EndRun
TECHNOLOGIES
"Smarter Timing Solutions"

Ninja *Precision Timing Module*

GPS-Synchronized, Portable Time and Frequency Standard

Ninja is a compact, high-performance time and frequency standard optimized for size, weight, and power (SWaP). This cost-effective, highly integrated module leverages the proven core of the industry-leading Meridian II Precision Time-Base. Nine optional, user configurable, time and frequency outputs and a standard NTP server are supported. Ninja is DC powered, consumes less than 8 watts and is easily integrated into portable, battery powered systems. An external AC/DC supply is available for standalone applications.

GPS Timing and Frequency Control
At the core of Ninja is EndRun's secure GPS Timing Receiver that provides exceptional Coordinated Universal Time (UTC) accuracy (<10 nanoseconds RMS with calibration option). An advanced timing and adaptive 3rd-order frequency-control algorithm provides high stability outputs (<6 x 10^{-14} averaged 100k seconds). The Real-Time Ionospheric Corrections (RTIC) option provides the ultimate in stability and accuracy (<4 x 10^{-14} averaged 100k seconds, <2.5 nanoseconds standard deviation). Ninja with the RTIC option exceeds the stability performance of a standard cesium atomic frequency reference at all observation intervals.

Inputs and Outputs
Standard I/O includes the GPS receiver antenna input, Ethernet port, RS-232 console port, and 9-18 VDC power input. Ninja also provides up to nine optional outputs. It's easy to tailor the unit to meet your requirements. Optional output signals include IRIG-B time code, low-phase noise 5 or 10MHz, alarm and user-selectable pulse rates that include a trigger function.

Secure Network Interface
To synchronize network clients, Ninja provides a robust Network Time Protocol (NTP) server and optional IEEE-1588 Precision Time Protocol (PTP) Grandmaster. The optional Synchronous Ethernet (SyncE) provides physical layer frequency synchronization with the performance of the Ninja reference oscillator. The IPv4/IPv6 management interface supports SSH, SNMPv3 and HTTPs. Ninja is also security-hardened to meet the highest Information Assurance (IA) requirements.

Reference Oscillators
We design and manufacture our own OCXO oscillators to achieve performance and quality not found elsewhere. The proprietary design uses a 3rd-overtone, SC-cut crystal built with the highest-quality components and is subjected to rigorous testing to guarantee industry-leading performance. Ninja is available with a High-Performance TCXO or a Medium-Stability, High-Stability, or Ultra-Stable OCXO. The Ultra-Low Phase Noise option enables up to four spectrally-pure 10 MHz outputs with phase noise less than -110 dBc at a 1 Hz carrier offset. 5 MHz outputs are available with any of the OCXO options.

GPS Antenna and Accessories
A GPS Antenna Kit is available and required with Ninja consisting of an antenna, 50 ft cable, SMA to TNC adapter, mounting pipe, and clamps. Extended cable lengths, lightning arrestors, in-line amplifiers, splitters, and fiber optic links are also available.

High Reliability and Two-Year Warranty
Ninja uses EndRun's power-efficient, fanless design and thermal packaging with an estimated MTBF of over 20 years. It's made in America, backed by a two-year warranty, includes a 60-day money-back guarantee and free technical support for life.

FEATURES
- Timing accuracy: <25 nanoseconds RMS to UTC(USNO). Optional calibration for <10 nanoseconds.
- Frequency accuracy: <6 x 10^{-14}.
- Short-term stability: <6 x 10^{-13} at 1 second (US-OCXO option).
- No frequency steps - guaranteed.
- Ultra-low 5/10MHz phase noise option: < -110 dBc at 1 Hz.
- Up to nine optional outputs: 1PPS, PPO, 5/10 MHz, time code (AM and DC) and alarm.
- Real-Time Ionospheric Corrections for ultimate stability & accuracy (optional).
- 10/100Base-T Ethernet port.
- Network Time Protocol (NTP).
- Optional IEEE-1588/PTP
- Optional Sync-E with SSM
- GPS almanac/ephemeris data, YUMA/RINEX formats.
- RINEX raw measurements for Precise Point Positioning.
- Free technical support and software upgrades.
- 60-day money-back guarantee.

BENEFITS
- Portable time standard traceable to UTC(USNO).
- Frequency standard with atomic clock stability.
- Ultra low phase noise frequency reference for communication systems and signal intelligence.
- Optimized SWaP solution easily integrated into a 1U host system.

Ninja Precision Timing Module
Specifications

GPS RECEIVER
- L1 Band - 1575.42 MHz. 12 Channels, C/A Code.
- 15 dB minimum gain at receiver input.
- Static and dynamic (shipboard) operating modes.
- Timing Receiver Autonomous Integrity Monitoring (TRAIM).
- SMA connector (female), $Zin = 50\Omega$. 5 VDC to antenna.

TIME TO LOCK
- <5 minutes, typical (HP-TCXO). <10 minutes, typical (OCXO).

TIMING CHARACTERISTICS
The following accuracy and stability specifications assume a stationary platform, 4 satellite lock, and antenna installation with a full view-of-the-sky.
- Accuracy: <25 nanoseconds RMS to UTC(USNO) locked*. <10 nsecs RMS with calibration option.
- Stability: TDEV <10 ns @ τ <10^5 secs, $\sigma\gamma(\tau)$ <6×10^{-14} @ τ=10^5 secs.
- Stability: TDEV <2 ns @ τ <10^5 secs, $\sigma\gamma(\tau)$ <4×10^{-14} @ τ=10^5 secs with the optional Real-Time Ionospheric Corrections (RTIC).
- User Calibration: +/- 500 us, 1 ns resolution.
- * See GPS-UTC Timing Specifications for details.

REFERENCE OSCILLATOR
Oscillator options are available to meet your short-term stability at 1 second (STS), phase noise at 1 Hz offsets in dBc/Hz (L(f)) , ageing rate/year, and temperature stability for 0-70° C.

OSCILLATOR	STS (1 sec)	L(f) 10/5 MHz	AGE RATE	TEMP STAB
HP-TCXO (standard)	1×10^{-10}	-70	1×10^{-6}	1.0×10^{-6}
Medium-Stability OCXO	3×10^{-12}	-95/-100	3×10^{-8}	4×10^{-9}
High-Stability OCXO	1×10^{-12}	-105/-110	3×10^{-8}	1×10^{-9}
Ultra-Stable OCXO	6×10^{-13}	-110/-115	3×10^{-8}	5×10^{-10}

See Oscillator Options datasheet for more information.

OPTIONAL OUTPUTS (A-I)

A,B,C,D - Low-Phase Noise or Sine Wave (5 MHz, 10 MHz)
Ninja can provide up to four spectrally-pure frequency signals with high port-to-port isolation. The low phase noise level and stability is dependent on the Ninja's reference oscillator.
- Signal: 5MHz (OCXO only), or 10 MHz @ +13dBm.

E - 1PPS
- Signal: TTL square wave into 50Ω. Pulse width: 20 usec, 1 ms, 100 ms or 500 ms.

F - Analog Time Code
- Signal: Amplitude-modulated (AM), 3:1 ratio, 1 kHz carrier, 1 Vrms into 50 ohms.
- Formats: IRIG-B120 (IEEE-1344/C37.118-2005), 122, 123; NASA-36, or 2137.

G,H,I - Programmable Pulse Output / DC Shift Time Code / Alarm
Ninja supports up to three Programmable Pulse Outputs/DC Shift Time Code outputs and an Alarm.
- Signal: TTL square wave into 50Ω except 1PPS which is 20 usec, 1 ms, 100 ms or 500 ms.
- User-Selectable Rates: 1, 10, 100, 1k, 10k, 100k, 1M, 5M, 10M PPS, 1PPM (pulse per 60 seconds), 1PP2S (pulse per 2 seconds), and DC Shift Time Code.
- Each PPO includes a TriggerPPO function that allows you to program the time for a pulse to occur.
- DC Shift Time Code: IRIG-B 000(IEEE-1344/C37.118-2005), 002, 003; NASA 36, or 2137.
- Alarm: Open Collector, 40 VDC/100 mA max. High impedance in alarm state. (Output I only).

SERIAL I/O PORT
- RS-232 serial I/O on DB9M jack for secure, local terminal access.
- Parameters fixed at 19200 baud, 8 data bits, no parity, 1 stop bit.

STATUS INDICATORS
- Sync LED: Amber LED pulses to indicate lock status.
- Alarm LED: Red LED indicates a serious fault condition.
- Network LED: Green LED flashes to indicate network activity.

NETWORK SYNCHRONIZATION ACCURACY
- NTP Timestamp Accuracy to reference clock: < 10 microseconds @ 2,500 packets/second.
- Optional PTP Timestamp Accuracy to reference clock: 8 nanoseconds.

NETWORK I/O
- 10/100Base-T Ethernet. RJ-45 jack.

NETWORK PROTOCOLS
- IPv4/IPv6.
- NTP v3, v4, SNTP, MD5/SHA/autokey authentication, broadcast/multicast mode.
- SSH client/server with "secure copy" utility, SCP.
- SNMP v1, v2c, v3 with Enterprise MIB.
- HTTPS (Web Interface).
- TELNET client/server.
- FTP and DHCP clients.
- SYSLOG.
- Optional PTP/IEEE-1588-2008 (v2) Grandmaster.
- Optional SyncE with Sync Status Messaging (SSM). G.8261, G.8262, G.8264 compliant.

DC POWER
- 9-18 VDC, 1 amp / 8 watts maximum.
- Connector: Molex Micro-Fit 3.0 2-pin jack.
  (Mate: Molex 43025-0200/20-24 AWG Terminal: Molex 43030-0008.)

SIZE
- Chassis: 1.5"H x 5.3"W x 4.44"D.
- Weight: < 1 pounds (0.45 kg).

ENVIRONMENTAL
- Operating Temperature/Humidity: 0° to +50° C / 5% to 90% RH, non-condensing.
- Storage Temperature/Humidity: -40° to +85° C / 5% to 95% RH, non-condensing.

IEEE-1588/PTP GRANDMASTER OPTION
- IEEE-1588–2008 (v2) with 8-ns timestamp resolution.
- Default or IEEE-802.1AS Profile.
- Transport: IPv4. Layer-2 (L2) and Layer-3 (L3).
- Delay Mechanism: E2E or P2P.
- Transmission Mode: Multicast or Hybrid.
- Sync Interval: 1, 2, 4, 8, 16, 32, 64 or 128 packets/second.
- Announce Interval: 1, 2, 4, 8 or 16 seconds.

ANTENNA KIT OPTION
- 40 dB gain LNA with band–pass filter for out-of-band interference rejection.
- Rugged, all-weather housing capable of operation over -40° to +85°C.
- 50' low-loss RG-59 cable. Optional lengths up to 1000' with preamplifiers.
- Mounting kit: 18" long, 3⁄4" aluminum pipe with clamps.
- TNC connector (female), $Zout = 50\Omega$. 5 VDC input.
- Antenna: 3.25"H x 3"diameter.

OTHER OPTIONS
- OCXO Oscillators (Medium-Stability, High-Stability, or Ultra-Stable).
- Low-Phase-Noise or Sine Wave Outputs (5 MHz, 10 MHz).
- Pulse Rate Outputs (1, 10, 100, 1k, 10k, 100k, 1M, 5M, 10M PPS; 1PP2S, 1PPM, Trigger).
- Time Code AM/DC Output (IRIG-B, NASA-36, 2137).
- 1PPS Output.
- 10 Nanosecond Accuracy.
- Real-Time Ionospheric Corrections (RTIC).
- Open-Collector Alarm Output.
- External AC/DC Power Supply.
- SyncE with Sync Status Messaging (SSM). G.8261, G.8262, G.8264 compliant.