

RTM3205 Precision Timing Module

GPS-Synchronized, Portable Time and Frequency Standard

The RTM3205 is a compact time and frequency standard designed specifically for portable, battery-powered systems. Optimized for size, weight and power (SWaP), the RTM3205 requires only 68 cubic inches of mounting space and consumes less than 10 watts of power. Based on the [Meridian II Precision Time-Base](#), it can provide a full time and frequency feature set with network timing services and the stability of an atomic frequency standard.

GPS Timing and Frequency Control

At the core of RTM3205 is EndRun's GPS Timing Receiver that provides exceptional Coordinated Universal Time (UTC) accuracy (<10 nanoseconds RMS). An advanced timing and adaptive 3rd-order frequency-control algorithm provides high stability outputs



(<6 x 10⁻¹⁴ averaged 100k seconds). [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). The RTM3205 with the RTIC option exceeds the stability performance of a standard cesium atomic frequency reference at all observation intervals.

User Configurable Outputs

The RTM3205 supports up to four optional hardware time and frequency outputs. You can custom configure the unit to provide a

variety of analog or digital outputs per your application requirements. Available output signals include IRIG-B time code, 10 MHz low-phase noise, direct digital synthesizer (DDS) from 1-10 MPPS, pulse rates, and an open-collector alarm.

Secure Network Interface

To synchronize network clients, RTM3205 provides a high-capacity Network Time Protocol (NTP) server and optional IEEE-1588 Precision Time Protocol (PTP) Grandmaster. The IPv4/IPv6 management interface supports SSH and HTTPs and is 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 subjected to rigorous testing to guarantee industry-leading performance. The RTM3205 is available with either a Medium Stability, High Stability, or Ultra-Stable OCXO. The Ultra-Low Phase Noise option enables two spectrally-pure 10 MHz outputs with phase noise less than -113 dBc at a 1 Hz carrier offset.

High Reliability and Two-Year Warranty

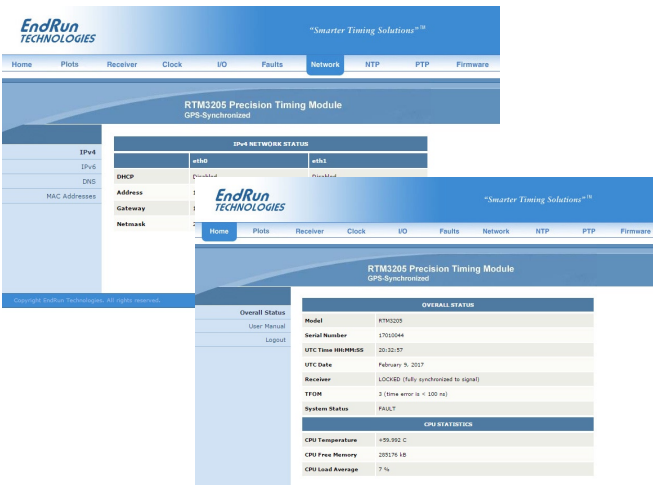
RTM3205 uses EndRun's power-efficient, fanless design and thermal packaging with an estimated MTBF of over 20 years. It is made in America, backed by a two-year warranty, includes free technical support, and a 60-day money-back guarantee.

FEATURES

- Timing accuracy: <10 nanoseconds RMS to UTC (USNO).
- Frequency accuracy: <6 x 10⁻¹⁴
- Short-term stability: <4 x 10⁻¹³ at 1 second (US-OCXO option).
- No frequency steps - guaranteed.
- Ultra-low 10MHz phase noise option: <-113 dBc at 1 Hz.
- Up to four optional outputs: 1PPS, PPO, 10 MHz, etc.
- Real-Time Ionospheric Corrections for ultimate stability & accuracy (optional).
- Dual-gigabit Ethernet ports.
- Network Time Protocol (NTP).
- IEEE-1588 PTP Grandmaster (optional).
- GPS almanac/ephemeris data, YUMA/RINEX formats.
- 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 host system.

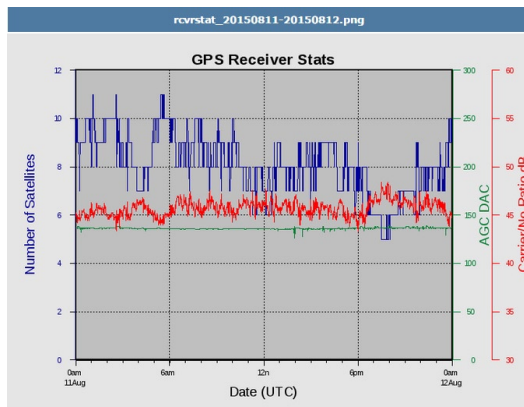


Secure Web Interface (HTTPS)
for System Monitoring & Firmware Upgrades

Web Interface

The RTM3205 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, CPU and RTIC statistics

Measurement Statistics and Charting

Real-time charting of GPS, Oscillator, NTP, CPU, and optional [Real-Time Ionospheric Corrections \(RTIC\)](#) 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 RTM3205 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. The RTIC statistics show the measured ionospheric delay performance relative to the GPS broadcast Klobuchar model.

Security-Hardened Network Interface

Extra care has been taken with RTM3205 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 RTM3205, 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.

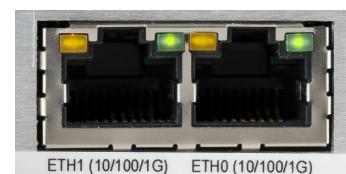
We designed RTM3205 in such a way that it is not necessary for you to know Linux to use the product. For those users who are familiar with Linux, we make it easy for you to customize various aspects of the operation to your requirements.

Full User Control

Configuration and control is accomplished through either the network or serial port. 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 RTM3205-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 resolution of less than 8 nanoseconds. See the [PTP/IEEE-1588](#) option datasheet for details on using RTM3205 as a PTP Grandmaster.



Dual Gigabit Ports

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Optional Outputs



The front panel of a fully-optional RTM3205 with (from left to right):
 - GPS Antenna Input, Output C - 10 MHz LPN, Output D - 10 MHz LPN (top row SMA connectors)
 - Output A - 1PPS, Output B - 1PPS (bottom row SMA connectors)

RTM3205 Inputs/Outputs

Standard I/O on the RTM3205 includes the GPS receiver antenna input, RS-232 console port, 24V DC power input, and dual-gigabit Ethernet ports that support two networks. Specifications are shown on the last page.

RTM3205 also provides up to four optional time and frequency outputs (SMA female connectors). This makes it easy to tailor the unit to support your applications. The following describes the available options:

1 PPS Output Option

RTM3205 can be configured for up to four 1 PPS outputs. 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.
- 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).
- Signal: Positive TTL pulse into 50 Ω .
- User-Selectable Width: 20 us, 1 ms, 100 ms, 500 ms.
- User Calibration: +/- 500 us, 1 ns resolution.

*See GPS-UTC Timing Specifications for details.

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). Up to four PPO outputs can be provided.

- Signal: TTL square wave into 50 Ω except 1PPS, PPS2S and 1 PPM provide a pulse at the standard 1 PPS configured pulse width (i.e. 20 usec, 1 ms, 100 ms or 500 ms).
- User-Selectable Rates: 1, 10, 100, 1k, 10k, 100k, 1M, 5M, 10M PPS, PP2S, PPM.
- Accuracy: < 6×10^{-14} to UTC for 100k second averaging times when locked.

Direct Digital Synthesizer (DDS) Option

The DDS Option provides user-selectable pulse rates from 1 PPS to 10 MPPS, in 1 PPS steps. The RTM3205 can provide up to four DDS outputs.

- Signal: TTL square wave into 50 Ω .
- User-Selectable Synthesized Rates: 1 PPS to 10M PPS in 1 PPS steps, including 1.544M PPS and 2.048M PPS. These rates are phase locked to the system oscillator and are not aligned with system time.

10 MPPS Output Option

RTM3205 can provide up to four 10 MPPS outputs on SMA connectors.

- Signal: TTL square wave into 50 Ω .
- Rate: 10 MPPS (other rates available).
- Accuracy: < 6×10^{-14} to UTC for 100k second averaging times when locked.
- Stability: See Oscillator Stability specifications below.

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. Up to two Alarm outputs can be provided via SMA connectors.

- Signal: Open Collector, 40V Max, 100 mA max saturation current.
- Alarm State: High impedance after signal loss or at major hardware fault.

Analog Time Code Output Option

RTM3205 can provide one analog time code output.

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

DC-Shift Time Code Output Option

Up to four digital time code outputs can be provided.

- Signal: TTL into 50 Ω .
- Formats: IRIG-B 000 (IEEE-1344/C37.118-2005), 002, 003; NASA-36 or 2137).

Low Phase Noise 10 MHz Output Option

RTM3205 can provide one or two spectrally pure frequency signals with high port-to-port isolation. When distributing low phase noise, best practice is to establish direct point-to-point connections to receiving equipment with high quality cable. The low phase noise level and stability is dependent on the RTM3205's reference oscillator.

- Signal: 10 MHz, +13 dBm.

Oscillator and Low-Phase-Noise Outputs

Several ovenized 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° C (TEMP STAB):

| OSCILLATOR | STS (1 sec) | LPN 10 MHz | AGE RATE | TEMP STAB |
|-----------------------|---------------------|------------|--------------------|---------------------|
| Medium-Stability OCXO | 3×10^{-12} | -95 | 3×10^{-8} | 4×10^{-9} |
| High-Stability OCXO | 1×10^{-12} | -105 | 3×10^{-8} | 1×10^{-9} |
| Ultra-Stable OCXO | 4×10^{-13} | -113 | 3×10^{-8} | 5×10^{-10} |

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

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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.

ANTENNA:

- 40 dB gain LNA with band-pass filter for out-of-band interference rejection.
- Rugged, all-weather housing capable of operation over -40° to $+85^{\circ}$ 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.

TIME TO LOCK:

- <10 minutes, typical.

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.
- 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.

NETWORK PROTOCOLS

- IPv4/IPv6.
- SNTP, NTP v2, v3, v4, 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.
- PTP/IEEE-1588-2008 (v2) Grandmaster (optional).

NETWORK SYNCHRONIZATION ACCURACY

- NTP timestamp accuracy to reference clock: < 10 microseconds @ 7,500 packets/second.
- PTP timestamp accuracy to reference clock: 8 nanoseconds.

NETWORK I/O

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

OPTIONAL PTP/IEEE-1588 GRANDMASTER

- Quantity: One or both network ports
- IEEE-1588-2008 (v2) with hardware timestamping.
- Parameters: Default Profile. Multicast. Hybrid (mixed Unicast/Multicast), Two-step Clock. Delay Mechanism: E2E or P2P. Delay Interval: 32 seconds. Transport: UDP/IPv4. Sync Interval: 1, 2, 4, 8, 16, 32, 64 or 128 packets / 1 second. Announce Interval: 1 packet per 1, 2, 4, 8 or 16 seconds.

See the separate PTP/IEEE-1588 Option datasheet for additional information.

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.

DC POWER:

- 15-28 VDC, 1A maximum.
- 13W maximum.
- Connector: Molex Micro-Fit 3.0 2-pin jack.
(Mate: Molex 43025-0200/20-24 AWG Terminal: Molex 43030-0008.)

SIZE

- Chassis: 1.7"H x 4.0"W x 10.0"D.
- Weight: < 3 pounds (1.35 kg).
- Antenna: 3.25"H x 3" diameter.

ENVIRONMENTAL

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

OPTIONS:

See previous page or call factory for option details.

- OCXO Oscillators (Medium Stability, High Stability, or Ultra-Stable)
- Real-Time Ionospheric Corrections (RTIC).
- 10 MHz Low-Phase-Noise outputs.
- Pulse Rate Outputs (1, 10, 100, 1k, 10k, 100k, 1M, 5M, 10M PPS).
- Time Code Output (IRIG-B120 (IEEE-1344), IRIG-B122, IRIG-B123, NASA-36 OR 2137).
- User-Selectable DDS Output (1 PPS - 10MPPS @ 1 PPS resolution, including 1.544 MPPS and 2.048 MPPS).
- DC Level Shift Time Code ((000/IEEE-1344, 002, 003), NASA-36, 2137).
- Alarm Output.

GPS ANTENNA and ACCESSORIES

A GPS Antenna Kit is included with the RTM3205 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.



GPS Antenna Kit (included)