

# Meridian II Precision TimeBase

## GPS-Synchronized, Modular Time and Frequency Standard

**The Meridian II Precision TimeBase is a high-performance, modular, network-centric, time and frequency standard that generates signals with unparalleled accuracy, stability and spectral purity.** The second-generation Meridian II combines our state-of-the-art time and frequency technology with a powerful network timing packet engine to synchronize virtually any stand-alone or network-connected system.

The modular architecture allows you to configure Meridian II to meet your requirements of today, and add option modules in the field to meet future needs. Meridian II's high-reliability design and trouble-free operation, combined with our efficient sales and support, provides the lowest total cost of ownership in the industry. Meridian II supports mission-critical operations in a wide range of government and commercial applications including telecommunications, satellite communications, digital video broadcast, simulcast radio, test range, test and measurement, calibration labs, power utilities and many more.



### GPS Timing and Frequency Control

At the core of Meridian II is an EndRun GPS Receiver optimized to provide an industry-best Coordinated Universal Time (UTC) accuracy (<10 nanoseconds RMS) and stability (<6 parts in  $10^{-14}$  averaged 1 day). For ultimate performance, the innovative **Real-Time Ionospheric Corrections (RTIC)** option measures and removes the ionospheric delay that meets or exceeds the performance of L1/L2 solutions.

### User Configurable, Modular Design

The system's modularity supports a suite of

field installable, plug-and-play option modules. Up to five modules can be accommodated, providing up to 23 time and frequency outputs in an efficient 1U chassis. Available output signals include IRIG-B time code, 1/5/10 MHz, ultra-low phase noise, telecom T1/E1, Direct Digital Synthesizer (DDS) from 1-10 MPPS, pulse rates, ASCII time messages, and more.

### Security Hardened - Dual Gigabit Network Interface

Meridian II introduces dual, security-hardened, gigabit Ethernet ports that provide a high-capacity Network Time Protocol (NTP) server and optional IEEE-1588 Precision Time Protocol (PTP) Grandmaster to synchronize clients on two networks. The IPv4/IPv6 management interface is security hardened to meet the highest Information Assurance (IA) requirements.

### Reference Oscillators

A variety of top-quality quartz and rubidium oscillators are available to handle the full range of holdover, phase noise and short-term stability requirements. 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 subjected to rigorous testing to guarantee industry-leading performance. The Ultra-Low Phase Noise option enables spectrally-pure 5 and 10 MHz outputs with phase noise less than -115 dBc and -110 dBc, respectively, at a 1 Hz carrier offset.

### High Reliability and Two-Year Warranty

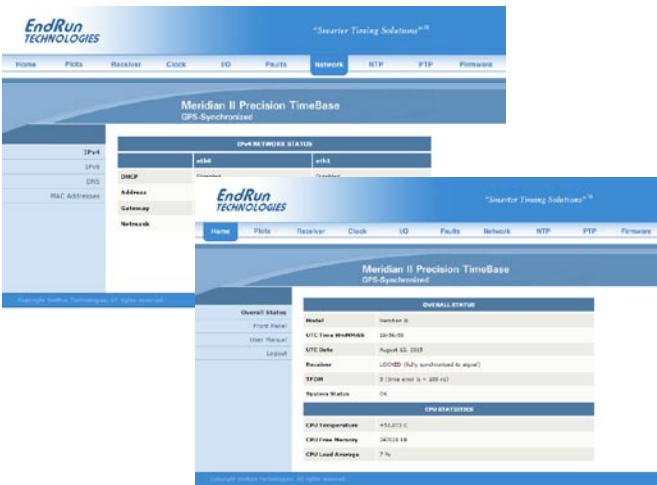
Meridian II uses EndRun's power-efficient, fanless design and thermal packaging with an estimated MTBF of over 25 years (16 years with Rubidium). The system is made in America, backed by a two-year warranty, a 60-day money-back guarantee, and supported by EndRun's top notch technical support team free of charge!

### FEATURES

- Timing accuracy: <10 nanoseconds RMS to UTC (USNO).
- Real-Time Ionospheric Corrections for L1/L2 performance (optional).
- Frequency accuracy: <6 x  $10^{-14}$ .
- No frequency steps - guaranteed.
- Ultra-low phase noise 5 & 10 MHz output options.
- Short-term stability <5.1 x  $10^{-13}$  at 1 second (optional).
- Dual-gigabit Ethernet ports.
- NTP Stratum 1 Server.
- IEEE-1588 PTP Grandmaster (optional).
- IRIG-B time code and 1 PPS outputs.
- Modular, plug-and-play design with up to 23 output signals.
- Telecom T1/E1 output option.
- Cesium Control Module option disciplines 5071A cesium to UTC.
- GPS almanac/ephemeris data, YUMA/RINEX formats.
- Free technical support and software upgrades.
- 60-day money-back guarantee.

### BENEFITS

- Time standard traceable to UTC (USNO).
- Frequency standard with atomic clock stability.
- Ultra low phase noise frequency reference for communication systems.
- Master Clock with time code generator.

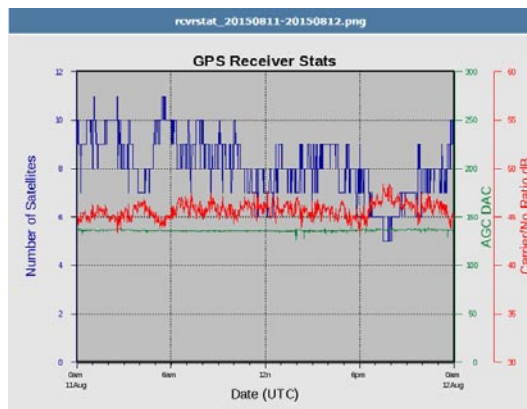


Secure Web Interface (HTTPS)  
for System Monitoring & Firmware Upgrades

## Web Interface

The Meridian II web interface is designed with security in mind, so its use is restricted to monitoring status, alarms, configuration settings, and installing firmware upgrades. Configuration and control is conducted via the network or serial command line interface. Firmware upgrades are enabled only after an authentication process. In addition, the web interface can be completely disabled for those who need the highest level of security.

The web page tabbed panels offer quick access to information about the GPS Receiver, Clock, I/O, Faults, NTP, PTP and the Firmware. Firmware upgrades are easy with the point & click upgrade process. Also, a link to the resident User Manual is available on the Home page.



Charts available for GPS, Oscillator, NTP and CPU statistics

## Measurement Statistics and Charting

Real-time charting of GPS, Oscillator, NTP and CPU statistics are available via the Web Interface. Measurements are continuously computed and displayed in real-time with daily and weekly charts. The charts are automatically archived into month and year directories that remain resident for up to ten years.

The GPS chart provides a valuable, quick reference to assess the current and historical status of the GPS link to insure the Meridian II is and was performing to specification. The

number of satellites in view, carrier-to-noise ratio, and the automatic-gain-control (AGC) are key metrics that reflect the quality and operation of the GPS receiver. The Oscillator chart shows the internal chassis temperature, oscillator electronic frequency control value and the offset of the receiver subsystem to the GPS reference. It is useful for verifying that the unit was locked to the GPS system at a certain time. The NTP statistics chart shows the NTP packets sent, packet rate and the accuracy of the NTP/System Time relative to UTC. The CPU statistics chart shows the free memory, processor load and CPU temperature.

## Security-Hardened Network Interface

Extra care has been taken with Meridian II to "harden" it against network attacks and achieve the highest level of information assurance. It was developed with the latest version of the Linux operating system and security protocols. The Linux distribution is based on Slackware, a distribution that is famed for its security.

In a purpose-built appliance like Meridian II, there are only a few settings that need to be made that are typically set only once in the lifetime of the product. Since this is a set-it-and-forget-it box, we have eliminated all extraneous protocols/services in order to minimize exposure to security holes. Configuration is primarily performed via the secure SSH interface although Telnet (if enabled) and the serial port are also available. Monitoring of system status and alarm information is easily accomplished via the secure HTTPS webpage interface, command line interface (SSH, Telnet, serial port), or SNMP. Security-conscious users can further strengthen the network interface by disabling protocols (e.g. HTTPS, Telnet) and restrict network access to specific hosts.

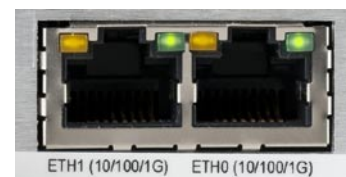
We designed Meridian II in such a way that it is not necessary for you to know Linux to use the product. For those users who are familiar with Linux, we make it easy for you to customize various aspects of the operation to your requirements.

## Full User Control

Configuration and control is accomplished through either the front-panel keypad/display, network or serial ports. A handful of simple commands and interactive configuration wizards are provided for you to setup and control the product. Online help for all of the Meridian II-specific commands is available, as well as the standard help (manual) files for all of the available Linux commands.

## Dual Gigabit Ports

Two independent 10/100/1000 Base-T Ethernet ports are provided. The ports are capable of generating 7,500 NTP packets per second with a timestamp accuracy of better than 10 microseconds. For PTP/IEEE-1588 applications, you can purchase the option to run on one or both ports with a timestamp accuracy of less than 8 nanoseconds. See the [PTP/IEEE-1588 option datasheet](#) for details on using Meridian II as a PTP Grandmaster.



Dual Gigabit Ports



Meridian II Rear Panel with Five Option Modules Installed

## Meridian II Inputs, Outputs and Options

Meridian II provides a complete suite of time and frequency capabilities with an exceptionally high number and variety of outputs in a standard 1U chassis. The modular, plug-and-play design of Meridian II and wide range of option cards make it easy to tailor the unit to support your applications. The base Meridian II supports several outputs via the standard CPU module that can also be expanded with options.

### CPU Module

The CPU module is standard on all Meridian II units and includes the GPS receiver antenna input, RS-232 console port, and three timing ports for 1 PPS, AM Code and Spare (for options). The 1 PPS reference is a positive pulse with the leading edge exactly on-time. The AM code output provides user-selectable IRIG-B formats as well as NASA-36 and 2137 time codes. The dual-gigabit Ethernet ports support two networks.

The following section describes the options available on the CPU Module:

#### Programmable Pulse Output (PPO) Option

The PPO Option provides user-selectable, on-time pulses at decade rates from 1 PPS to 10 MPPS (1, 10, 100, 1k, 10k, 100k, 1M, 10 MPPS). Other selections are 1PPM (pulse per 60 seconds, on the minute), 1PP2S (pulse per 2 seconds, on the even second), and Inverted 1 PPS (falling edge on-time). The PPO output is provided on the Spare BNC.

#### 1 PPS Output Option

Additional 1 PPS outputs can be provided on the Spare BNC. A 1 PPS at RS-422 levels is available via a DB9M connector in lieu of the Spare BNC.

#### Direct Digital Synthesizer (DDS) Option

The DDS Option provides user-selectable pulse rates from 1 PPS to 10 MPPS, in 1 PPS steps. The DDS output is provided on the Spare BNC.

#### 10 MPPS Output Option

The 10 MPPS Rate Output Option provides a fixed on-time pulse rate on the Spare BNC.

#### Alarm Output Option

The Alarm option provides an open-collector output to indicate a major alarm condition such as loss of GPS system lock. The Alarm output is commonly connected to a switch and distribution chassis and is installed on the Spare BNC or a terminal block.

#### Serial Time Output Option

The Serial Time Output consists of a once-per-second, ASCII time message to sync computer systems or equipment. Format selections are Sysplex, Truetime, EndRun, NENA and NMEA. The output is at RS-232 or RS-422 levels on a DB9M connector.

## Power Supply Options

The Meridian II is equipped with an AC power supply and supports an optional DC supply. For high reliability, dual-redundant power supplies are supported in AC/AC, AC/DC or DC/DC configurations. A dual power supply configuration occupies two option slots.

- AC power supply: 90-132/180-264 VAC.
- DC power supply: 12, 24, 48, or 125 VDC.
- Connector type: IEC 320 (AC), 3 position terminal block (DC).

## Modular Plug-and-Play Architecture

Meridian II's versatile, modular design allows you to configure the unit to meet your application requirements. The plug-and-play architecture supports up to 5 option modules and 23 time and frequency outputs. Option modules are normally installed at the factory, but most are available as field upgrades so you can add modules in the field and accommodate future requirements. Following is a summary of the standard Meridian II option modules. For a detailed description, please see the [Meridian II Options](#) data sheet.

### Digital Output Module

This module adds four buffered, digital signal outputs to your Meridian II. The module is used to distribute digital pulse rates and time code.

- Signal types: 1 PPS, Programmable Pulse Output (PPO), Time Code, Direct Digital Synthesizer (DDS) at integer rates between 1 PPS and 10 MPPS.
- Signal level and connector: TTL (BNC), RS-232 (DB9M), or RS-422 (DB9M).

### Analog Time Code Output Module

This module adds four buffered analog time code outputs to your Meridian II that match the user-selected format of the CPU AM Code output.

- Signal types: IRIG-B120 (IEEE-1344), IRIG-B122, IRIG-B123, NASA-36, or 2137.
- Signal level and connector: 1 Vrms (BNC).

### Low Phase Noise Output Module

This module outputs four spectrally-pure frequency signals with high port-to-port isolation. The low-phase-noise level and stability is dependent on the Meridian II's reference oscillator.

- Signal types: 5, 10 MHz.
- Signal level and connector: +13 dBm (BNC).

### Sine Wave Output Module

This module adds four frequency outputs to your Meridian II for customers that do not need high-performance low phase noise. The stability is dependent on the Meridian II's reference oscillator.

- Signal types: 1, 5, or 10 MHz.
- Signal level and connector: +13dBm (BNC).

### Telecom Clock Module

This module adds two telecom outputs to enable Meridian II as a Primary Reference Clock. A full suite of telecom signal types and formats are available to provide high-stability BITS clock signals directly to digital equipment. An oscillator upgrade to an OCXO or rubidium is required to meet G.811, G.823 and G.824 standards.

- Signal types: T1, J1, E1, Composite Clock, 1.544/2.048 Mbps. Optional Alarm.
- Connector type: RJ48C or DB9M.

### Cesium Control Module (CCM)

This module disciplines a 5071A Cesium Primary Frequency Standard to the GPS or UTC time scale. CCM combines the benefits of the Meridian II, 5071A Cesium, and Real-Time Ionospheric Corrections for the ultimate accuracy, stability and holdover.

- Signal types: 10 MHz (4).
- Signal level and connector: +13 dBm (BNC).

# Meridian II Precision TimeBase 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).
- TNC connector (female) on rear panel,  $Z_{in} = 50\Omega$ . 5 VDC to antenna.

## ANTENNA

- 40 dB gain LNA with band-pass filter for out-of-band interference rejection.
- Rugged, all-weather housing capable of operation over  $-40^{\circ}$  to  $+85^{\circ}$ C.
- 50' low-loss RG-59 cable. Optional lengths up to 1000' with preamplifiers.
- Mounting kit: 18" long, 3/4" PVC pipe with clamps.
- TNC connector (female),  $Z_{out} = 50\Omega$ . 5 VDC input.

## 1 PPS 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:  $<10$  nanoseconds RMS to UTC (USNO) when locked\*.
- Stability:  $TDEV <10$  ns @  $\tau <10^5$  secs,  $\sigma_y(\tau) <6 \times 10^{-14}$  @  $\tau = 10^5$  secs.
- Positive TTL pulse into  $50\Omega$  ( $Z_{out} = 50\Omega$ ) or RS-422 levels (option).
- User-Selectable Width: 20 us, 1 ms, 100 ms, 500 ms.
- User Calibration:  $\pm 500$  us, 1 ns resolution.

\* See [GPS-UTC Timing Specifications](#) for details.

## LOCAL REFERENCE OSCILLATOR

Several oscillator options are available to meet your short-term stability at 1 second (STS), phase noise at 1 Hz offsets in dBc/Hz (LPN), ageing rate/year (AGE RATE), and temperature stability for  $0-70^{\circ}$  C (TEMP STAB):

| OSCILLATOR                | STS (1 sec)           | LPN 10/5 MHz | AGE RATE            | TEMP STAB            |
|---------------------------|-----------------------|--------------|---------------------|----------------------|
| - TCXO (standard)         | $6 \times 10^{-10}$   | -70/na       | $1 \times 10^{-6}$  | $2.5 \times 10^{-6}$ |
| - 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       | $5.1 \times 10^{-13}$ | -110/-115    | $3 \times 10^{-8}$  | $5 \times 10^{-10}$  |
| - Rubidium                | $2 \times 10^{-11}$   | -80/na       | $1 \times 10^{-9}$  | $1 \times 10^{-9}$   |
| - High-Stability Rubidium | $1.2 \times 10^{-11}$ | -80/na       | $5 \times 10^{-10}$ | $1 \times 10^{-10}$  |

See [Oscillator Options](#) datasheet for more information.

## TIME TO LOCK

- $< 5$  minutes, typical (TCXO).  $< 10$  minutes, typical (OCXO/Rb).

## NETWORK I/O

- Two rear-panel RJ-45 jacks.
- 10/100/1000Base-T Ethernet.

## NETWORK PROTOCOLS

- IPv4/IPv6.
- SNTP, NTP v2, v3, v4, SHA/MD5 authentication, broadcast/multicast mode and autokey.
- SSH client/server with "secure copy" utility, SCP.
- SNMP v1, v2c, v3 with Enterprise MIB.
- HTTPS (Web Interface).
- TIME and DAYTIME server.
- TELNET client/server.
- FTP and DHCP clients.
- SYSLOG.
- Optional PTP/IEEE-1588-2008 (v2) Grandmaster. 8 ns hardware timestamping.

## NETWORK SYNCHRONIZATION ACCURACY

- NTP Timestamp Accuracy:  $< 10$  microseconds @ 7,500 requests/second.
- PTP Timestamp Accuracy to Reference Clock: 8 nanoseconds.

## TIMECODE CHARACTERISTICS

- Signal: Amplitude-modulated (AM), 3:1 ratio, 1 kHz carrier, 1 Vrms into  $50\Omega$ .
- User-Selectable Formats: IRIG-B120 (IEEE-1344), IRIG-B122, IRIG-B123, NASA-36, or 2137.

## 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.

## SYSTEM STATUS INDICATORS

- Sync LED: Amber LED pulses to indicate lock status.
- Alarm LED: Red LED indicates a serious fault condition.

## ALPHANUMERIC DISPLAY/KEYPAD

- Display: Brilliant 16x280 dot-matrix vacuum-fluorescent.
- Keypad: Enter, Back, Edit, Right, Left, Up, Down, Help.

## POWER

- 90-264 VAC, 47-63 Hz, 1.0A Max. @ 120 VAC, 0.5A Max. @ 240 VAC.
- 3-Pin IEC 320 on rear panel, 2 meter cord included.

## SIZE

- Chassis: 1.75"H x 17"W x 10.75"D.
- Weight:  $< 5$  pounds.
- Antenna: 3.25"H x 3" diameter.

## ENVIRONMENTAL

- Operating Temperature/Humidity:  $0^{\circ}$  to  $+50^{\circ}$  C / 5% to 90% RH, non-condensing.
- Storage Temperature/Humidity:  $-40^{\circ}$  to  $+85^{\circ}$  C / 5% to 95% RH, non-condensing.

## COMPLIANCE

- CE, FCC, RoHS, WEEE.

## GPS ANTENNA and ACCESSORIES

A GPS Antenna Kit is included with the Meridian II consisting of an antenna, 50 ft cable, mounting pipe, and clamps. Extended cable lengths, lightning arrestors, in-line amplifiers, splitters, and fiber optic links are also available.



## MERIDIAN II OPTIONS

Refer to the [Meridian II Options](#) datasheet for detailed information on all options.

## RELATED PRECISION TIMEBASE

The [Tycho II](#) is similar to the Meridian II but with a reduced accuracy specification of 25 ns to UTC (USNO) and without the front-panel keypad/display.

## RELATED DISTRIBUTION PRODUCTS

EndRun provides frequency, pulse and time code distribution products to expand Meridian outputs:

|         |   |
|---------|---|
| FDC3302 | High-Performance Frequency Distribution Chassis |
| FDC3300 | Frequency Distribution Chassis                  |
| PDC3301 | Pulse Distribution Chassis                      |
| TDC3303 | Time Code Distribution Chassis                  |