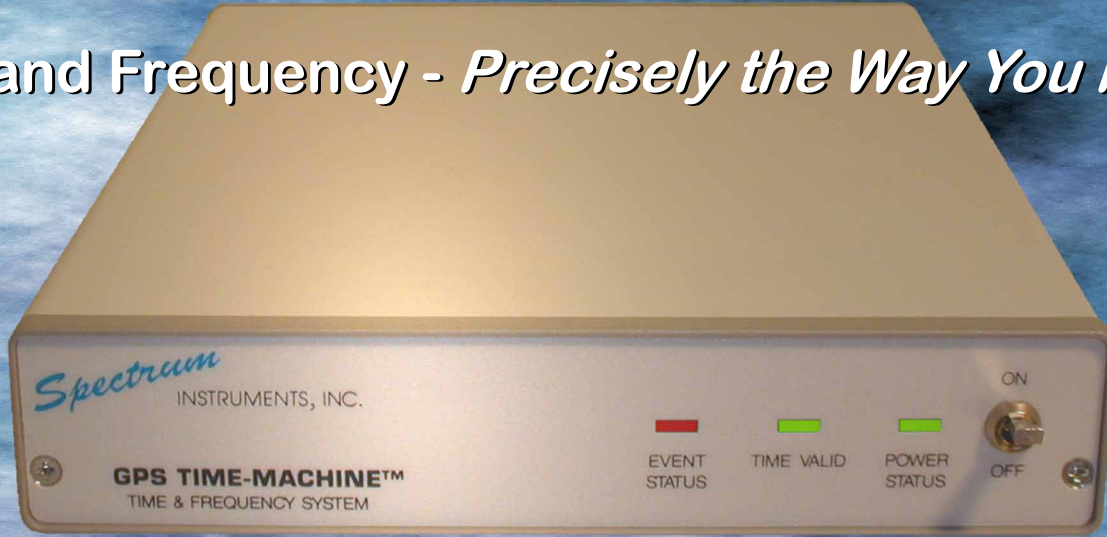


Time and Frequency - *Precisely the Way You Need It*



The GPS TIME-MACHINE/TM-3™, A Complete Time & Frequency System

Spectrum Instruments, Inc., the leader in high-performance, low-cost timing and frequency technology has introduced the GPS Time-Machine/TM-3™, a complete GPS time & frequency system offering a unique combination of features, performance and low cost. Highlights of the TM-3's features include:

- GPS-disciplined ovenized oscillator, with 10 MHz sine wave and TTL outputs.
- Meets MTIE requirement for a Stratum-1 primary clock source.
- Optional auxiliary frequency output (such as 1.544 MHz or 2.048 MHz) slaved to primary frequency reference.
- Frequency accuracy of 1×10^{-11} (long term, while tracking).
- Timing accuracy of ± 50 ns.
- One pulse-per-second (PPS) with separate ASCII serial time message.
- Programmed output pulse (POP) with 100 ns resolution.
- External event time-tag (ETT) with 100ns resolution.
- Optional IRIG-B serial time code output (TTL & modulated).
- GPS-corrected frequency synthesizer with six selectable outputs: 1, 10, 100 kHz and 1, 5, 10 MHz.
- State-of-the-art GPS technology.
- Timing information requires only one satellite in static mode.

The GPS Time-Machine/TM-3™ consists of a state-of-the-art GPS timing receiver, integrated with proprietary microprocessor controlled timing and interface logic, and comes with an external GPS antenna.

The GPS receiver simultaneously tracks every available satellite. The timing and interface logic derives precise timing information from these satellites and provides additional features, including a 1 PPS output with associated ASCII serial time message, external event time-tag, programmed output pulse, GPS-corrected frequency synthesizer, optional IRIG B time code output, and optional Stratum-1 qualified filtered frequency output, correlated to the primary 10 MHz signal.

Control and operation of the GPS Time-Machine/TM-3™ is achieved via a user-friendly Windows®-based software package included with each unit. All communication to and from the unit utilize a series of compact ASCII messages which allow the host to make changes to the operating parameters and to read GPS tracking, status and timing information.

The GPS Time-Machine/TM-3™ is capable of autonomous operation without connection to a host computer. Once power is supplied, the unit requires no intervention to acquire satellites and provide the basic time and frequency functions based on factory default settings. A host computer may be connected for initialization purposes and left connected to monitor the system operation. The host may be disconnected at any time, and the

unit will continue to operate normally with the selected configuration.

A GPS-disciplined ovenized crystal oscillator (OCXO) is incorporated into the GPS Time-Machine/TM-3™ to provide an exceptionally stable and precise frequency reference. After a few hours of tracking GPS signals, the accuracy of this source approaches that of the Cesium clocks on the GPS satellites. The sine wave output is extremely high quality in terms of phase noise and spectral purity, and is suitable for use as the primary source for driving local oscillator synthesizers in wireless communication systems.

The programmed output pulse feature allows the user to specify a date, time, polarity and repetition rate for generating an output pulse with exceptional 100ns resolution.

The event time-tag function marks the date and time of occurrence of an external event with the very same 100ns resolution. Multiple events are buffered and supplied to the host computer via the control interface.

An optional IRIG B serial time code generator can provide two outputs: IRIG B002, a PWM logic signal, and IRIG B122, a 1 kHz amplitude modulated carrier.

Another unique option for the TM-3 is the filtered pulse timing output. This may be set to a variety of frequencies, is coherent with the 10 MHz clock and has the same accuracy as the primary 10 MHz output. The leading edges of this signal are synchronized to the average value of the 1 PPS signal from the GPS receiver, and it exhibits extremely low jitter.

The TM-3 also offers an optional PLL synthesizer that can be factory set to many common frequencies, including 1.544 and 2.048 MHz. Since this signal retains the accuracy and stability of the primary 10 MHz output, it also meets the MTIE requirements for a Stratum-1 primary clock source. The performance of this system in the absence of GPS signals (coasting) is excellent, due to the high-quality OCXO incorporated in the product.

The GPS Time-Machine/TM-3™ comes complete with an external antenna, a 50 foot RG-58 coaxial cable assembly, control/display software, a PC interface cable, an AC power adapter and a comprehensive user manual.

GPS TIME-MACHINE/TM-3™: Technical Specifications

PHYSICAL (TM-3)

HEIGHT: 1.52 in. (38.6 mm)
WIDTH: 7.29 in. (185.2 mm)
DEPTH: 9.00 in. (228.6 mm)
WEIGHT: 2.6 lbs. (1.2 kg)

PHYSICAL (ANTENNA)

HEIGHT: 5.0 in. (126.6 mm)
DIAMETER: 3.54 in. (90.0 mm)
WEIGHT: 0.66 lbs (0.30 kg)
MOUNTING: Flush mount. Optional 1.25" mast mount.

CABLE: RG-58 (50 ft.) with TNC connectors standard. Longer cables optional.

ENVIRONMENTAL (TM-3)

OPERATING TEMPERATURE: -10 to +60°C
HUMIDITY: Up to 95% R.H., non-condensing.

ENVIRONMENTAL (Antenna)

OPERATING TEMPERATURE: -45 to +85°C
HUMIDITY: Waterproof/All-Weather

POWER

INPUT SUPPLY VOLTAGE: 18 to 32 VDC
AC ADAPTER: 105 to 130 VAC, 60 Hz
POWER CONSUMPTION: 350 mA, warm-up, 200 mA operation, nominal @ 24 VDC
ANTENNA: 5 VDC, 20 mA
Antenna power is supplied via the coaxial cable from the unit.

PERFORMANCE (GPS)

RECEIVER TYPE: Eight-channel, parallel tracking, CA code, L1 carrier

TIME TO FIRST FIX (typical):

Hot Start: <15 seconds (valid almanac, time, date position & ephemeris)
Warm Start: <45 seconds (valid almanac, time, date & position)
Cold Start: <10 minutes (no information)

ALTITUDE: -1,000 to +40,000 ft.

POSITION UPDATE RATE: Once per second, nominal.

MAXIMUM VELOCITY: 1,000 knots (515 m/s)

POSITION ACCURACY: Less than 15 m SEP

PERFORMANCE (TIME)

1 PPS OUTPUT: (Referenced to UTC)

Conditions:

Static Mode, position known
2D Dynamic Mode - HDOP <2
3D Dynamic Mode - PDOP <2

Accuracy: ±50ns

1 PPS Message: Serial, ASCII date and time of next 1PPS epoch.

PERFORMANCE (FREQUENCY)

GPS-CORRECTED FREQUENCY OUTPUT:

Conditions: Time Valid

Frequency: 10 MHz

Long-term stability: 1×10^{-11} after 24 hours of tracking. ($\Delta t=12$ hours)

Short-term stability:

5×10^{-12} ($\Delta t=1$ second)

8×10^{-12} ($\Delta t=10$ seconds)

2×10^{-11} ($\Delta t=100$ seconds)

1×10^{-10} ($\Delta t=1,000$ seconds)

Accuracy while coasting:

(24 hours of tracking followed by 24 hours of coasting)

< 1×10^{-9} at constant temperature

< 3×10^{-8} over 0 to 50 °C range

Phase noise, 1 Hz bandwidth:

1 Hz: <-85 dBc

10 Hz: <-115 dBc

100 Hz: <-135 dBc

1 kHz: <-145 dBc

10 kHz: <-155 dBc

Harmonic Outputs: <-35 dBc

Spurious Outputs: <-70 dBc

INPUTS & OUTPUTS

1 PPS OUTPUT:

Connector: BNC

Drive: TTL levels into 50Ω

Rise Time: 10 ns, maximum

Pulse Width: Positive pulse, 1 ms nominal. Rising edge on-time.

10 MHz OUTPUT:

Connector: BNC

Drive: High spectral-purity sine wave, 1.75 V_{pp} into 50Ω

CONTROL PORT:

Connector: DB-9 (female)

Signal Levels: RS-232C

Baud Rate: 9600

Signals: Serial in, serial out, ground

AUXILIARY PORT:

Connector: DB-15 (male)

Alarm Output: Open collector

Serial Time Code Output: TTL into 50Ω

Programmed Output Pulse:

Drive: TTL levels into 50Ω

Rise/Fall Time: 10 ns, maximum

Pulse Width: 20 μsec, nominal

Polarity: Selectable



All external connections to the GPS-Time Machine are made through the back panel with standard connectors.

GPS-CORRECTED OUTPUTS

10 MHz TTL FREQUENCY OUTPUT:

Accuracy: Same as 10 MHz sine wave frequency output, both tracking and coasting.

Level: TTL into 50Ω

OPTIONAL AUXILIARY CLOCK OUTPUT:

Frequency: Various frequencies available, such as 1 MHz, 5 MHz, 1.544 MHz, 2.048 MHz and others.

Accuracy: Same as 10 MHz sine wave frequency output. Meets Stratum-1 MTIE specifications.

Level: TTL into 50Ω

OPTIONAL FILTERED TIMING PULSE:

Frequency: Various frequencies available, such as 1 Hz, 25 Hz, 216.66 Hz and many others.

Accuracy: Same as 10 MHz sine wave frequency output. Meets Stratum-1 MTIE specifications.

Level: TTL into 50Ω

Characteristics: Coherent with 10 MHz. Leading edge synchronized with average value of PPS from GPS receiver.

Multiplexer Output:

Drive: TTL levels into 50Ω

Rise/Fall Time: 10 ns, maximum

Selectable Output: 1 kHz, 10 kHz, 100 kHz, 1 MHz, 5 MHz, 10 MHz

1 PPS Output: Same as BNC output

Time Message Output: RS-232C, 1200/2400/4800/9600 baud, software selectable

External Event Input: TTL/CMOS level, edge-triggered, edge software selectable

Optional IRIG B Modulated Output:

Output Level: 2.7 V_{pp} into 600Ω

Modulation Level: 3.3:1

Optional Auxiliary Clock Output:

Drive: TTL levels into 50Ω

Rise/Fall Time: 10 ns, maximum

Output: 50% duty-cycle

Frequency: Various, factory-set

Optional Filtered Timing Pulse Output:

Drive: TTL levels into 50Ω

Frequency: Various, factory-set

Rise/Fall Time: 10 ns, maximum

Output: Positive pulse, 500 μsec, nominal. Rising edge on-time.

ANTENNA INPUT: TNC connector

DC POWER INPUT: Coaxial jack

Spectrum
INSTRUMENTS, INC.