

PERFORMANCE
DEPENDABILITY
AVAILABILITY



BROADBAND SEISMOMETER
Trillium



Nanometrics
SCIENTIFIC INSTRUMENTS

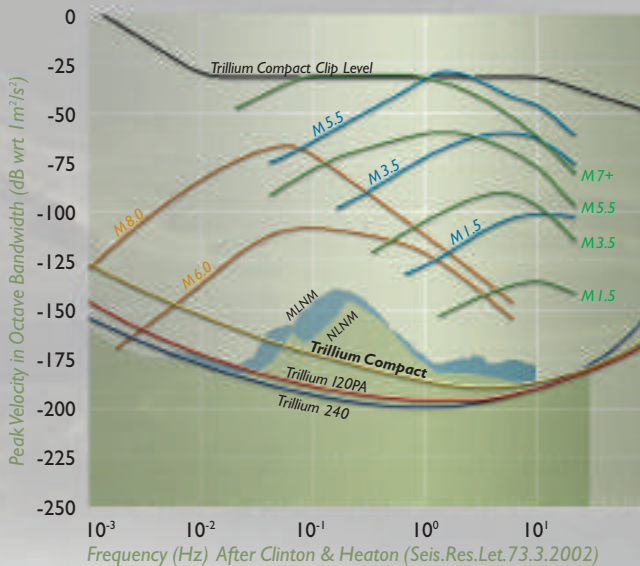
The Earthquake Spectrum

- Local events ~10 km Several seconds to 30 Hz
- Regional ~100 km 30 seconds to 10 Hz
- Teleseismic ~3000 km 3600 seconds to 2 seconds

Note: Sensor noise floors and earth noise models have been converted to equivalent peak amplitudes using a full octave bandwidth assuming Gaussian distribution and 95% probability.

References

- New Low-Noise Model (NLNM)** from Peterson (1993)
Observation and Modeling of Seismic Background Noise
- PDF Mode Low-Noise Model (MLNM)** from McNamara and Buland (2004) Ambient Noise Levels in the Continental United States
- Event Magnitudes** from Clinton and Heaton (2002)
Potential Advantages of a Strong Motion Velocity Meter Over a Strong Motion Accelerometer



PERFORMANCE

The Trillium's innovative patented design employs simple yet elegant mechanics with fewer parts, delivering exceptional performance in the harshest of environments.

DEPENDABILITY

The robustness and reliability of the mechanical suspension system is well-proven. This design ensures that every seismometer "arrives alive," reducing costs and contributing to project success.

AVAILABILITY

Trillium seismometers are designed for ease of manufacture and are produced in large volumes to meet your delivery requirements. Whether you select the Trillium 240, 120PA or Trillium Compact, we guarantee on-time delivery, allowing you to plan with confidence.



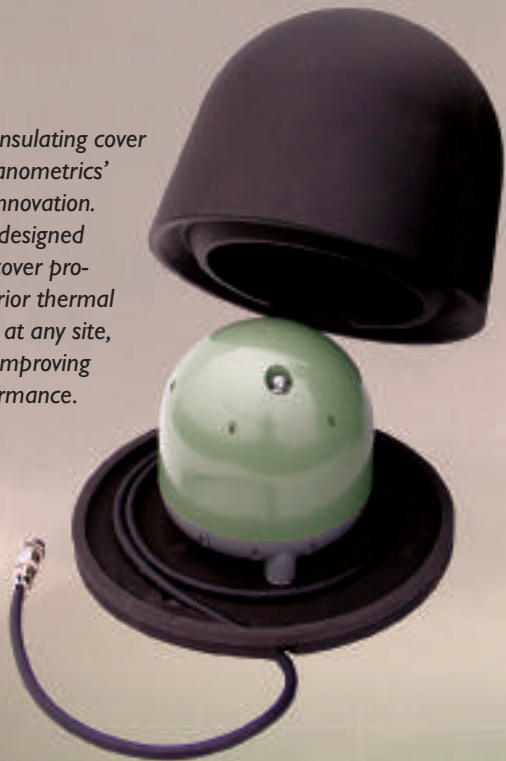
BROADBAND SEISMOMETER
Trillium

Nanometrics' Trillium seismometers are ideal for weak motion earthquake research at local, regional and teleseismic distances. Every Trillium seismometer is built around a classic symmetric triaxial force feedback design with axis orientation in UVW. A single axis design for all components ensures identical response. An innovative field-proven suspension system eliminates the need for a mass lock, significantly simplifying the internal mechanics and increasing overall robustness and reliability. Low power consumption and improved temperature stability are hallmarks of the Trillium seismometers, making them ideal for portable and fixed network applications.



Nanometrics
SEISMOLOGICAL INSTRUMENTS

The Trillium insulating cover continues Nanometrics' tradition of innovation. The custom-designed form-fitting cover provides a superior thermal environment at any site, significantly improving sensor performance.



Trillium 240



The Trillium 240 is a very broadband seismometer capable of sensing the full spectra of events. The sensor is exceptionally quiet, having an instrument self-noise below the NLNM from 100 seconds to 10Hz. Excellent performance is maintained out to 1000 seconds and beyond, allowing the instrument to take advantage of quiet sites, recording more of the earthquake spectra at longer periods.

The Trillium 240 is simple to deploy and operate. Nanometrics' field-proven mass suspension system needs no mass lock, so there is nothing to reconfigure or forget before shipping. Once on site, an integrated bubble level and truly accessible leveling feet allow for quick deployment in vault or post-hole installations. A base-mounted connector simplifies cable routing and reduces cable-induced noise.

Local or remote, fast, one-touch mass centering ensures the masses are centered fast and reliably, first time, every time. Mass position outputs and a mass centering control line are accessible via the single, base-mounted connector.

B E N E F I T S

- *Sophisticated internal design attenuates temperature effects resulting in exceptional performance to beyond 1000 seconds*
- *Switchable XYZIUVW output to provide independent calibration of sensor axes*
- *Simple operation with no mass lock and fast "one-touch" mass centering*
- *Base-mounted connector simplifies cable strain relief, minimizing strain noise*



Nanometrics' new ultra-flexible seismometer cables improve sensor performance by reducing strain-induced noise.



The highly successful Trillium 120 is now available with motorized mass centering. This new version maintains exceptional performance over a wide temperature range with the added benefit of fast "one-touch" mass centering. Motorized mass centering simplifies seismometer installation and gives customers the option of remotely re-centering the masses via a telemetry connection.

The Trillium 120PA is an exceptional seismometer having an instrument self-noise within 4dB of the NLNM at 100 seconds and below the NLNM up to 10Hz.

This instrument incorporates the same symmetric triaxial design and suspension system as the highly successful Trillium 240. The robustness and reliability of the mechanical suspension is well-proven; with over 1000 Trillium units operating in the field, there have been no mechanical failures.



Trillium 120PA

B E N E F I T S

- *Motorized mass centering for rapid deployment in harsh environments*
- *Very broadband performance from a portable low-power seismometer*
- *Simple operation with no mass lock to forget*
- *Wide temperature operation +/-45°C without re-centering*
- *Switchable XYZ/UVW output to provide independent calibration of sensor axes*

N Nanometrics
Trillium 120PA ASM14214R1 SN: 000780



Optional transport/ installation case provides shock protection and serves as a thermal insulating sensor cover, providing a consistent operational environment and ensuring the highest quality data.



Trillium Compact combines the superior performance of a broadband seismometer with the installation convenience of a rugged geophone. The instrument incorporates a symmetric triaxial force feedback sensor design with a response flat to velocity from 120 seconds to 100 Hz.

Compact is extremely simple to deploy with no mass lock and no mass centering required. The utility of the unit is further enhanced by an impressively low power consumption of just 160 mW.

The Trillium Compact incorporates a web server and serial interface supporting the Nanometrics' *Discovery* protocol. When connected via a Nanometrics digitiser, Compact announces its availability and reports serial number and response information. This unique feature facilitates the automatic asset and instrument response management provided in Nanometrics systems.



Trillium Compact



BENEFITS

- *Low-noise broadband seismometer performance combined with the handling and installation convenience of a geophone*
- *Ultra-low power operation (160 mW) means smaller power systems and higher station reliability*
- *Exceptionally small size significantly reduces time and effort required for site preparation and installation*
- *Quick and easy to deploy with no mass lock, no mass centering and wide tilt range*
- *Integrated web server facilitates instrument management*



Nanometrics
SEISMOLOGICAL INSTRUMENTS

Technical Specifications

Specifications subject to change without notice.

	Trillium 240	Trillium 120PA	Trillium Compact
TECHNOLOGY			
Topology	Symmetric triaxial	Symmetric triaxial	Symmetric triaxial
Feedback	Force balance with capacitive transducer	Force balance with capacitive transducer	Force balance with capacitive transducer
Mass centering	Automatic motorized re-centering, can be remotely initiated	Automatic motorized re-centering, can be remotely initiated	Not required
Leveling	Integrated bubble level Adjustable locking leveling feet	Integrated bubble level Adjustable locking leveling feet	Integrated bubble level Adjustable locking leveling feet
Alignment	Vertical scribe marks (E/W) Holes for 5/16" alignment rod (N/S)	Vertical scribe marks (N/S) Precision guide in cover for straight-edge, line or laser level Holes for 5/16" alignment (E/W)	Vertical scribe marks (N/S) Precision guide in cover for straight-edge, line or laser level
PERFORMANCE			
Self-noise	Below NLNM 100 s to 10 Hz (See graph)	(See graph)	(See graph)
Sensitivity	1200 V-s/m nominal $\pm 0.5\%$ precision Contact factory for other options	1200 V-s/m nominal $\pm 0.5\%$ precision Contact factory for other options	750 V-s/m $\pm 0.5\%$ Off-axis Sensitivity: 0.5%
Bandwidth	-3 dB points at 240 s and 200 Hz	-3 dB points at 120 s and 145 Hz	-3 dB points 120 s to 100 Hz
Clip level	>15 mm/s up to 1.5 Hz	>15 mm/s up to 1.5 Hz	26 mm/s from 0.1 Hz to 10 Hz
Temperature	$\pm 10^\circ\text{C}$ without motorized re-centering	$\pm 45^\circ\text{C}$ without motorized re-centering	
INTERFACE			
Connector	19-pin MIL-C-28642	19-pin MIL-C-28642	14-pin, shell size 12, MIL-C-26482 Series I, top mounted
Velocity output	40V peak-to-peak differential Selectable XYZ or UVW mode	40V peak-to-peak differential Selectable XYZ or UVW mode	40V peak-to-peak differential Selectable XYZ or UVW mode
Mass position	Three independent voltage outputs	Three independent voltage outputs	Single voltage output representing maximum mass position 3 channel mass positions available through serial port
Calibration input	Single voltage input with one active-high control signal per channel Remote calibration in XYZ or UVW mode	Single voltage input with one active-high control signal per channel Remote calibration in XYZ or UVW mode	Single voltage input calibrates all three channels Remote calibration in XYZ or UVW mode Individual channel selection by serial port
Serial port	For enhanced instrument control and status: <ul style="list-style-type: none"> • Mass center, UVW/XYZ mode, short/long period mode, firmware updates • Temperature, mass position, instrument status, serial number 	For enhanced instrument control and status: <ul style="list-style-type: none"> • Mass center, UVW/XYZ mode, short/long period mode, firmware updates • Temperature, mass position, instrument status, serial number 	For enhanced instrument control and status: <ul style="list-style-type: none"> • UVW/XYZ mode, short/long period mode, firmware updates • Temperature, mass position, instrument status, serial number
POWER			
Supply voltage	9 to 36 volts DC isolated inputs	9 to 36 volts DC isolated inputs	9 to 36 volts DC isolated inputs
Power consumption	650 mW typical at 15 volts	620 mW typical at 15 volts	< 160mW typical at 15 volts
Protection	Reverse-voltage protection Auto-resettable over-current protection (no fuse)	Reverse-voltage protection Auto-resettable over-current protection (no fuse)	Reverse-voltage and over-voltage protected Self-resetting over-current protection
PHYSICAL			
Diameter	25 cm	21 cm	9 cm
Height	26.5 cm without leveling feet 29.1 cm ± 0.5 cm depending on leveling feet extension	21.4 cm ± 0.5 cm depending on leveling feet extension	12.8 cm including leveling feet and connector
Weight	14 kg	7.5 Kg	1.2 kg
Handling	Detachable carrying handle on lid	Detachable carrying handle on lid	Rugged carrying case doubles as insulating cover for sensor installation
ENVIRONMENTAL			
Operating temp.	-20 to +50°C	-20 to +50°C	-40 to +60°C
Humidity	0 to 100 %	0 to 100 %	0 to 100 %
Shock	20 g half sine, 5 ms without damage, 6 axes No mass lock required for transport	20 g half sine, 5 ms without damage, 6 axes No mass lock required for transport	100 g half sine, 5 ms without damage, 6 axes No mass lock required for transport
Packaging	Rated to IP68 and NEMA6P for outdoor use	Rated to IP68 and NEMA6P for outdoor use	Rated to IP68 and NEMA6P for outdoor use