

# 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 3<sup>rd</sup>-order frequency-control algorithm provides high stability outputs (<6 x 10<sup>-14</sup> averaged 100k seconds). The [Real-Time Ionospheric Corrections \(RTIC\)](#) option provides the ultimate in stability and accuracy (<4 x 10<sup>-14</sup> 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.



management interface supports SSH, SNMPv3 and HTTPS. It's 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 3<sup>rd</sup>-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<sup>-14</sup>.
- Short-term stability: <6 x 10<sup>-13</sup> 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: 1 PPS, 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).
- IEEE-1588 PTP Grandmaster
- 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.

### 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 IPv4/IPv6

### 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.



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## 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),  $Z_{in} = 50\Omega$ . 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 @  $\tau < 10^5$  secs,  $\sigma_y(\tau) < 6 \times 10^{-14}$  @  $\tau = 10^5$  secs.
- Stability: TDEV <2 ns @  $\tau < 10^5$  secs,  $\sigma_y(\tau) < 4 \times 10^{-14}$  @  $\tau = 10^5$  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)	$1 \times 10^{-10}$	-70	$1 \times 10^{-6}$	$1.0 \times 10^{-6}$
Medium-Stability OCXO	$3 \times 10^{-12}$	-95/-100	$3 \times 10^{-8}$	$4 \times 10^{-9}$
High-Stability OCXO	$1 \times 10^{-12}$	-105/-110	$3 \times 10^{-8}$	$1 \times 10^{-9}$
Ultra-Stable OCXO	$6 \times 10^{-13}$	-110/-115	$3 \times 10^{-8}$	$5 \times 10^{-10}$

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  $50\Omega$ . 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  $50\Omega$  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/autkey 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.
- PTP/IEEE-1588-2008 (v2) Grandmaster Option.

### IEEE-1588/PTP GRANDMASTER OPTION

- IEEE-1588-2008 (v2) with 8-ns hardware timestamping.
- Default or IEEE-802.1AS Profile.
- Transport: IPv4. Layer-2 (L2) or 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.

### 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 4.44"W x 5.3"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.

### 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),  $Z_{out} = 50\Omega$ . 5 VDC input.
- Antenna: 3.25"H x 3" diameter.

### 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.
- IEEE-1588/PTP Grandmaster.
- GPS Antenna Kit

