features the same sensor as the Titan Accelerometer with its low noise floor, exceptionally low hysteresis, and industry leading dynamic range. The integrated digitizer and recorder facilitate both standalone and networked free-field monitoring deployments.

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**ACCELEROMETER TECHNOLOGY AND PERFORMANCE**

- **Topography**: Trietal, horizontal-vertical
- **Feedback**: Force balance with capacitive displacement transducer
- **Centering**: Electronic offset arming via user interface
- **Full-scale Range**: Electroneally selectable range: ±4 g, ±2 g, ±0.5 g, ±0.25 g, and ±0.125 g (nominal)
- **Bandwidth**: DC to 430 Hz (-3 dB point)
- **Dynamic Range (Integrated RMS)**: 65 dB, 3 to 30 Hz
- **Offset**: Electroneally armed to within ±0.005 g
- **Non-linearity**: < 0.5% total non-linearity
- **Hysteresis**: < 0.005% of full scale
- **Cross-axis Sensitivity**: < 0.015% total non-linearity
- **Offset Temperature**: Electroneally zeroed to within ±0.005 g/°C, typical

**DIGITIZER PERFORMANCE & CAPABILITIES**

- **Type**: True 24-bit ADC per channel, simultaneous sampling
- **Anti-alias Filters**: 140 dB (linear phase) or 120 dB (minimum phase) at Nyquist frequency, 0 dB at Nyquist
- **Filter Type**: Linear phase (contact Nanometrics for other options)
- **Dynamic Range**: 142 dB @ 100 sps, 135 dB @ 500 sps (full-scale peak to RMS shorted-input noise)
- **Sample Rates**: 1, 2, 5, 10, 20, 40, 50, 80, 100, 200, 250, 500, 1000, 2000 sps
- **Dual Sample Rate**: A second sample rate can be selected from the sample rates above
- **Sensitivity**: 2, 4, 8, 16, 32, and 64 digitizer counts per µg, ±1%
- **Digital Filters**: User-configurable low-pass and high-pass 1st to 5th order, 0.1 mHz to Nyquist
- **SNR**: 142 dB @ 100 sps, 135 dB @ 500 sps
- **Dynamic Range**: 166 dB @ 1 Hz over 1 Hz bandwidth
- **Non-linearity**: < 0.5% total
- **Offset**: Electronically zeroed to within ±0.005 g, ±0.25 g, ±0.125 g (nominal), ±2 g/°C, typical

**TIMING - GNSS & PRECISION NETWORK TIMING**

- **Timing System**: Internal DCXO clock disciplined to selectable timing source
- **Timing Source**: Select from GNSS (TitanSMA and TitanEA Master), PTP (Precision Timing Protocol), NTP or free-running
- **Timing Server**: Can serve as PTP or NTP time to other Centaur, TitanSMA/EA or Meridian
- **Timing Accuracy**: < 5 µsec (GNSS Always on), < 100 µsec (GNSS duty cycled, PTP or local NTP)
- **Error Budget**: < 0.005% of full scale

**DATA RECORDING AND RETRIEVAL**

- **Internal Memory**: 6 GB flash memory
- **Removable Media**: SD card up to 64 GB (TitanSMA)
- **Data Retrieval**: Direct download via Ethernet

**PHYSICAL AND ENVIRONMENTAL**

- **Housing**: Aluminum, surface-resistant to corrosion, scratches, and chips
- **Mounting**: Single bolt keyhole mount
- **Leveling**: Integrated bubble level
- **Size**: Length: 26 cm (10 in.), Width: 11.8 cm (4.6 in.), Height: 11.8 cm (4.6 in.)
- **Weight**: 2.6 kg
- **Operating Temperature**: -20°C to +40°C (TitanSMA), -40°C to +70°C (TitanEA)
- **Humidity**: 0 to 100%
- **Weather Resistance**: Rated to IP67

**POWER - TitanSMA**

- **Supply Voltage**: 9 to 36 V DC isolated input
- **Power Consumption**: 2.8 W quiescent, Ethernet active (nominal)
- **Protection**: Reverse-voltage and over-under-voltage protected, self-resetting over-current protection
- **Isolation**: Supply power is isolated from signal ground
- **Battery Manager**: User-configurable low voltage shutdown and restart thresholds

**POWER-OVER-ETHERNET - TitanEA (MASTER AND SLAVE)**

- **Voltage Range**: 37 to 57 V DC
- **Supported Mode**: Mode A and B

**INTERFACE**

- **Connectors**: TitanSMA: Power, Ethernet, Timing, Media, overall Status, Event notification
- **TitanEA: Power, Ethernet, Timing, Media, overall Status, Event notification
- **TitanEA Slave: Ethernet (type A, female)
- **Graphical User Interface**: Provided via onboard web server
- **Status LEDs**: Used for state-of-health and waveform monitoring, viewing and downloading events, calibration, configuration, and maintenance

**COMMUNICATIONS**

- **IP Addressing**: Static IP or DHCP
- **Protocols**: UDP/IP (unicast/multicast), or HTTP-based (inbound or outbound streaming)

**Strong Motion Instrumentation**

250 Herzberg Road, Kanata, Ontario, Canada, K2K 2A1
613-592-6776 | Fax: 613-592-5929
www.nanometrics.ca | sales_mkt@nanometrics.ca